Munich Airport

Perspectives

Environmental Statement 2008

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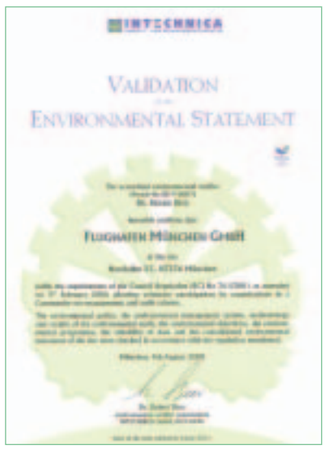


Validation

Environmental statement

The next consolidated environmental statement will be submitted for validation by July 2011 at the latest.

In the intervening period, an annual update of the environmental statement will be prepared for validation by the environmental auditor.

Environmental auditor/organization
Reiner Beer, Dr.-Ing. (Registration Number D-V-0007)
INTECHNICA GmbH (Registration Number D-V-0248)
Ostendstr. 181
90482 Nuremberg
Germany

Validation

Having conducted a comprehensive review, I declare the environmental policy, the environmental management system, the methodology and results of the preparatory environmental review and environmental audit, and the environmental goals, environmental program and environmental statement of

Flughafen München GmbH
Nordallee 25
85356 Munich
Germany

to be valid under the terms of Directive EC 761/2001 (version dated February 3, 2006).

4.8.2008

Date

R. Beer, Dr.-Ing.
Environmental auditor

Foreword

In 2007, Munich Airport recorded its the highest ever passenger growth in its history as annual passenger movements rose to around 34 million. For several years now, Munich has also been one of the fastest growing commercial airports among the ten busiest in Europe. And with passenger traffic up 6 percent during the first six months of 2008, Munich remains one of international aviation's key growth drivers.

The sheer pace of growth at Munich is a striking testament to the generally escalating demand for business and personal mobility. Against the background of climate change, though, the focus now must be on successfully balancing economics with ecology, and Flughafen München GmbH (FMG), Munich Airport's operating company, is keen to play a part in protecting the environment and slowing climate change.

At the start of this year, FMG embarked on an innovative initiative to slow aviation emissions growth: From January 1, 2008, Munich, together with Frankfurt Airport, began charging carriers emissions-based fees. The aim behind this move is to create an economic incentive to encourage airlines to operate aircraft that emit as little nitrogen oxide as possible. At the same time, the introduction of emissions-dependent fees sends out a strong signal to aircraft makers showing that we support their ongoing efforts to take aviation technology forward.

On the ground, Munich Airport is advancing a biofuels project, launched to migrate ramp service vehicles over to renewable, alternative fuels. We have converted 12 diesel-powered vehicles to run on rapeseed oil, and we have purchased a number of new vehicles and converted others to run E85 bioethanol. Besides reducing our energy costs and carbon footprint, these alternative fuels also support local farmers and producers, because all of the fuel is sourced locally in the airport's surrounding region.

We continue to advance the airport's environmental certification program, with the Kempinski Hotel Airport München recently achieving first-time validation under the EMAS and DIN EN ISO 14001 environmental standards, and FMG affiliate Allresto GmbH obtaining accreditation under DIN EN ISO 14001. In both cases, the main concern was to take active and systematic steps to avoid and reduce environmental impacts and consume less energy. Going forward, other Flughafen München GmbH affiliates are to follow suit.

To encourage the development of new technologies and to promote better environmental stewardship at airports, FMG has introduced the MUC Award, a new innovation and environmental prize worth €10,000, which we bestowed for the first time in 2008. We instituted the award with the intention of promoting creative potential in the academic and scientific community and leveraging research outcomes in areas that can enhance airport's resource conservation and environmental performance.

We also plan to document better Munich Airport's initiatives toward sustainable airport operations, and as part of these plans our Environmental Statement will be superseded in 2009 by a detailed Sustainability Report. This report will address more than just environmental topics, it will also cover economic and community issues associated with airport's sustainability performance.

Dr. Michael Kerkloh
President and Chief Executive Officer
Personnel Industrial Relations Director

Munich Airport

Mobility is basic and constantly expanding need in today's society, a need evident in the growing demand for air transport as passenger volumes and the numbers of aircraft movements increase continuously from one year to the next. Aviation is currently expanding at a rate of around 5 percent annually, compared to 2–3 percent for the global economy as a whole.

For Germany, a nation that relies heavily on exports, domestic and international aviation plays a crucially important role in the economy, and the country has a dense network of air transport routes connecting it with major business centers all over the globe.

But aviation's continuing expansion comes at a price: Air traffic consumes significant amounts of energy and emits pollutants that contribute to global warming. However, aviation is not the biggest climate change driver, with aircraft accounting for just 2 percent, or thereabouts, of all anthropogenic carbon emissions.

For Munich Airport, more air traffic brings with it a greater burden of responsibility toward the environment in general and the local region in particular. Although nothing more than a piece of infrastructure put in place to service aviation, the airport – its construction and its operation – have inevitably had a significant environmental impact and continue to do so.

Given rising energy prices and the increasing shortage of resources, Munich Airport also feels duty-bound to help mitigate climate change. We at Flughafen München GmbH consider ourselves a forward-thinking, innovative airport operator, committed to successfully balancing business and environmental interests.

This is why we are working constantly to improve the company's environmental performance and are committed to exceeding rather than just meeting statutory requirements. Key targets that we have set ourselves include reducing pollutant emissions and energy consumption across the entire airport and avoiding and limiting additional environmental impacts and risks.

Record growth at Munich Airport in 2007

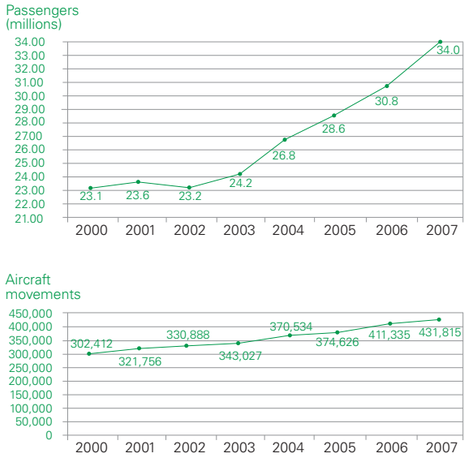
In 2007, Munich Airport's traffic growth exceeded forecasts by a significant margin. Recording its sharpest ever increase in passenger numbers in a single year – a gain of 3.2 million passengers and a 10.4 percent increase on 2006 – the airport saw passenger movements climb to a new all-time high of around 34 million. This exceptional performance enabled Munich to build out its number seven position among Europe's busiest passenger airports. In absolute as well as percentage terms, Munich posted the second-highest rate of growth in Europe and moved up in the world rankings from 30th to 28th. Not just the continued expansion of hub operations by Lufthansa and its partners but, crucially, a growing commitment to Munich from carriers operating out of Terminal 1 as well, helped achieve the stellar traffic growth, with carriers in the Air Berlin Group in particular showing strong gains.

The number of takeoffs and landings across all traffic segments increased by 5 percent to 431,815 movements in total in 2007.

For the fourth year in succession, our cargo traffic grew in double digits, with the quantity of freight carried by air expanding 11.3 percent to 251,075 metric tons. Aggregated with goods classed as air cargo but carried by truck, the overall volume handled totaled 451,075 tons in 2007, a gain of 11.5 percent on the prior year.

In 2007, more than 100 airlines operated regular services to Munich Airport, serving 244 destinations – 19 domestic, 149 European and 76 intercontinental – in a total of 73 countries.

Traffic growth



Workload units (WLU*)

* See glossary

Flughafen München GmbH (FMG) shareholders:
Free State of Bavaria (51 percent)
Federal Republic of Germany (26 percent)
City of Munich (23 percent)

Name:
Munich Airport

ICAO code:
EDDM

IATA airport code:
MUC

FMG employees (at December 31, 2007):
4,644

FMG Group employees (annual average):
approx. 7,400

Total Munich Airport employee population (2006):
27,400

Group sales in 2007:
EUR999.6 million

Location:
28.5 km (15.5 nm) to the northeast of Munich,
448 m above sea level (MSL),
48° 21' 17" north, 11° 47' 15" east

Runway system:
Two parallel runways, 4,000 meters long and 60 meters wide, 2,300 meters apart and offset by 1,500 meters

Aviation and climate change

Sound environmental stewardship

The aviation industry is aware of its responsibility for the environment. As an airport operator, we engage in a variety of measures and initiatives to combat climate change. These range from emissions-based landing fees and the use of alternative fuels to comprehensive monitoring of our environmental footprint in a company-wide sustainability project.

As the volume of air traffic at Munich Airport grows, it brings with it greater responsibility for the environment and the airport's surrounding region. Although aviation currently only accounts for around 3 percent of climate-change emissions (according to the UN's IPCC report), airports and airlines have an obligation to help protect the world's climate. The German Air Transport Initiative, set up by Flughafen München GmbH, Fraport AG, Deutsche Lufthansa AG and Deutsche Flugsicherung DFS with the aim of keeping the aviation industry competitive yet environmentally compatible, takes the same line.

Four-pillar strategy

Improving environmental performance effectively can only be achieved in the context of a wider overall approach. The German Air Transport Initiative pursues a four-pillar strategy:

- Reduction of carbon emissions through technological advancements and innovations, above all in the area of aircraft engine design
- A more efficient infrastructure and demand-based alignment of airport capacity – with the goal of avoiding environmental impacts resulting from, say, holding patterns
- Operational measures, including optimization of processes on the ground
- Economic incentives.

Alternative fuels

Another innovative project at Munich Airport involves using rapeseed oil, E85 bioethanol, and biomethane produced from renewable resources to power vehicles. The project has three objectives: to reduce carbon emissions, to support regional producers by sourcing biofuels locally, and to lower energy costs. The airport's biofuel filling stations, which are located inside the airport's restricted area, are not just open to those vehicles in FMG's own fleet that have been specially converted to run on these fuels, but also to similar vehicles operated by other organizations located at the airport.

Greater use of quiet aircraft

Munich Airport's noise performance is generally very good. In spite of renewed year-on-year increase in the number of aircraft – 5 percent compared to 2006 – continuous sound pressure levels recorded at our aviation noise monitoring system's 16 fixed measuring stations did not show a uniform and consistent rise. At eight of the stations, levels were the same as a year earlier; seven registered a marginal increase; and just one recorded a level of 60 dB(A), which, under recent aircraft noise legislation, requires noise abatement measures to be taken. At the same time, the incidence of individual noise events in excess of 75 dB(A) was actually 3 percent lower than a year earlier, thanks to carriers' greater use of quieter aircraft types. Levels in excess of 85 dB(A) were only recorded three times a day, on average – the same number as in 2006.

Industry agreement on climate change

At an aviation industry summit on air traffic and the environment held in Geneva on April 24, 2008, Flughafen München GmbH and more than 300 other airport operators attending from all over the world signed a joint declaration on climate change.

Although the aviation industry only accounts for around 2 percent of the carbon emissions worldwide, the purpose of the declaration was to affirm the industry's commitment to progress in the area of technology with the goal of reducing its climate impacts.

Road traffic

Given the speed with which air traffic at Munich Airport is expected to expand, the quality and capacity of landside transport systems must be developed accordingly. To ensure easy access and to optimize connectivity between air and ground traffic, the road and rail infrastructure has to be improved. Our objective is to combine and leverage the specific strengths of each mode of transport to benefit the system in its entirety. So for Munich Airport, the primary focus is on creating connections to mainline rail services and on achieving an efficient intermodal interplay between rail and air transport. In 2007, roughly half of passengers traveled to the airport by car and around 31 percent used the S-Bahn transit rail system. Although this figure is high in comparison with other airports in Germany (only Frankfurt and Berlin have broadly similar figures), additional efforts must be made to move as much feeder traffic onto rail services as possible. This applies particularly to long-distance traffic.

Road infrastructure: High-capacity roads are crucial

The A92 Munich-Deggendorf autobahn is the main feeder road connecting the airport to the national road network. Along with the A9 Munich-Nuremberg autobahn and the A99 autobahn ring road, the A92 provides a fast, high-capacity connection to Bavaria's capital, Munich, and to Nuremberg, Stuttgart, Salzburg and Lindau and their surrounding regions. These autobahns are equipped with traffic management systems that control flow to ensure efficient capacity utilization as well as greater overall road safety.

As regards the local road network, completion of the B388a trunk road between the towns of Fischerhäuser and Hallbergmoos to the west of the airport is essential to improve airport access. Construction work is expected to begin in the foreseeable future. The east expressway connects the airport with the region to the east and with the national road network. Two sections of this road have yet to be completed, but construction is underway. A network of regional bus lines and shuttle bus services provide road transport to the airport from every direction.

Public transport: Continuous improvement is essential

Currently, the only rail services connecting the airport with the regional and national mainline rail networks are the S1 and S8 rapid transit rail lines. Given that these are essentially commuter rail services with long journey times between the city of Munich and the airport and the fact that inbound and outbound travelers need to transfer to and from mainline services at Munich Central or Munich East Station, rail is a travel option which, for many, holds very little appeal.

Because the rail infrastructure is concentrated in the west, passengers and a large numbers of airport employees rely on their own cars to get to the airport. However, with the completion of the Erding circular, the Walpertskirchen branch and the Neufahrn counter curve, rail services to the airport from the east will improve significantly.

The aim with these measures and the extension of the mainline rail line connecting Munich, Mühldorf, Freilassing and Salzburg is to provide air travelers from eastern Bavaria and Austria with attractive rail connections.

The key step toward developing a sustainable, integrated transport system and toward strengthening Munich Airport's capabilities as a domestic and international aviation hub is to add a fast and efficient link to Deutsche Bahn's mainline rail network. FMG therefore continues to call emphatically for the construction of a mainline connection to regional and national rail services directly at the airport. Looking at airports where this kind of infrastructure is in place, we can say that a direct, high-capacity, intermodal connection is the only way forward in the interest of achieving major environmental benefits and significant transport efficiency gains.

Environmental management system

Environmental policy

FMG's environmental policy frames a mandatory set of guidelines that is binding on all of the company's units and underscores the immense importance we place on sound environmental practices within the company.

Our environmental policy:

A) Preamble

As an international aviation and intermodal transportation hub, Munich Airport has a responsibility to meet the expectations of its customers and to fulfill environmental requirements. In keeping with this responsibility, we have accorded the principles of sound environmental stewardship a central place in our corporate culture:

Environmental protection as a corporate goal

As the operator of Munich Airport, FMG embraces its responsibility for ensuring the airport's sustainability as a business enterprise. Responsibility for the environment has therefore become an important value in our company policy. We operate an environmental management system whose goal it is to ensure compliance with statutory requirements and regulations. We believe that developing our business sustainably means taking not just our environmental footprint but also economic and societal factors into account.

This enables us to ensure continuous improvement in our environmental performance and, thus, work toward preserving the environment in the long term.

To achieve this objective, Flughafen München GmbH upholds the principles stated below:

B) Our principles

1. Continuous improvement in our environmental performance

In keeping with the principle of sustainability, we focus our environmental protection activities on continuously improving FMG's environmental performance and raising the company's environmental standards.

We pay special attention to noise, air quality, energy, water and waste because, given the scale and nature of our business, its environmental impact can extend beyond the bounds of the airport campus. Executive management and all FMG units collaborate actively on implementing environmental policy and initiatives.

We are a forward-looking and innovative company. To ensure that we engage in sound environmental practices, we assess and monitor the environmental impacts of new and existing processes and new methods and procedures. We are constantly introducing innovative, environment-friendly technology, solutions and environment-driven organizational initiatives. In addition, FMG promotes research and plays an active part in the advancement of environmental technology.

Our priority is to avoid adverse effects on, and risks to, the environment. If these prove unavoidable, we look for ways to reduce the impact, to protect nature, and to conserve natural resources. To achieve this, we put state-of-the-art technologies to work insofar as they are economically viable.

2. Voluntary efforts beyond the scope of statutory requirements

Compliance with environmental legislation, statutory requirements and other environmental obligations is something we do as a matter of course. As an innovator and a forward-thinking company, we aim to achieve a level of environmental performance that exceeds legal obligations.

3. Encouraging environmental awareness and responsibility among our employees

We seek to promote environmental awareness and an understanding of causes and effects among our employees. We recognize the importance of providing our workforce with detailed information and take steps to motivate our people to support and adopt environmentally sound practices. We welcome and encourage innovative ideas from within the company. As a result, our employees have a high level of environmental awareness.

FMG offers an extensive employee training and education program in a wide range of areas as a means of ensuring the company's sustainable development.

4. Open communication with airport employees, local communities and business partners

We foster and encourage an active and open culture of communication, both in-house and externally.

The company publishes environmentally relevant information in extensive detail, as it is essential that our entire workforce be kept fully up-to-date. This environmental information is delivered internally through a number of channels.

We maintain constant contact with the airport's neighboring communities as we are committed to delivering timely communications on environmental issues and concerns.

We also collaborate closely with customers and business partners as part of our efforts to achieve higher environmental standards throughout the airport.

We publish information on Munich Airport's environmental impacts and performance at regular intervals and promote collaboration with our host region.

5. Participation of FMG subsidiaries and other organizations on the airport campus

To safeguard a sustainable, future-focused course of development that encompasses environmental, economic and societal factors, FMG works closely with its subsidiaries and other organizations on campus. To ensure environmental legal compliance at the airport, subsidiaries are subject to environmental reviews and, if possible, certified under EN ISO 14001 and/or EMAS.

6. Safeguarding environmental progress

We work to ensure ecological progress by actively managing environmental affairs. Besides working toward improved environmental performance, our efforts include not just environmental oversight measures that ensure company practices are consistent with our environmental policy and objectives but also initiatives that are designed to embed sound environmental management practices in company processes and procedures.

Working toward sustainability

The Umweltpakt Bayern environmental accord, signed in 1995, has become a model for environmental protection. Founded on the principles of voluntary membership, independent responsibility and cooperation, its goals are to promote innovation and to foster environmentally compatible economic growth along sustainable lines.

Flughafen München GmbH is again a signatory to and member of the latest round of the accord, because we believe that sound environmental stewardship has an essential place in responsible corporate policy. As a member of Umweltpakt Bayern, we have set out to achieve specific environmental objectives that are consistent with the qualitative and quantitative goals and principles of the accord and more than fulfill statutory environmental requirements. Our stated aim is to continuously improve our environmental performance as a business enterprise.

ÖKOPROFIT is a project initiated by the city of Munich to help Munich businesses to reduce their environmental footprints. Supported by outside experts, the companies taking part in the project work to define viable, real-life initiatives to bring down costs and reduce environmental impacts. They assess and identify the legal requirements that they must fulfill, and they receive professional help toward implementing these requirements. Businesses that have successfully taken part in ÖKOPROFIT benefit through PR and publicity work by the city of Munich; they also receive a commendation, qualify to use the ÖKOPROFIT logo, and enjoy a significant image gain.

Since 2002, FMG has been a member of the ÖKOPROFIT Club. The Club holds quarterly meetings and workshops that enable member organizations to share ideas and experiences, adopt others' best practices for in-house environmental protection, and discuss compliance issues. ÖKOPROFIT members have jointly published a brochure describing their environmental initiatives and programs, the outcomes, the scale of the capital spending involved, and the cost savings they have achieved.

FMG's environmental management system was validated on November 15, 2005, by an independent environmental auditor and declared valid under the terms of DIN ISO 14001:2004 and the European EMAS Directive 761/2001.

Deploying, expanding and refining the FMG environmental management system helps ensure greater efficiency, transparency and verifiability of our environmental activities and planning. Going forward, the goals and initiatives we define specifically for individual company units within the framework of the environmental management system will help us to continuously improve our environmental performance and processes.

Sustainability

Globalization, climate change, energy, sound working conditions, mobility and demographic change all pose major challenges for policymakers, industry and society in the twenty-first century, and call for the will and the power to act. Crucial to solving these challenges is the ability to weigh short- and long-term goals and interests against one another and to make well-founded decisions.

For businesses, sustainability essentially means making responsible use of resources of all kinds – from financial and human capital to business relationships and, of course, materials and natural resources. A sustainable business strategy means greater efficiencies, enables a business to deliver more innovative products, technologies and services, and creates a significant competitive advantage in domestic and international markets.

FMG already engages in programs and initiatives to promote sustainability in many areas of its business activities, and executive management has now authorized the FMG Sustainability Project, which has been set up with the aim of optimizing and publicizing these programs and initiatives.

Integration

If pursuing a policy of sustainability is to benefit the company, that policy must be embraced and implemented at every level within the organization. By incorporating sustainability into company strategy, we ensure it is accorded the requisite importance. Sustainability targets in a balanced score card connect the company's objectives with the process of delivering sustainability. Therefore, including sustainability in the BSC involves defining an implementation plan and anchoring it in individual target agreements.

Environmental stewardship already plays a linchpin role in Flughafen München GmbH's corporate value system. Our overarching goal is to help ensure that tomorrow's generations enjoy at least the same living conditions as today's. Munich Airport, given its size and the type of role it fulfills, has a wide variety of environmental impacts, and this is why we have embraced environmental management and the sustainability of our business in our guiding corporate principles.

We take steps to address environmental and sustainability issues while at the same time pursuing our interests as a business operation. Our uppermost goal is to avoid impacting negatively on the environment in general and on our neighboring communities in particular, which is why we have given top priority to making economical use of land, water, power and air and to avoiding aviation noise and air pollutants.

The importance of stakeholder groups

The business activities and value of successful companies are not shaped purely by economic factors. On the contrary, companies have to take into account the interests of their customers, business partners, employees, and the host communities in which they operate in their decision-making and strategy implementation. Not just shareholders but also stakeholders in the company, on the corporate campus, in the surrounding region and beyond are important.

An airport's relationship with its host region is inevitably complex and dynamic, because an airport operator's activities are governed to a significant degree by environmental issues and by the way the airport operator embraces its citizenship responsibilities toward its local communities and surrounding area. The way in which an airport engages with its stakeholders is therefore of exceptional importance.

Sustainability report

A sustainability report plays an important role in the process of delivering sustainability as an integral part of an open approach to corporate communications that inspires faith both in-house and externally. A sustainability report describes for its target audience the company's sustainability initiatives and performance and constitutes an important complementary document to the annual report. We will therefore be publishing a sustainability report to provide a thorough overview of our activities. It will cover the environmental, business and community initiatives and programs through which we strive to make a difference – initiatives and programs for which we have set ambitious targets.

Goal

FMG's goal is to improve further its sustainability performance and to document this performance in a sustainability report to be published in 2009. This goal reflects our commitment as a company to implementing our corporate values.



Environmental impacts

Munich Airport tracks and evaluates all of its direct and indirect environmental impacts.

Direct environmental impacts are those which arise as an immediate result of FMG's activities at the airport and which FMG can directly influence. Indirect impacts are those that result indirectly from FMG's activities and over which FMG does not have complete control.

Environmental impacts are rated and classified annually according to two criteria:

1. Importance
2. Scope for control

Topmost in the classification are those environmental impacts that are of high importance and over which we have considerable control:

Environmental factors with direct impacts

- Energy consumption
- Fuel consumption
- Procurement
- Wastewater disposal
- Waste disposal
- Land use
- Water consumption
- Subsidiaries

Environmental factors with indirect impacts

- Aviation noise
- Pollutants produced by aviation
- Third-party companies on campus
- Groundwater and soil protection
- Passenger travel to the airport
- Electrosmog
- Influence on flora and fauna (off campus)
- FMG employees' commutes
- Light emissions
- Other employees' commutes
- Third-party operators' service ramp traffic
- Aviation exhaust emission smell
- Microclimate change

Organizational structure and responsibilities

Corporate management carries the overall responsibility for ensuring compliance with the requirements established by the environmental management system. These responsibilities include:

- Defining and implementing company environmental policy
- Ensuring the availability of sufficient human, technical and organizational resources to operate and sustain the environmental management system
- Regularly conducting reviews to verify the effectiveness of the environmental management system.

Group Environmental Strategy and Management is responsible for:

- Ensuring that ISO 14001 and EMAS certification standards are upheld
- Verifying compliance with environmentally relevant statutory regulations and requirements
- All environmental issues.

The environmental management team is tasked with developing environmental plans and strategies, coordinating environmental activities, developing, planning and implementing new environmental initiatives, and monitoring compliance with environmentally relevant statutory regulations and requirements.

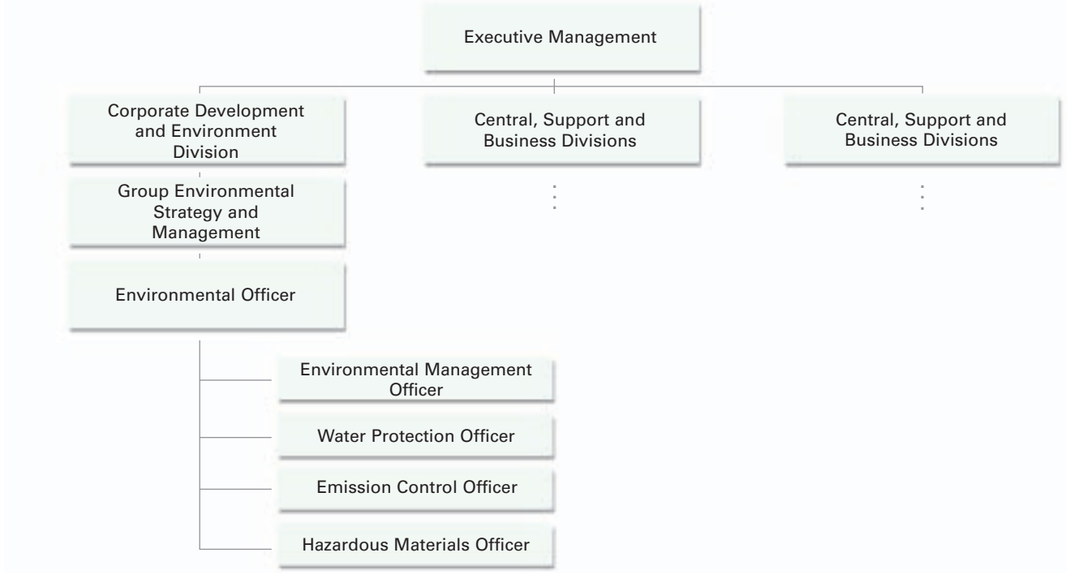
The team carries the overall responsibility for rolling out and extending the environmental information and management system and for environmental public relations work. It maintains contact with government bodies and associations and acts as an interface between FMG's executive management and functional units on issues of environmental protection. In addition, its tasks and duties include delivering internal and external communications and publishing information on environmental affairs.

To ensure that the environmental management system continues to operate effectively over the long term, FMG has an environmental management officer who is tasked with ensuring that the system functions effectively and as intended.

Heads of central, business and support divisions are responsible for implementing the environmental management system in their own units and for ensuring that their employees understand and follow the requirements of the environmental management system as they pertain to them.

In addition, division heads must ensure that the requisite process documentation is kept up-to-date and that the information and data necessary for tracking process outcomes at yearend are available for review.

Additional company officers have been appointed as required by law.



Internal and external policy initiatives

Work in airport organizations

Munich Airport is a member of key national and international airport organizations. Officers of Flughafen München GmbH represent the airport in German and European environmental working groups set up by the German Airports Association (ADV) and the Airports Council International. The work carried out by these groups ranges from the planning of residential developments in the vicinity of airports to the creation of systems of environmental indicators and the publication of recommendations regarding noise limits for aviation.

Subsidiaries

When FMG obtained environmental certification in 2005, the company set itself the goal of achieving the same in its subsidiaries. With those that play a public role, we work toward EMAS certification; with those that do not, the DIN EN ISO 14001 standard applies.

The first was the Kempinski Hotel Airport München, a five-star luxury facility with more than 400 beds, two restaurants and a spa area, which was validated under EMAS in November 2007. This success gives much-deserved recognition to numerous ideas and initiatives for reducing the hotel's environmental impacts and energy consumption, a number of which have already been implemented. The Kempinski Hotel's environmental statement is available at www.kempinski.com. Additional programs are in place to further reduce the hotel's environmental footprint in line with defined targets.

Allresto Flughafen München Hotel und Gaststätten GmbH, the hospitality company that operates over 40 restaurants as well as cafés, restaurants and a microbrewery at the airport, received certification to DIN EN ISO 14001.

Having obtained certification, these two companies are now compliant organizations. Compliance checks were conducted to ensure that all of the employees were are familiar with and uphold the environmental requirements. At both organizations, every area in which environmental protection plays a role was examined and described; energy consumption and costs were analyzed and documented, as were disposal practices and procedures.

The environmental management system will remain in place in years ahead and will be subject to continuous improvement. Corporate parent FMG will support this process through Group Environmental Strategy and Management, which offers practical advice and assistance and is responsible for conducting the annual audits.

Suppliers

FMG requires high environmental standards throughout the airport and applies the same standards when sourcing goods and services. Munich Airport conducted its first supplier evaluations in 2005. Given that the airport is EMAS-certified, the supplier evaluation system was extended in 2007 to include additional environmental criteria so that EMAS or ISO 14001 certification could be taken into account.

Flughafen München GmbH

We seek to promote employees' environmental awareness and an understanding of causes and effects. We recognize the importance of providing our workforce with detailed information, and we take steps to motivate our people to support and adopt environmentally sound practices and to encourage them to come up with new ideas. It is largely thanks to this approach that there is a high level of environmental awareness among FMG employees.

In addition, FMG offers an extensive training and education program for employees in order to promote the principle of sustainable development within the company.

Open communication

Internal communications

The company publishes comprehensive environmentally relevant information through a number of channels, including our monthly employee newsletter *Flughafen Report*, which regularly runs pieces on environmental topics, and the corporate intranet, through which the latest information can be delivered swiftly to the workforce. As of 2008, a parallel online edition of *Flughafen Report*, *FRonline*, provides coverage on news, events and plenty more relating to the airport. The highly current and condensed reports online enable employees to find out faster about major newsworthy occurrences within the FMG Group.

The Communications Office

The Communications Office was set up in December 2006 with the aim of keeping everyone who works at Munich Airport informed about the project to build a third runway. Through this office, businesses and other organizations located at the airport can find out about everything from the runway specifications to the current project status, approach and departure routing, and the anti-noise program.

One important aspect of the Communications Office's work is its advocacy program. Employees act as advocates of the third runway, engaging in dialogue with people within their own communities to actively promote the expansion plans and to help convince people of the project's merits. They are equipped with the requisite knowledge by the Communications Office, which works closely with FMG's public relations department and the Runway 3 Project Team to provide the necessary information.

Extensive information on the Runway 3 Project is available on the Web at www.munich-airport.de and www.muc-ausbau.de.

Regional communications

We place considerable importance on engaging in dialogue with our neighboring communities and on actively involving our host region in environmental initiatives. As part of our policy of open communication, we publish numerous news releases as well as *M Dialog*, a monthly newsletter for airport neighbors, which reports on Munich Airport's environmental footprint and performance and seeks to foster collaboration with local communities. In addition, we continuously publish information on environmental issues and local topics as well as data on noise and air pollutant levels on the Web.

Flughafen München GmbH's regional relations officer plays a central role in maintaining good relations with airport neighbors. Rudolf Strehle, deputy regional relations officer since February 2007, has taken over the post from Florian Fischer, who had maintained, managed and coordinated relations between the airport operator and the airport's neighbors since November 2002.

Active regional policy

Flughafen München GmbH works to promote intensive collaboration with neighboring communities and aims to network systematically with its wider locale at a number of different levels. Our goal is to identify common ground shared by the airport and its surrounding region and to collaborate on projects in areas like infrastructure. Our vision in the long term is to firmly establish Munich Airport as an integral part of its host region.

The importance of our regional relations work is underscored by the fact that the airport has its own regional relations officer and regional relations office, installed to interface between FMG and the local region and to provide local communities with a point of contact for inquiries and comments.

The Communities Council

The Communities Council was formed in the summer of 2005 with the aim of finding solutions that would help to limit to the greatest extent possible the negative impacts on airport neighbors resulting from the construction of a third runway. Chaired by a neutral facilitator, the Council's role is to organize the dialogue with the region on Flughafen München GmbH's expansion plans and to provide a framework for the exchange of opinion. The Council has served as a forum for the discussion of key issues with airport neighbors, on one occasion holding a conference, attended by three Bavarian government ministers, on improving the airport's surrounding transport infrastructure.

Flughafen München GmbH has proposed setting up a voluntary impact fund for the region that would help provide compensation for cases of hardship or burdens resulting from the construction of the third runway. A Communities Council working group is tasked with deciding on the allocation of the resources that FMG may make available.

Regional marketing working group

One example of successful collaboration between the airport and its host region is a regional marketing initiative operated and funded by FMG in association with the Erding and Freising administrative districts to promote industry and tourism. A joint task force, set up in 2005, works to actively develop the region and to promote its particular qualities and advantages.

Energy

Energy management

One fundamental requirement for the successful operation and expansion of a modern commercial airport is a reliable, innovative, environmentally compatible and economical supply of energy, drinking water and firefighting water, and efficient, environmentally compatible wastewater disposal. The reliability and efficiency of all these utilities play a major role in the attractiveness of an airport, the satisfaction of passengers, airlines, visitors and employees, and the facility's acceptance by its host region.

The airport's energy requirements are covered by its on-site cogenerating facility, which provides power, emergency power and HVAC, and by connections to the national power network operated by E.ON Bayern Netz GmbH, the district heating system operated by Fernwärme Freising GmbH, and the gas supply network operated by Erdgas Südbayern GmbH.

Power procurement and sales

More than half of Munich Airport's overall power requirements are covered by the airport's own generating capacity; the remainder is sourced from an outside utility. FMG and its affiliates account for around two-thirds of the total power consumed at the airport, while the remaining third is sold to external customers.

The combined heat and power plant: Centerpiece of the energy supply system

Munich Airport provides mains power, emergency power, heating, and cold water for air-conditioning from its combined heat, power and cooling plant, boiler systems, refrigerating machines, and the public district heating network. At the same time, the airport's energy center bears the entrepreneurial responsibility for regulatory compliance, environmentally compatible and economic operation, and adherence to quality targets.

With the grant of planning approval by the regional government of Upper Bavaria on July 8, 1979, the airport was required "to plan its heating supply system to incorporate the latest technologies for conserving energy."

As a result, rather than build a central emergency power plant, a central heating plant and a central cooling plant with electric compression refrigerating machines, the zoning approval was amended to allow seven modular combined heat and power generating units to be built, to which two more were added when Terminal 2 was constructed.

There are seven diesel and gas-powered modules and two gas Otto-cycle modules that convert fuels (natural gas and fuel oil in the case of the diesel and gas-powered units) into electric power and heat.

The combined heat and power plants and other gas consumers (the hotel, catering facilities, boilers, and the hydrogen filling station's steam reformers) are supplied with natural gas via the airport's own gas network (PN4), which is connected via a substation to the upstream gas utility main (PN70). To store the sulfur-free fuel oil used to power the seven gas and diesel combined heat and power generating units and, if necessary, the three boilers (dual fuel burners), the facility has two double-walled fuel oil storage tanks, each with a capacity of around 1,000 cubic meters.

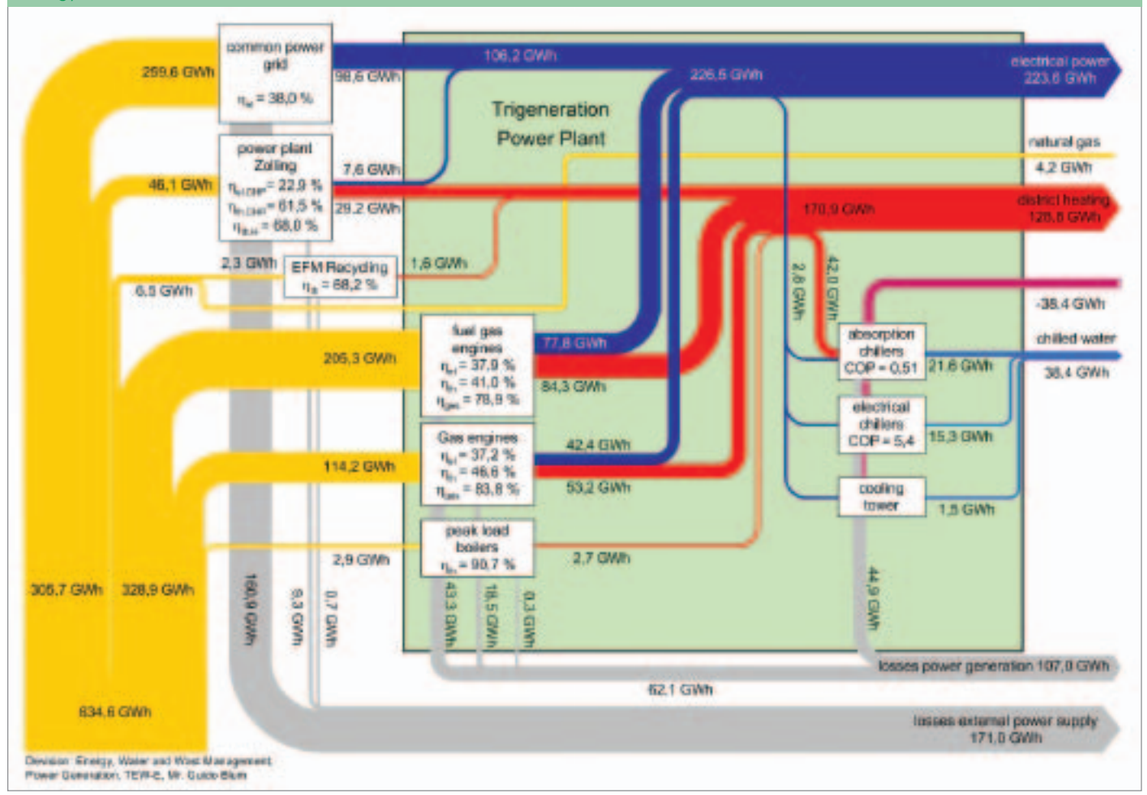
The combined heat and power plant units generate a total electrical output of 18.5MWel. The lubricant, motor coolant and exhaust gas heat exchangers in the heating circuit deliver a total thermal output of 21MWth.

The gas and diesel units and the gas Otto-cycle engines convert the fuels into power and heat with an aggregate gross efficiency of 78 percent (el = 39 percent, th = 39 percent) and 83 percent (el = 38 percent, th = 45 percent), respectively, under standard operating conditions.

To keep the combined heat and power units operating continuously at full load, the energy center has a heat storage unit (shuttle storage). When surplus heat is generated, it is transferred to the heat reservoir. The heat can be extracted from the storage system when it is needed at a later time.

The heating energy generated by the combined heat and power modules and stored in the heat reservoir is used for heating purposes year-round and for cooling by means of absorption refrigeration in the summer. The use of generated heat to drive the absorption refrigeration machines (part of the heat, power and cooling co-generation process) means that the combined heat and power units can be operated efficiently all year, with the result that, on average, they achieve an aggregate gross efficiency of 78 percent (gas/diesel) and 83 percent (gas/Otto cycle) annually.

Energy flow chart for 2007



Heat supply and distribution

At Munich Airport, heating energy is mainly needed for space heating and for hot water. It additionally provides industrial and process heat used by the airport's largest catering operator and by the HVAC system's absorption refrigeration machines. With an annual heat output of around 180,000MWH, the heat extracted from the combined heat and power generating units – 21MWth – covers the basic load (70 percent) for the district heating network, the industrial heat supply, and the energy needed to drive the absorption refrigeration machines.

The system has an annual heating energy output of around 150,000MWh, and since Terminal 2 opened the highest demand for heating energy that has had to be covered was roughly 55MW. The heat generating facility supplies substations in the buildings via a network of district heating pipes, some buried in the ground and some installed in a system of walkable underground tunnels. The district heating network on the Munich Airport campus is around 18 kilometers in length.

Cooling energy generation and distribution

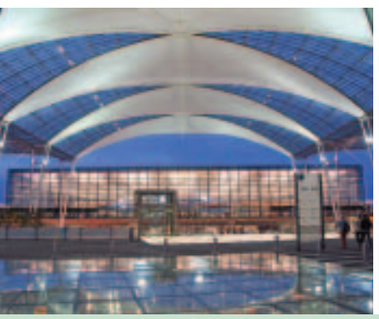
The centerpiece of the airport's cooling system is the central refrigeration plant, located in the energy center. Beside free cooling in winter, the center uses absorption and compression refrigeration machines. The cooling medium is a permeate of partially desalinated water produced in a reverse osmosis system. In addition to the central cooling plant on the west side of the airport campus, there is also a temporary cooling center on the east side equipped with an additional compression refrigeration machine. A main district cooling system pipe that passes through the airport's Central Area connects the temporary cooling center with the main cooling plant.

The cooling medium generated on the airport campus is delivered to the consumer system over an extensive network of lines fed from a master line running through the Central Area. The branch lines distribute the cooling medium into the service areas of buildings. For the most part, consumer system endpoints are connected directly to the network without intermediate heat exchangers. The district cooling system operates with a varying inlet temperature. In the winter and transitional periods, this is around 12° C but it is lowered gradually to around 5.5° C as outside temperatures increase.

Emergency power

Munich Airport has a comprehensive emergency power strategy in place so as to ensure safe and reliable operational continuity in the event of a mains power outage. The requirements that an emergency power system must meet are determined by zoning, aviation law and ICAO regulations, construction regulations and requirements, and customer and user requirements.

An official annual inspection must be carried out each year to ensure that the backup power supply and related safety and changeover systems function correctly. An annual emergency power test, which also serves as a functional test for the connected loads authorized to receive emergency power in the event of a switchover, is carried out conducted to provide proof of function. At present, the central test is carried out on the night of the second Sunday in May. The practice of always running the test at the same time each year has proven its worth, because all customers, tenants and users have plenty of time to plan and prepare for it.



Renewable energies

The Renewable Energies Act

Under the terms of Germany's Renewable Energies Act, FMG is classed as a network operator. As such, the company is obligated to allow third-party suppliers generating power from renewable sources to feed that power into its network and is required additionally to remunerate these suppliers for that power at the rates set in the Act. The suppliers receive monthly installments, and the final amount owed is settled at yearend based on the metered amount of power delivered. There is a solar power installation on the roof of Terminal 2, and FMG is required to pay for the power it generates. In addition, FMG is obligated to purchase a set amount of power generated from renewable sources from the local utility, E.ON Bayern Netz GmbH.

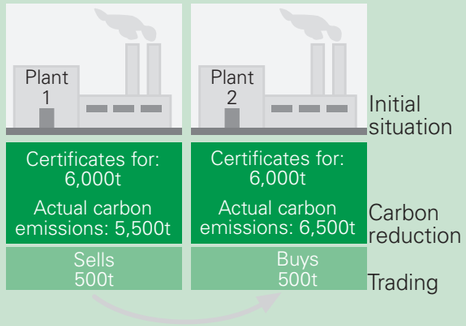
Since 2007, FMG has been testing rapeseed, biogas and bioethanol as environment-friendly alternative fuels, and a number of production vehicles at Munich Airport are now running on renewables. The goal of this project is to evaluate the technical requirements, the performance of the test vehicles, and the cost-effectiveness of these fuels under operating conditions at the airport. Besides their high environmental compatibility, these three innovative fuels offer an additional benefit in that they are inexpensive.

Carbon trading and the Greenhouse Gas Emission Entitlements Trading Act

The signing of the Kyoto Protocol in 1997 marked the conclusion of a agreement under international law whose ratification was to secure a binding reduction in greenhouse gases by industrial nations. These nations agreed that, between 2008 and 2012, they would reduce their total emissions of greenhouse gases – specifically, carbon dioxide, methane, dinitrogen monoxide, partially halogenated chlorofluorohydrocarbons, perfluorocarbons, and sulfur hexafluoride – by 5 percent compared to the base year 1990. An EU Directive on greenhouse gas emissions requires companies operating plants with a rated thermal input of more than 20MW to obtain a permit to emit greenhouse gases. In addition, under the Directive, every plant is granted specific emission allowances; these allowances can be traded. Operators must retain sufficient allowances to cover the carbon emissions produced by the plants they operate.

The power, heating and cooling plants installed at Munich Airport have a rated thermal input of more than 20MW, so FMG has been required to take part in carbon emissions trading since 2005. Under Germany's Greenhouse Gas Emission Entitlements Trading Act this involved submitting applications in 2004 to the German Emissions Trading Authority (DEHSt) for free carbon emissions certificates. These certificates were granted in sufficient numbers for the airport's plants and installations, with the result that, to date, no additional certificates have had to be purchased on the market during the first trading period. Under the terms of the aforementioned Act and the EU Monitoring Guidelines, extensive reporting obligations must be met. An emissions report for 2005 for the first trading period was prepared in early 2006 and verified by an independent expert. The Emissions reports, which detail the number of carbon certificates required in the year covered by the report, must be signed electronically and submitted by March 1 of the following year to the relevant authority – in the airport's case, the Bavarian Office for the Environment, Public Health and Consumer Protection. Having conducted its own review, the Office forwards the reports to the Emissions Trading Authority. Plant and installation operators must then deposit the requisite number of certificates in the DEHSt account by April 30 of each year. If the certificates credited to the account are not sufficient to cover the requirements, the shortfall must be covered through purchases on the emissions market.

Principle of carbon emissions trading



The Hydrogen Project

Over a period of ten years and with 8,000 refueling operations, 115,000 kilograms of hydrogen, and 500,000 kilometers traveled, the Hydrogen Project operated by the H2argemuc consortium at Munich Airport has reached a successful conclusion. The hydrogen filling station, the first public installation of its kind in the world, has now been decommissioned.

The project set out to assess the economics of hydrogen fuel, to encourage an interest in the fuel among the public at large, and to demonstrate the reliability, safety and everyday usability of hydrogen. All of these objectives were achieved – importantly, without any system failures or accidents. The project has succeeded in demonstrating that it is feasible to use hydrogen, an important outcome, given declining fossil energy reserves and the need to protect the climate.

However, hydrogen is not a readily available natural resource but has to be produced using energy – by breaking down water into oxygen and hydrogen, for example. Only when sufficient alternative carbon-free energy is available to produce it can hydrogen help to protect the climate. Hydrogen is therefore simply a technology with the potential to deliver the energy needed for mobility.

Biogas

Biogas, with its potential carbon savings of more than around 20,000 metric tons a year, prompted a group of partners in industry, agriculture and politics to sign a memorandum of understanding initiating the Biogas Project at the 2nd Energy Forum.

Munich Airport has been using rapeseed oil and ethanol as biogenic fuels for some time. Every liter of conventional fuel replaced using, say, ethanol, translates into 2.5 kilograms less carbon emitted into the atmosphere.

However, biogas produces the lowest emissions by a significant margin. Up to 30,000 tons of garden waste are produced on the airport campus each year. This waste – wood chips and cut grass – is a valuable resource that can be turned into biogas. Organic kitchen waste, too, is an excellent resource for the production of biogas.

This ambitious project is creating an important benefit for the airport region because there are plans to begin collecting raw materials for producing biogas in the airport's surrounding area, too. In fact, it has even been proposed that the airport utilize organic kitchen waste collected as far afield as the Ebersberg, Dachau and Munich municipalities in an effort to reduce greenhouse gas emissions.

Most of the biogas will be fed into the airport's combined heat and power plant, with just a small amount being used to fuel airport vehicles. The aim in the longer term is to cover close to 30 percent of the airport's natural gas requirements with biogas, producing an annual carbon saving of around 20,000 tons.

Initially, FMG plans to run pipes from two existing biogas plants into the airport from the east.

Solar generating facilities

One of the largest photovoltaic installations installed at a commercial airport to date was built on the roof of Terminal 2 and went online in 2003. The solar power plant is a project operated jointly by BP Solar, Deutsche BP AG, B.A.U.M., Deutsche Lufthansa AG, Flughafen München GmbH, and a number of private investment companies.

The installation consists of 2,856 modules of silicon cells with a photovoltaic area of 3,594 square meters and generates an AC output of 395kW that is fed into the mains power network. The annual output is around 445,000kWh, equivalent to the amount consumed in a year by around 155 average households. Throughout its service lifespan of 30 years, the solar facility will save around 12,000 metric tons of carbon.

Powering sweeper trucks with vegetable oil

Vegetable oil produced from rapeseed, a renewable resource, is now being used at the airport as fuel in Faun sweeper trucks. The vegetable oil has the advantage that it has a positive energy balance. This means that the energy released by this fuel is greater than the energy required in order to produce it. It is also especially environment-friendly in that it cuts carbon emissions by 80 percent compared to diesel fuel.

The FMG sweeper trucks used to clean the aprons and the service roads in the airport's airside areas are ideal when it comes to using vegetable oil. Their ancillary engines are powered with vegetable oil and run well on it during continuous use. The annual consumption will be around 20,000 liters.

The results have also been good with 13 converted tow trucks. These vehicles have prechamber diesel engines that may no longer be state-of-the-art but, with special modifications, they are especially well suited to running on vegetable oil. The proven engine design enables the oil to burn efficiently without the buildup of harmful deposits in the engine, and the amount of vegetable oil leakage into the engine oil is low.

However, the development process is moving forward continuously, and fleet management continues to look for solutions that will enable vehicles with modern powertrains to run on vegetable oil.

Bioethanol

Like rapeseed oil, bioethanol distillate is a renewable fuel being used at Munich Airport. The filling station in the technical area has its own bioethanol filling station, where the numerous airport vehicles that run on bioethanol can fill up. A number of automobiles have been specially converted to run on the fuel, and a number of new vehicles designed for it have been purchased. The distillate, which is made from crops like sugar beet, is currently produced in eastern Germany from local Bavarian products. In the intermediate term, this "field-grown fuel" will be produced entirely in the airport's local region, benefiting local producers and avoiding transporting the fuel long distances to the point of use.

Air pollution control

Air quality monitoring

Air quality monitoring has shown that the extent to which the airport is responsible for local area pollutant levels is low, and extensive analyses indicate that operating a third runway will make little difference to this. All projected and airport-related pollutant concentrations will be well below the statutory limits.

Air quality monitoring at Munich Airport involves taking continuous readings at a number of measuring stations, the first of which was set up a year before the new airport began operating.

The stations monitor and measure the following:
- Sulfur dioxide (SO_2)
- Carbon monoxide (CO)
- Nitrogen monoxide (NO)
- Nitrogen dioxide (NO_2)
- Ozone (O_3)
- Dust (suspended dust until 2000, then PM10 particulate matter)
- BTX hydrocarbons – benzene, toluene and xylene (since 1999)
- Meteorological data

Levels of almost all of these air pollutants have generally been in the low-to-middle range. The only exception is ozone. Elevated levels have been detected at the airport in the spring and summer months, especially in the afternoons but, as yet, these have been below the defined limit. Overall, the air pollutant situation at the airport's perimeter and in public areas of the airport is roughly comparable to that of a small or medium-sized town, such as Kelheim or Passau. Conducting measurements continuously to determine the composition of the air over a prolonged period of time provides a valuable set of data for long-term observations.

Measuring methods

Biomonitoring

With this voluntary monitoring program, Flughafen München GmbH aims to track pollutant levels at the airport and across its local area to provide the public with precise information on the quality of the air.

Since 1991, Munich Airport has monitored air pollutant levels with technical analysis equipment. In the fall of 2006, the monitoring program was augmented to include biomonitoring and widened to encompass neighboring communities around the airport campus. Curly kale plants and precipitation collectors set up at 14 locations in the area around the airport are used to track airborne pollutants. Curly kale was chosen because it tends to accumulate concentrations of air pollutants easily and because it is a human food plant, making the program findings especially interesting for consumers.

In biomonitoring, air pollutants currently affecting the plants (representing vegetation in general) are measured. In contrast to measurements carried out with technical equipment, biomonitoring allows continuous monitoring and precise conclusions regarding the impact of a large number of substances on the environment, particularly as this method takes into account external influences as well as the compound action of pollutants. The underlying thinking is that the effects on organisms are different and potentially stronger than measurements based purely on technical equipment may show. The biomonitors described here make it easier to assess the impact on, or possible threats to, human health and the environment.

The environmental measurements are conducted by an independent specialist in biomonitoring and recognized analysis labs in association with the Bavarian State Office of the Environment.

Passive measuring methods

In addition to the biomonitoring, so-called passive measuring methods are used to measure air quality at the airport.

These deposition and precipitation measurements of dry particulates and wet matter (used to track the accumulation of pollutants) are part of Munich Airport's wider voluntary environmental monitoring initiatives.

Substances in solution in precipitation and water-soluble materials from dry deposition are collected in bulk collectors and their quantities recorded. The method is based on guidelines issued by the International Water Study Group. An outer pipe, 1.5 meters high, encloses a collection vessel connected to a trap funnel. Samples are taken every 14 days and checked for ammonium and nitrates (nitrogen compounds), sulfate (sulfur compounds), and other water-soluble substances. The total nitrogen and acid deposition is assessed based on amounts set by Bavaria's State Office of the Environment and area-related threshold values.

LASPORT

Since late 2005, FMG's Group Environmental Strategy and Management unit has been working with the Aerospace Faculty of the Munich University of Technology on simulating air pollution at Munich Airport. The simulation is based on the LASPORT emissions propagation model, an airport version of the widely recognized LASAT model.

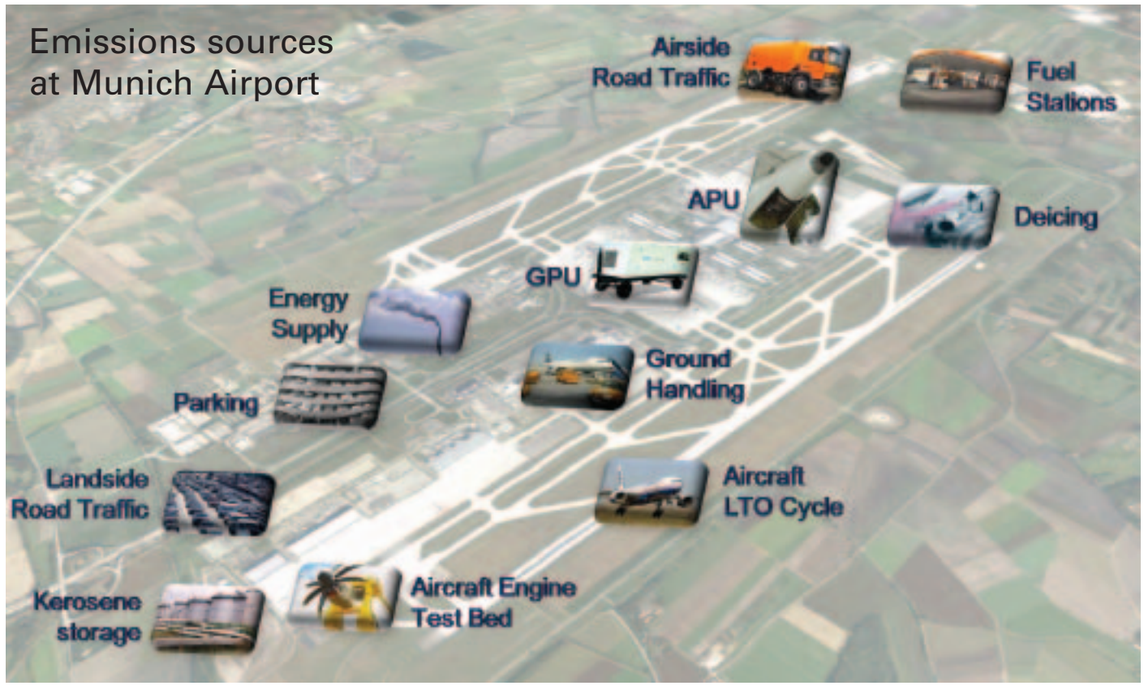
The entire airport infrastructure was modeled and the operating data recorded for all significant pollutant sources to be included in the simulation. LASPORT enables users to create an emissions inventory, in other words a catalog of pollutants emitted by different sources at the airport (e.g., aircraft, road traffic and ramp operations). The pollutants and factors currently being studied include hydrocarbons, nitrogen oxide, particulate matter, sulfur dioxide, and the airport's annual carbon balance.

The emission propagation computations shed light on the concentrations of these substances caused by airport operations and, therefore, the airport's and individual emission sources' share in the air pollution situation, not just on the airport campus itself but in surrounding towns and communities too. By comparing the results of the simulation with the mean annual figures from the airport's own pollutant monitoring installations, it is possible to determine both the airport's share and the background load. The model shows that airport operations only account for 6–8 micrograms per cubic meter of NO_2 at the airport perimeter, or 25 percent of the measured concentrations (31 micrograms per cubic meter).

The levels caused by the airport decline rapidly with distance, so figures in Attaching are below 4 micrograms per cubic meter and figures in Freising below 2 micrograms per cubic meter. The remaining load is caused by road traffic unrelated to the airport, by industry, by households and by other sources.

The simulation also allows a comprehensive assessment of the environmental impacts of airport expansion projects and technical and operational measures, such as the use of alternative fuels.

The simulation serves as a strategic decision-making resource in the planning of technical equipment and installations to be added to the airport's infrastructure. By reviewing possible future scenarios, we can promptly identify potential problems issuing from rising airborne pollutant levels and resolve them by taking appropriate action.



RegioExAKT

Munich Airport is one of the main clients and backers of the Regioexakt Project, set up to track extreme weather events through to the year 2030 and to develop appropriate response strategies. A key focus of this project is on the assessment of the scale of regional heavy storm risk with a view to avoiding property damage from gale-force winds, tornados, hail, heavy rain, and lighting strikes.

The three-year project, launched in January 2007, networks users with a cross-disciplinary research group that builds hydrometeorological and insurance-relevant extreme weather scenarios using regionally focused climate and vulnerability projections based on regional climate change.

This enables insurance and construction requirements to be aligned to the anticipated threat from storms through to the year 2030. For Munich Airport, provisions in anticipation of extreme weather events comprise optimized forecasting of heavy storms and an extended drainage plan.

Environmental study: Clean apples

In response to public complaints concerning soiled apples, FMG conducted a joint environmental study in association with the Erding and Freising administrative district offices and the Munich University of Technology in Weihenstephan.

The study examined in detail the causes of unexplained deposits on fruit, vegetables and building roofs that had been reported in the airport's surrounding region. The purpose was to ascertain whether airport operations were responsible for the problem. In response to requests from individuals, a total of 26 samples, plus samples from reference sites, were collected and tested for plant diseases and possible contamination from mineral oil hydrocarbons. The findings with all of the samples was that the deposits had been caused by fungi.

Testing for hydrocarbons was difficult because the composition of aircraft exhaust gases differs depending on the engine manufacturer and the amount of thrust produced by the engine – something that can be demonstrated on an engine test rig. The samples examined all showed different concentrations of a wide range of pollutants. However, samples from reference locations outside the airport area also exhibited partially elevated levels. The analyses were consistent with environmental data records in that they revealed no demonstrable link between aviation emissions and the deposits found. Deposits on fruit, leaves, garden furniture, glass roofs or patios are therefore unlikely to be due to aviation and can have a large variety of causes.

The results of the study were published on the administrative district office and Flughafen München GmbH web sites.

Emission charges

Munich and Frankfurt airports have introduced an emissions-based component to their takeoff and landing fees. Under this pilot project – initiated by the German Air Transport Initiative in association with Germany's Federal Ministry of Transport, Building and Urban Affairs – Munich and Frankfurt on January 1, 2008, began charging airlines €3 per unit of equivalent emissions, computed on the basis of individual aircraft types' nitrogen oxide and hydrocarbon output. This model is based on recommendation 27-4 issued by ERLIG, the Emissions Related Landing Charge Investigation subgroup set up by the European Civil Aviation Conference (ECAC), and follows a lead taken by the United Kingdom and Sweden. The project was rolled out successfully and received broad support from airline companies.

This means that FMG now also bases its takeoff and landing fees on pollutant emissions as well as on aircraft noise. By introducing the additional pollution-based component to the charges, we are helping to drive forward the development of, and investment in, advanced, more environmentally efficient aircraft. The noise and emissions charges can be adapted dynamically in relation to local noise and pollutant levels.

From the airlines' and airline associations' point of view, tying airport charges to emissions of nitrogen oxides and hydrocarbons plays a valuable role in protecting the environment. This model is generally regarded as far more sensible than imposing ticket taxes or unrelated emissions levies on airline passengers.

The emissions-based landing fees do not generate extra revenues for Munich Airport. The additional expense to airlines is offset by a corresponding reduction in the fixed portion of landing fees based on the maximum takeoff mass of the type of aircraft operated. The move protects Germany's competitiveness as a center of aviation while at the same time extending our array of instruments for responding to changes in airport air quality with financial incentives. The emissions-based charges are also an effective local complement to the global carbon emissions trading program that will be introduced for aviation in 2012.

As the readings taken by the Federal Environment Agency over many years show, air pollutant levels in Germany have gone down significantly and, more or less, on a nationwide scale. However, it is impossible to exclude the possibility that major population centers, which are typically the sites of large commercial airports, may encounter problems with local air quality and with tougher EU restrictions on NO_2 to be introduced in 2010 to protect human health. These problems can largely be attributed to a combination of separate urban emission sources, including an array of different modes of transport. They are not caused primarily by aviation, nor can they be rectified solely through remedial or optimization programs by airlines and airports.

Technological advancements and operational measures have allowed aviation-driven environmental impacts to be divorced from growth. The introduction of emissions-based landing charges has created an incentive for carriers to operate aircraft that produce as little in the way of NO_x emissions as possible and sends out a signal to manufacturers underscoring the importance of innovating and advancing technology to improve environmental efficiency. This means that the aviation industry is engaging voluntarily in initiatives in those areas where it can make a significant environmental contribution, and this is why emissions-based landing charges are being trialed at Munich and Frankfurt over the next three years.

New technologies

Reducing aircraft engines' pollutant emissions

Smoke emissions from aircraft engines are very much a thing of the past and emissions of carbon monoxide and unburnt hydrocarbons have improved enormously. Compared to diesel and Otto-cycle engines they are now extremely low, thanks to the continuous combustion process in engines. However, nitrogen oxide (NO_x) emissions remain problematic, and without the introduction of pollutant-reducing combustion chamber technologies, they will likely continue to increase. Unlike earlier engines, today's run hotter, because the higher an engine's process temperature, the greater its thermodynamic efficiency. High efficiency means lower fuel consumption and, thus, lower carbon emissions. Given today's rising fuel prices and intensive climate debate, the trend toward higher combustion temperatures will likely continue as there is a clear need for fuel-efficient, low-carbon power units.

Overall efficiency can be improved further with the bypass ratio. The propulsion efficiency of an engine increases in relation to the bypass ratio – ultimately, that is, with the diameter of the fan (the large set of blades visible at the front of the engine). Over the past 30 years, aero-engine makers have succeeded in increasing bypass ratios substantially, almost halving kerosene consumption in the process. Optimizing the bypass ratio even further would produce an additional reduction in kerosene consumption. However, this will require a reduction in the size of the core engine, something that can only be accomplished by raising process pressures and temperatures. New engines fitted to the Airbus A380, Boeing 787 and Airbus A350 have already gone in this direction.

One way to significantly increase the bypass ratio and to boost efficiency at the same time is to insert a step-down gearbox between the core engine and the fan. This type of engine is known as a Geared Turbofan™, or GTF for short, and promises an additional reduction in fuel consumption of around 5 percent in comparison with advanced competing engines. Engines currently being developed for regional jets are fitted with this kind of gearing. A positive side-effect of GTFs is that they also produce less noise (a cumulative reduction of around 10 dB).

Projects using heat exchangers in engines are pointing the way to future developments even further ahead. A recuperator uses the thermal energy in the exhaust gas stream. This concept is being tested in NEWAC, a large-scale EU-funded research project. Given the technological challenges involved, commercial availability is not expected until after 2020.

Engines with a high efficiency need low NO_x combustion chambers. Advances in NO_x reduction in combustion chambers are heading in the direction of lean combustion. To date, systems of this kind have been based on multiple chambers in which individual stages could be enabled automatically depending on the performance requirements. In a European collaborative research project, a CLEAN technology engine with a multiple-stage lean combustion chamber demonstrated that, compared to the technology generally in use today, it could reduce NO_x emissions by as much as 70 percent.

Engines with multistage combustion chambers are already on the market. But because systems of this kind are costlier, heavier, more complex and, therefore, more fault-prone, researchers are pursuing other lines of thinking in the development of new engines. Through a multi-stage fuel/air mixing process, lean operating conditions with extremely favorable NO_x emissions can be achieved extensively within the combustion chamber without substantially increasing chamber complexity.

All current development efforts and initiatives in the aero-engine industry being implemented in major EU-sponsored technology programs are working toward a single, common goal: By 2020, the aviation industry wants to be in a position to cut NO_x emissions by up to 80 percent while at the same time lowering kerosene consumption and carbon emissions by 50 percent. Achieving this will require advances in aircraft design and aviation management as well as in power units.

Dr. Stefan Hohmann, combustion specialist,
MTU Aero Engines, Munich

Aviation noise

Aviation noise monitoring

Under Section 19a of Germany's Aviation Act, airport operators are required to set up and continuously operate equipment to measure the noise levels of inbound and outbound aircraft at their airports and in airports' surrounding areas.

At Munich Airport, aircraft noise is monitored at fixed measuring stations at locations in the airport's surrounding area chosen jointly with the Aircraft Noise Commission. The main criterion for choosing where to site these stations was the proximity to arrival and departure routes and to individual towns and villages. Noise levels are measured according to the standard DIN 45643, "Measuring and assessing aviation noise."

Readings taken at the 16 fixed measuring stations are retrieved by a central office at night and are mapped to air traffic data. This means that every individual noise event is correlated to the aircraft movement that caused it. As of April 2002, these correlations have been made using radar data supplied by German air traffic control; this data enables noise events and flights to be mapped to one another with extremely high accuracy, and much of the correlation process to be automated.

To ensure that high-quality readings are obtained, meteorological data recorded concurrently at three measuring stations is used to ascertain whether there were extreme weather conditions at any time during the readings. If there were, aviation noise events are flagged and eliminated from the statistics. Following a manual review of the correlated aviation noise events to identify possible instances of corruption through noise from third-party noise sources, key audio data (on the distribution of individual noise events and continuous noise, for example) can then be computed in a final step. It is then possible to provide reliable information on noise levels resulting from individual arrivals and departures and on longer-term patterns in the general noise situation.

At places where there are no fixed measuring stations to record aviation noise levels, mobile readings are taken. So as to be able to respond swiftly to requests for mobile readings, the airport has two mobile measuring stations, one vehicle-mounted and one in a container cabin. These are fitted out with the same aviation noise measuring equipment as the fixed measuring stations and play a vital role in the airport's aviation noise monitoring system.

From 1992 through to the end of 2007, the mobile stations had conducted a total of 116 measurements of aviation noise at 77 locations in the airport's surrounding area. In 2007, seven separate sets of measurements were conducted, with readings being taken for 37 days at a time, on average.

The purpose of most of these readings was to collect general aviation noise data. Besides mapping the current noise situation, FMG tracks patterns in aviation noise over the longer term by carrying out repeat measurements at the same locations. By means of parallel readings taken by both mobile measuring stations, it has been possible to document the effects of introducing new departure routes on the aviation noise situation. Mobile readings are also taken when new departure routes are introduced. In the village of Fischerhäuser, for example, FMG carried out noise measurements that helped to determine the effect of a new departure route for propeller aircraft.

The operating radius of FMG's mobile measuring stations increased significantly between 1992 and 2007. Initially, readings were conducted at the request of communities close to the airport, but they have since been requested by and conducted in towns and villages as distant as Karlsfeld, Olching and Talham.

The readings taken by the fixed and mobile measuring stations provide an objective base of data for assessing the noise situation in the airport's surrounding area. The figures are published in noise reports on the Web to keep local stakeholders informed.

Continuous equivalent sound levels (LEQ4-6vM) and numbers of aircraft movements in the six busiest months of the years 1992–2007*

LEQ4-6vM: LEQ4 for the six busiest months

Operating year	Continuous equivalent sound levels (LEQ4-6vM) at measuring stations in dB(A)				Aircraft movements in the six busiest months		
	BRA	LAG, PAL from 2005**	REI	VIE	Mean aircraft movements per day	Operating direction East in %	Operating direction West in %
1992*	55	54	54	52	558	40	60
1993	54	53	51	52	554	37	63
1994	52	51	53	52	577	41	59
1995	53	52	54	52	619	40	60
1996	53	52	53	51	667	44	56
1997	52	52	53	51	769	39	61
1998	53	51	52	49	785	30	70
1999	51	52	53	51	838	45	55
2000	53	52	53	50	899	36	64
2001	53	52	52	49	959	29	71
2002	52	50	53	50	974	39	61
2003	52	49	52	51	979	37	63
2004	54	50	53	51	1087	31	69
2005	54	51	53	53	1153	41	59
2006	55	53	54	53	1175	39	61
2007	56	54	54	52	1233	32	68

* June–December 1992
** Measuring station relocated from Lageltshausen to Pallhausen

Continuous equivalent sound levels in the years 1992–2007*

LEQ4: LEQ4 of operating year in dB(A)

Station	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
ACH/ACI	58	57	57	57	57	57	57	56	55	55	54	56	56	56	58
ASK					44	42	45	45	45	47	47	47	48	49	49
ATT	58	55	56	57	56	56	56	56	56	56	56	56	57	57	57
BRA	54	52	53	53	52	52	51	52	53	51	51	53	53	54	55
EIT	55	54	55	55	54	53	54	54	53	54	53	54	54	54	54
FAH	46	46	47	48	47	43	46	46	43	45	45	46	45	45	46
GLA	52	52	53	54	53	53	53	54	56	55	54	56	56	56	57
HAL	60	58	58	58	57	58	57	57	57	56	55	57	57	57	57
LAG	53	51	52	52	52	51	52	52	51	50	48	49	50		
MAS	51	51	51	50	48	49	50	51	50	51	52	52	53	54	53
MIN	53	50	51	53	50	47	48	46	46	46	45	47	47	47	48
NEU	51	49	49	50	48	45	45	43	41	42	41	43	46	46	46
PAL													51	53	54
PUL/PLG	52	49	59	59	59	58	59	60	59	59	59	60	60	60	61
REI	51	54	54	53	53	52	53	53	52	53	52	53	53	54	54
SCH	60	59	59	59	59	59	59	59	58	58	58	59	59	60	60
VIE	52	52	52	51	51	49	51	50	49	50	51	51	52	53	53

Noise level frequency distribution*

Month	Numbers of noise events in excess of 85 dB(A)			
	2004	2005	2006	2007
ACI	16	19	39	72
ASK	1	2	0	2
ATT	37	27	39	27
BRA	24	37	35	44
EIT	0	0	1	0
FAH	0	0	0	0
GLA	0	4	2	3
HAL	34	44	32	15
LAG	1			
MAS	0	0	0	2
MIN	1	2	2	1
NEU	2	0	0	2
PAL	0	0	0	1
PLG	264	294	220	137
REI	0	1	0	1
SCH	463	593	722	608
VIE	23	22	24	11

* Note: Absolute comparisons are impossible due to changes in departure routes, changes in route usage, differences in operating direction priorities, and equipment outages (e.g., due to extreme weather or technical problems).

Night flight curfew

Since March 2001, night traffic at Munich Airport (flights between 10:00pm and 6:00am) has been governed by amended regulations issued by the regional government of Upper Bavaria. In the main curfew period between midnight and 5:00am, only mail flights and ATC survey flights are permitted. Other exceptions to the curfew include medical emergency and aid flights, landings required for reasons of air safety, and flights for which special dispensations have been granted by Bavaria's Ministry for Economic Affairs, Transport and Technology. There is a public interest that these aircraft movements be allowed to take place, so there is no restriction on when they can occur.

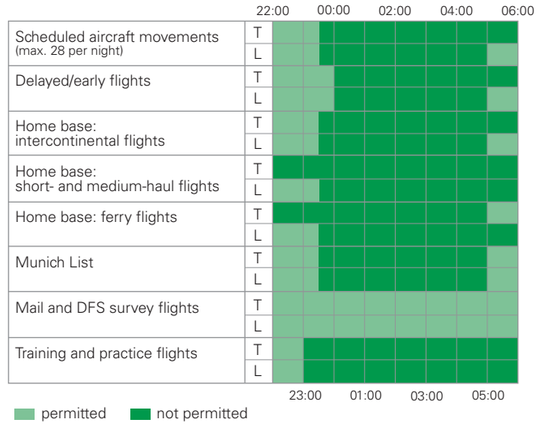
In the remaining night time hours (between 10:00pm and midnight and between 5:00am and 6:00am), only aircraft on the federal transport ministry's so-called bonus list are allowed to operate. The only exceptions to this rule are delayed or early flights by planes with at least a Chapter 3 ICAO noise rating. In addition, aircraft movements are required to be one of the following:

- a planned movement by a scheduled or charter aircraft (max. 28 a night)
- a flight operated by a carrier that has a home base in Munich
- a flight by an aircraft on the so-called Munich List that does not, on average, cause individual noise events of more than 75dB(A) at measuring stations in the vicinity of Munich Airport
- a training or practice flight.

In addition, night-flight operations are only permitted insofar as they do not exceed a set annual noise quota. The amount of noise is computed based on the number of inbound and outbound flights and on the type and size of the aircraft. The quieter the aircraft operated, the greater the number of flights permitted and vice versa.

Each year, the airport is required to submit a noise report to the aviation authorities to prove that it has not exceeded its noise quota. This also ensures that the general public is kept informed about the airport's compliance with the night-flight regulations.

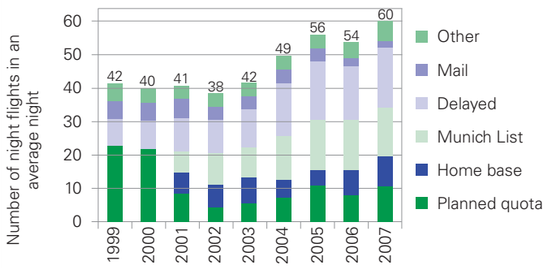
Night flight restrictions



Also permitted:

- Takeoffs and landings necessary for emergency services, disaster relief and police operations
- Landings for meteorological, technical or other air safety-related reasons
- Flights granted special dispensations by Bavaria's Ministry of Economic Affairs, Infrastructure, Transport and Technology or the Authority for Aviation Supervision to avoid substantial disruptions to air traffic or for other reasons of special interest

Night flights



Since March 2001, night flights in the Munich List and home base categories have not been included in the planned quota of aircraft movements.

Engine testing

Under statutory regulations on airport use, engine testing may only be carried out at purpose-built aircraft engine test stands.

Munich Airport has exact rules on how engine test runs and idle runs must be requested, approved, conducted, documented and monitored. Under these rules, standard operating procedures have been changed as follows:

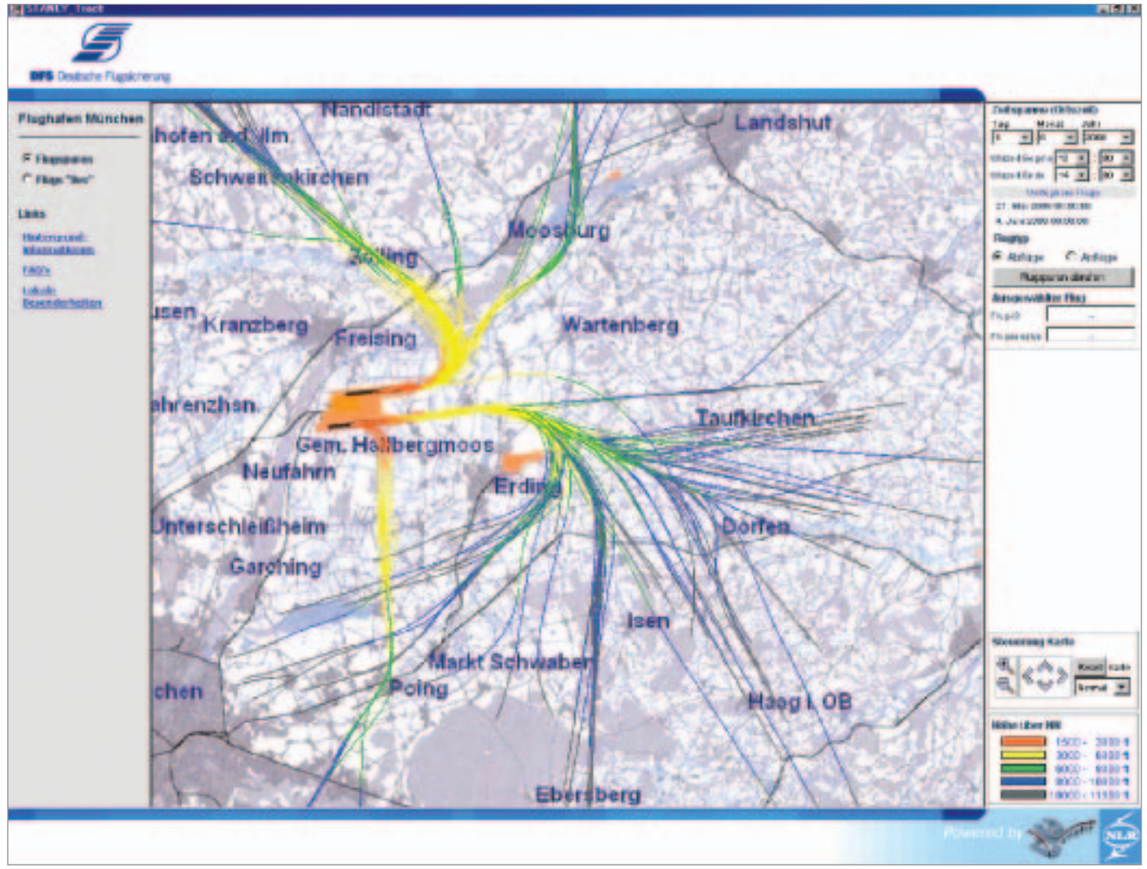
- As of June 1, 2002, idle runs between 10:00pm and 6:00am require prior approval from airport traffic management.
- The procedure for using the hush house has been specified with greater precision (markings have been added to show where to park planes, and airlines have been notified of the changes in writing)
- Idle runs and use of the engine test stand are subject to spot checks by traffic management.

Air traffic control

Flight tracks on the Web

The STANLY_Track system uses radar data to show the flight tracks of aircraft that are operating on instruments and flying into and out of Munich Airport. Viewers can choose between a live mode and a flight track mode. The system was co-developed by the German Air Traffic Control (DFS) Location and Information Center and the Dutch National Aerospace Laboratory (NLR).

Martin Köppl, DFS's press officer in Munich, on how the system had performed in Bavaria: "From our point of view, STANLY_Track has been considerable success with the general public. Anyone who is interested can now access key information on an aircraft's flight track, type and altitude at the click of a mouse. Particularly as the altitude of aircraft no longer has to be estimated, it helps us a great deal in discussions with the public. Overall, STANLY_Track has given us an outstanding platform through which to engage in technical discussions with the public on the processes and constraining factors involved in air traffic control."



The "Quiet Aviation II" research project

In a research project supervised by the German Aerospace Center (DLR), air-traffic control operator DFS and Flughafen München GmbH have been collaborating on finding ways to reduce the noise caused by aircraft takeoff and landing operations.

The German Aerospace Center has successfully completed its "Quiet Aviation II" research project and has presented its findings at an event in Göttingen to members of the aviation industry, policymakers, and representatives of environmental organizations. The project proposes a number of solutions for technical, operational and planning measures to reduce noise in areas around airports. The project marks a continuation of the "Quiet Aviation" project conducted jointly by the German Aerospace Center with the Helmholtz Association of German Research Centers (HGF). To pool synergy benefits in aviation noise research and to find solutions rapidly, researchers at the German Aerospace Center collaborated closely with people in government agencies, the aviation industry and affected communities.

The researchers concentrated on a number of cross-disciplinary topics. The reduction of noise directly at source – in other words the development of quieter aircraft engines and wing components and new, lower-noise aircraft designs – offers the greatest potential for reduction in the long term. The results of numeric projections and procedures were validated experimentally under realistic airflow conditions with a model fan developed by the German Aerospace Center. This means that the goal of cutting noise by 10 dB(A) could be achieved in the next ten years. The basis for this success is a slower-turning fan, the tips of which rotate at subsonic speeds during takeoff, unlike those in any of today's aero engines. The speed of the free exhaust plume, another significant source of noise in an aero engine, is also slower.

Noise-optimized arrival and departure procedures

Given that advances in further reducing engine noise anticipated for the years ahead will only help to improve the noise situation at airports in the longer rather than the shorter term on account of the time it will take for these improvements to find their way into new production aircraft, the aim of this joint research project is to bring about nearer-term improvements. The project focuses on ways to minimize noise on departure routes by taking into account the average wind direction and its impact on noise propagation; on gauging the potential for noise reduction in mapping flight paths to the course of autobahns; and on estimating the potential for noise reduction through weather-dependent flight paths. FMG is contributing to the project by supplying data recorded by its noise monitoring installations.

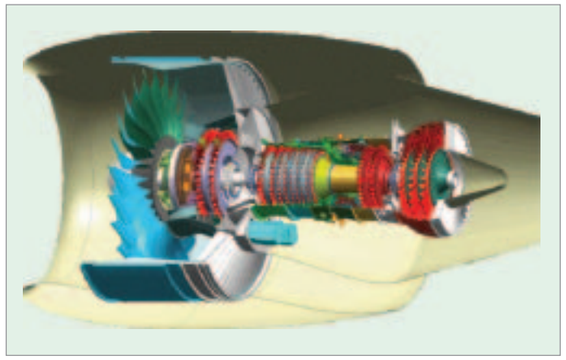


Figure 1: Three-dimensional section through a geared turbofan with a thrust class of 30klbf, designed for tomorrow's low-noise short- and medium-haul aircraft

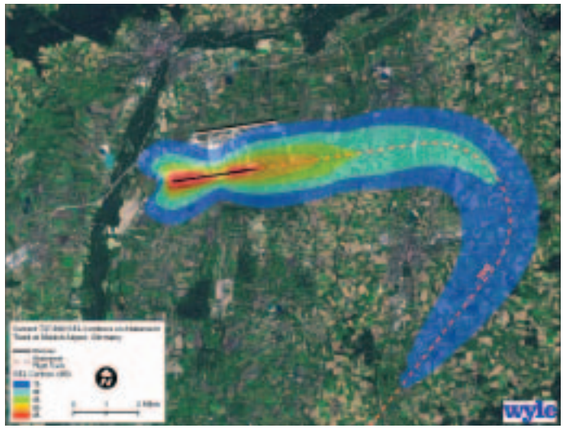


Figure 2: A noise map of Munich Airport for one of today's short- and medium-haul aircraft fitted with modern turbofan engines

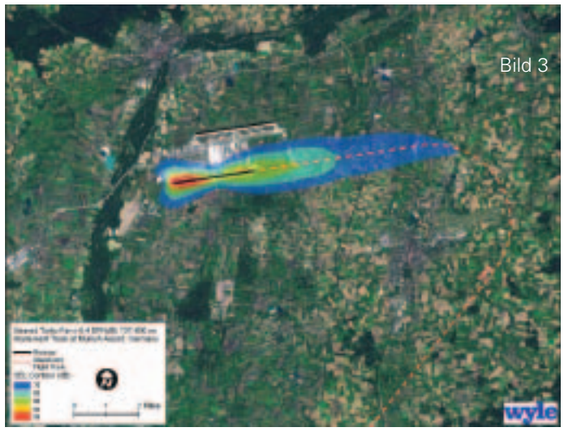


Figure 3: For comparison, a noise map of Munich Airport for a future short- and medium-haul aircraft fitted with low-noise GTF engines

Less noise and lower carbon emissions with geared turbofans

Increasingly, local populations' exposure to noise is becoming the primary obstruction standing in the way of the efficient handling of tomorrow's air traffic. Although noise generated by aircraft during takeoff and landing has been reduced to almost a quarter of what it was 40 years ago through technological advances in airframes and power units, this advantage is being tempered to an increasing degree by current rapid growth in the volume of traffic.

The consequences in terms of today's noise situation include night-flight restrictions and noise-optimized approach and departure routes, as well as opposition to and obstruction of construction and airport expansion work by the local populace. The latter have a powerful influence on a region's economic growth opportunities.

Other challenges include the increasing burden of carbon emissions on the environment (caused in part by aviation) and the growing shortage of crude oil reserves and the attendant – and significant – rises in fuel prices.

One option for significantly reducing aviation noise and fuel consumption is to use a geared turbofan or GTF engine, which engine maker MTU Aero Engines and its U.S. partner Pratt & Whitney have been working on introducing for more than 20 years.

A GTF engine incorporates additional gearing that enables fan speed to be independent of the rest of the engine's low-pressure system and therefore allows more precise optimization of turbo modules in the low-pressure system (the fan, low-pressure compressor, and low-pressure turbine). This additional scope for optimization creates benefits over the best possible turbofan. These are:

- a saving of 5-7 percent in engine fuel consumption

- a reduction of engine noise (here, fan, compressor and turbine noise) by a cumulative margin of 10dB (which equates to a reduction of around 25 percent in perceived noise), and

- an improvement of up to 15 percent in engine operating costs.

Compared to engine types currently in operation, a GTF engine uses 15-17 percent less fuel. Figure 1 shows a 3-D section through a GTF engine. Figures 2 and 3 show the effects on noise footprints based on the situation at Munich Airport.

These improvements come at a price, however. GTF engines are heavier and have a larger fan and a more complex drive system.

Engine makers P&W have recently achieved an important breakthrough. Japanese aircraft maker Mitsubishi Heavy Industries (MHI) has chosen to equip its future MRJ regional jet exclusively with GTF engines. The first aircraft of this type are to be delivered to customers in 2013. The GTF has also been chosen for Bombardier's C-Series, a new family of aircraft with 110-130 seats that is currently being planned but has not been launched as yet. The first C-Series planes are also slated to go into service in 2013. Interestingly, these two aircraft series could herald the introduction of GTF engine technology in successors to the short and medium-haul Airbus A320 and Boeing 737. These aircraft types, which are likely to be deployed some time between 2015 and 2017, could result in the greatest market penetration for GTF engines and the greatest number of manufactured units.

The engine consortium is currently working toward other milestones in GTF engine development. After the initial results of ground tests carried out with a demonstration engine in the final quarter of 2007, there are plans to conduct two flight tests in the latter half of 2008 (with a B747 in the third quarter and a converted Airbus A340 in the fourth quarter) to demonstrate the GTF's capabilities in the air.

Dr. Stefan Donnerhack,
MTU Aero Engines, Advanced Product Design

Water management

FMG's water management programs and initiatives are based on requirements issuing from the zoning approval granted to Munich Airport in July 1979, all subsequent amendments to this approval, and all water-related laws, standards and regulations. Under various requirements and regulations, the airport has been granted statutory authorizations and permits for water management plants and installations designed to meet the needs of protecting the environment, in particular bodies of water, groundwater and soil. Munich Airport's water management unit plans and builds the installations used to reroute water courses, control groundwater, provision potable and firefighting water, and drain and treat wastewater. It is also responsible for ensuring that these installations are operated correctly, cost-effectively, and in compliance with rules and regulations so that water provisioning and disposal function correctly and, importantly, that environmental requirements are met. According to statutory regulations, water resources must be managed so that they are not impaired or impacted in any way that is avoidable.

Water resources' ecological balance

Water is the planet's most important resource; life cannot continue without it. An adult human needs to consume around three liters of water a day in the form of fluids and through other foodstuffs. Water is not just essential to life, it is also needed in large quantities by industry.

Under Section 1a of Germany's Water Management Act, water resources must be managed in such a way that no avoidable impairment to them occurs. The goal of water management is to manage water resources (by tracking and regulating water volumes in the water cycle and controlling the water balance) in such a way that the ecological equilibrium of water resources is protected.

The sewer system at Munich Airport comprises a network of drainage pipes and serves to trap and drain domestic and industrial wastewater, rainwater runoff from roads, lightly polluted runoff from runways, taxiways and ramp areas, and wastewater containing residual deicing agent from runway, pavement and aircraft deicing operations.

Drinking and firefighting water supplies

The drinking water at Munich Airport is supplied by a local utility company at nearby Moosrain, which pumps its supply from tertiary strata through four bore holes roughly 150 meters deep. The airport has two separate systems of water pipes: one for drinking water, with narrow-diameter pipes that ensure a high rate of flow for hygiene reasons, and one for firefighting water, which has thicker pipes capable of delivering water in high volumes in the event of a fire. Together, the two systems have around 100 kilometers of pipes.

Munich Airport's system of separate drinking water and firefighting water networks was the first of its kind worldwide. Because the firefighting water network and its three storage tanks were designed and built with sprinkler installations in mind, there was no need to install complex water tanks in the sprinkler centers in the airport buildings. The system is capable of covering all fire water requirements up to a load of 380 liters per second. Today, new airports are copying Munich's system of separate drinking and firefighting water networks.

The drainage areas near ramps where aircraft are refueled and handled and where rainwater picks up kerosene and oil are connected to the sewer system over rainwater spillways and oil traps. Wastewater from kitchens, canteens and airline catering operators runs through grease traps. Wastewater from aircraft washing is given preliminary treatment in a special treatment facility. The deicer from taxiway deicing operations is broken down biologically into water and carbon dioxide by soil bacteria in an underground system. In addition, the water and glycol mix from aircraft deicing operations is trapped and processed in a recycling plant at the airport's north operations area.

Sewer system and wastewater treatment

All of Munich Airport's wastewater is piped to a nearby modern, highly efficient large-scale sewage treatment plant operated by a local Erdinger Moos wastewater operator, which also processes sewage from 12 local communities as well as from the airport.

The wastewater from the airport processed at the plant consists of domestic wastewater, deicing water and rain water. The airport's sewage system consists of around 275 kilometers of pipes. The various types of wastewater are collected separately by the sewage system and stored in separate retention basins. The wastewater in these basins is pre-treated and then piped in controlled batches to the treatment plant at Eitting.

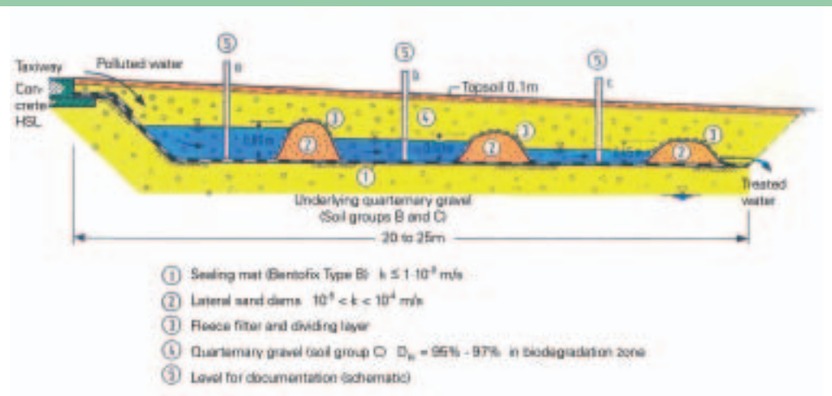
The airport's wastewater comprises:

- Domestic wastewater (e.g., from passenger buildings, offices and HR facilities)
- Industrial wastewater (e.g., from kitchens, canteens and airline catering companies and from aircraft cleaning operations)
- A mix of untreated wastewater and rainwater
- Rainwater runoff from roads and parking areas
- Rainwater runoff contaminated with oils from aprons where aircraft are refueled and handled
- Rainwater runoff with a low contaminant load from runways, taxiways and apron taxi areas
- Wastewater contaminated with deicing agents from paved areas and aircraft deicing operations

Aircraft wash water

Even jetliners need regular cleaning. Wastewater from aircraft washing – typically around 5,000 liters per jet – carries a payload of detergent residue, oil, kerosene and heavy metals. At Munich Airport, this water is fed from the three maintenance hangars through a network of drainage pipes to the airport's own treatment plant for wash water. Once cleaned and processed, the water is tested for quality, given a final check and then fed into the sewage system. Regular testing has shown that, thanks to the on-site processing, residual pollutant levels are well below the statutory limits for wastewater.

Schematic illustration of the deicer biodegradation system installed along taxiways



Wastewater from deicing operations

Maintaining trouble-free airport operations involves clearing around 3.8 million square meters of operating areas of snow and ice to ensure that paved areas afford sufficient grip to enable aircraft to take off, land and taxi safely. As a rule, these areas are cleared by snow plows, blowers and sweepers. Snow from aprons, taxiways and runways is moved to specially paved snow dumps equipped with drains that feed into the deicing wastewater system. Sand is spread on paved areas to improve traction but, if the weather conditions call for it, deicer is also deployed – glycol for aircraft and formates for paved areas and runways. Under the zoning approval provisions, methods used to deice operating areas must not contaminate either surface water or groundwater in the area of the airport and must not impact on the Eitting wastewater treatment facility. Before chemical deicing agents are introduced, Bavaria's State Water Office must confirm that they are not harmful when used in the manner intended. Munich Airport only uses deicers that are biodegradable. Sodium formate and potassium formate are deployed to deice aviation operating areas. Reinforced concrete channels running along the edges of the runways trap the runoff from deicing operations and carry it to a retention basin. From here it is piped to the Eitting wastewater facility, where it is treated using biological processes.

Biodegradation system on the taxiways

The chemical deicing agents deployed on taxiways by snow teams flow along with the meltwater and runoff over the edges of the taxiways and drain through the topsoil into the groundwater roughly two meters beneath the surface. In the area around the taxiways, the deicing water is cleaned by a biodegradation system pioneered and first deployed successfully at Munich Airport. A 20-meter-wide impervious geotextile mat consisting of two pieces of needled fleece material enclosing a three-millimeter layer of bentonite powder was buried in the ground at a depth of 1-1.5 meters. This bed is flat, with no slope either laterally or longitudinally so as to ensure that meltwater draining down onto it spreads out evenly. A layer of sandy gravel was applied on top of it. In addition, sand banks running parallel to the taxiways were installed to slow and steady the flow of contaminated meltwater. At ground level, there is a ten-centimeter layer of humus covered with grass. Given an adequate supply of oxygen, soil bacteria in the gravel and sand convert the deicer into water and carbon dioxide. The biodegradation system essentially acts as a form of low-load underground wastewater treatment facility.

Wastewater from aircraft deicing operations

Aircraft deicing at Munich Airport is carried out by the company EFM – Gesellschaft für Enteisen und Flugzeugschleppen am Flughafen München GmbH, an FMG subsidiary. As with paving and runway deicing, the number one priority is safety. Aircraft are generally deiced with chemical deicer at specially designated remote areas next to the heads of the runways by mobile deicing crews nicknamed "polar bears." The wastewater from aircraft deicing operations drains into a system of channels and fed into an underground tank. If the glycol concentration is 5 percent or more, the water is piped to the recycling plant for processing and glycol recovery; if it is lower, the water is piped to the Eitting wastewater treatment plant.

The deicing areas are equipped with a system for trapping deicing agent. This means that a significantly larger amount of spent deicer can be collected than with deicing operations on the apron. The remote areas are open during the deicing season between October and April.

Groundwater management, rerouting, and quality monitoring

Groundwater management

Munich Airport has a system for remotely controlling and monitoring summer and winter groundwater target levels in the drainage ditches and for recording water levels and outflow volumes. The system is also equipped to detect the presence of water contaminants such as oil and kerosene. In an emergency, control elements such as sluice gates are closed immediately. The water management control system, which plays an important role in the protection of water resources, also regulates drainage into the water table to the north of the airport and records and regulates outflow volumes of water rerouted through the airport site.

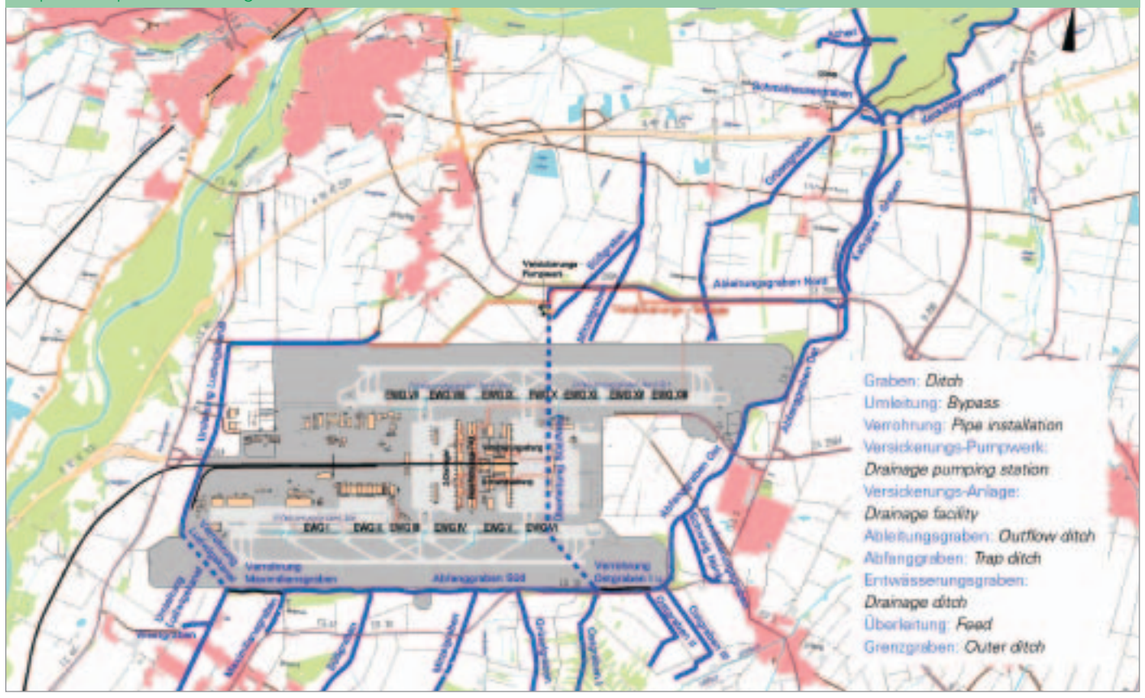
Groundwater rerouting

Erdinger Moos, the area where Munich Airport was built, used to be crisscrossed with a large number of small streams that served as drainage for the area's cultivated land and kept the water table at a level that was well suited for agriculture. The streams drained the land and stabilized the groundwater level. These streams essentially ran from the southwest to the northeast, following the lie of the land. The airport site crosses the streams, which meant that their watercourses needed to be diverted and rearranged. The resulting streams are routed either across or around the airport site and then returned to their original beds on the north side of the airport.

The reorganized system of streams is extensive and, as such, plays an important role in the local ecology. By avoiding straight, linear routing and by aligning profiles to minimum technical requirements, widely varied, meandering watercourses were created, with a mix of shallows and deeper troughs, faster-moving passages and calm inlets, combined with higher, dry sand and gravel areas. This landscaping has been rounded out by planting native bushes and shrubs that provide the banks with natural protection, prevent the leaching of nutrients, and ensuring the right temperature balance. These riverbank zones also provide a habitat for many endangered plant and animal species.

Besides its ecological importance, the near-natural landscaping of the new streams also has an economic value in that, occasional intervention aside, there is no need for continuous care and maintenance. Over the years, ecologically stable, low-maintenance habitats have developed whose role in the natural balance as retreats for rare species has become increasingly valuable in an otherwise cleared and cultivated landscape.

Airport campus and drainage ditches



Groundwater levels and quality monitoring

Groundwater levels

Munich Airport's flight operations areas are complex, high-quality pieces of engineering. To ensure safety from frost, the water table had to be lowered. To limit the range of the lowering of the water table, defined summer and winter groundwater target levels must be maintained. The airport is required to document the consequences resulting from lowering the groundwater. Because the groundwater level depends additionally on factors beyond the airport's control, groundwater fluctuations have to be recorded extensively and in detail in order to fulfill this requirement. This documentation provides the only means of differentiating between the individual influencing factors.

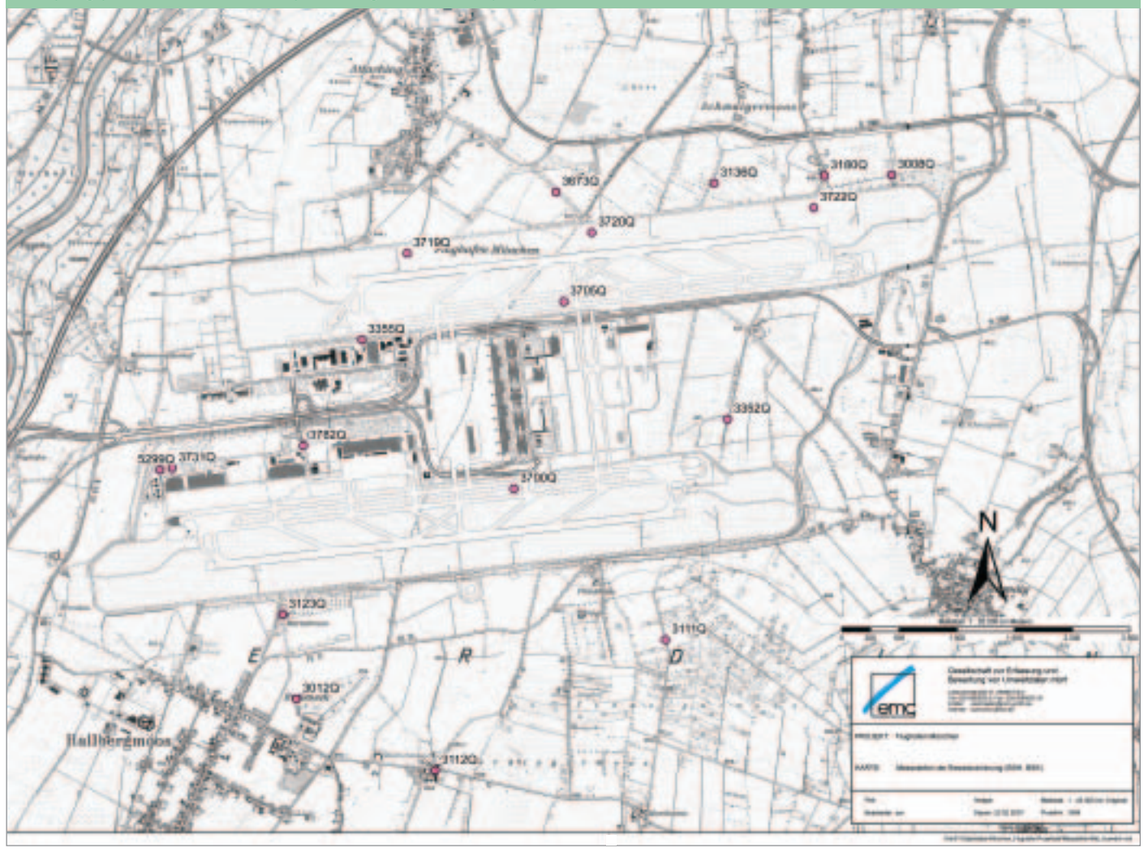
The area monitored spans the entire space between the Isar river in the west and north and the villages of Dorfen and Zengermoos in the south. The airport monitors 323 groundwater measuring points across this entire area, of which 267 record groundwater levels continuously using data loggers. The data recorded is evaluated statistically, incorporated into a numeric groundwater model, and, in accordance with the requirements, submitted to government bodies.

Groundwater quality

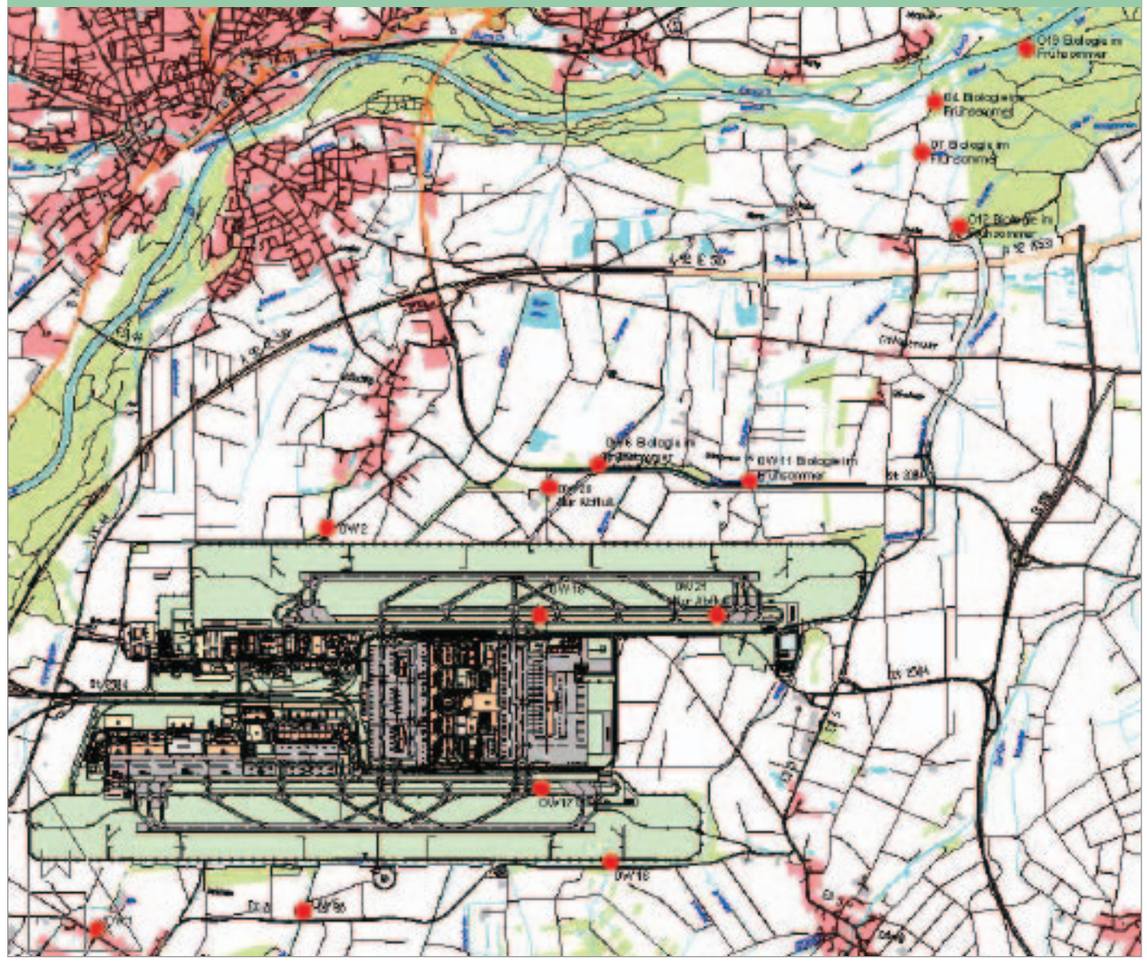
In compliance with statutory regulations, FMG monitors the quality of the groundwater at Munich Airport by taking samples four times a year, generally at 18 separate groundwater test points. Each sample of water collected is tested by checking up to 40 different parameters. The results of these tests are reviewed by an expert and submitted to the Munich Water Board. No pollutants have been identified during the tests carried out to date.

Fluctuations in oxygen levels and, in some instances, higher organic loads have been observed in a number of additional tests. Identifying the cause of these impacts is difficult because the Erdinger Moos groundwater is generally low in oxygen and contains organic materials from the mossy soil in the area.

Sampling points used to collect proof of groundwater quality



Surface water



Surface water

To ensure that surface water in the surrounding area is not affected by airport operations, the water's quality is checked several times a year by testing as many as 20 different parameters in samples taken at up to 14 points.

In 2007, tests did not show signs of changes in the chemical or biological quality of the water that could be attributed to airport operations.

Precipitation

Precipitation is checked twice a year by testing up to 13 different parameters in samples taken at one measuring point. Tests in 2007 produced no conspicuous findings.

Soil

The quality of the soil is checked twice a year by testing 17 parameters in samples taken at two points.

Snow and ice control

Deicing agent that drips onto the ground during aircraft deicing operations drains along with melted ice and snow through channels into a large underground collecting tank. If the glycol concentration is 5 percent or more, the meltwater is taken by tanker truck to the recycling plant for processing. It is cleaned mechanically and chemically in various process stages and then distilled to recover the glycol-containing substance on which the deicing agent is based. Additives are introduced to turn it into type I deicer. Following lab tests and manufacturer approval, the deicing agent is then reused. This enables EFM to cover between 60 and 70 percent of its annual type I deicer needs with recycled material. Besides recovering reusable deicing agent, recycling has a practical side-effect: The recycling process produces waste heat that is exploited to help heat Munich Airport. If the glycol concentration is under 5 percent, the mix of glycol and meltwater is piped to the wastewater treatment plant in Eitting. Additional information is available on the Web at www.efm.aero.

EFM GmbH - a jointly held subsidiary

The company EFM - Gesellschaft für Enteisen und Flugzeugschleppen am Flughafen München mbH began operating at Munich Airport in early 1993, a few weeks after it was formed as a joint subsidiary by Deutsche Lufthansa AG and Flughafen München GmbH. GlobeGround Deutschland GmbH, a wholly owned Lufthansa subsidiary, owns 51 percent of EFM, and Flughafen München GmbH owns 49 percent.

The services provided by EFM include aircraft pushback and towing, deicing, and air-conditioning. The company also offers consulting services to other businesses, delivers training programs, and provides technical support.

Certification for EFM's environmental management system

Central to EFM's quality profile is a commitment to sound environmental stewardship. This is why the company sought and obtained certification to the ISO 14001 environmental management standard in July 2003.

To reduce its environmental footprint as far as possible, EFM has made environmental protection an integral part of its quality management system. This means that environmental factors are taken into account fully in the company's day-to-day operating processes and in new projects. EFM has defined a number of environmental targets within the framework of its environmental management system. One of its core principles is to utilize resources economically and in an environment-friendly fashion.

Waste management

Waste avoidance and reduction

FMG places considerable importance on avoiding and preventing waste through careful product procurement. We also analyze waste flows, waste volumes and waste types, continuously review current waste handling practices, and introduce optimization measures as and where appropriate. Raw materials are in increasingly short supply worldwide, yet at the same time demand is increasing. Waste management therefore plays a significant role in the efficient utilization of resources and energy as well as in protecting the planet's climate.

Waste recycling and disposal

As part of our end-to-end waste management system, all waste and reusable materials occurring on the airport campus are sent for recycling or disposal.

Reusable materials: Separate collection and sorting for reuse

Reusable materials such as paper, glass, wood, plastics, and metal are collected where they accumulate – in administrative departments, technical departments, the passenger terminals, and the cargo and maintenance areas – in specific waste separation systems, and then sent for recycling. Thanks to innovative processes and capital investment in waste handling capabilities, FMG has a recycling rate in excess of 50 percent across its total waste volume. The reusable materials collected are processed in different sorting stations for specific materials and then sent to other organizations (a paper factory, or example) for further processing. Lightweight packaging material is sorted on site at the airport's own recycling center in a modern sorting plant.

Waste: Different types, different disposal methods

Waste collected all over the airport campus and left over after the separation of reusable fractions is sent for disposal, mostly to the Freising municipal waste management operator. Waste from cleaning aircraft cabins can be reduced substantially by rigorously separating newspapers from residual waste during the collection process. The residual waste and catering waste (leftovers from airline meals) from aircraft are disposed of at the garbage incineration plant in the north of Munich as per statutory requirements (EU Animal By-products Regulation EC No. 1774/2002 and Germany's Animal By-products Disposal Act). The organic waste from Munich Airport's kitchens and restaurants is processed in a biogas plant and converted into electric power by a gas-powered motor.

Although Munich Airport attempts to make the greatest possible use of environmentally compatible products, a certain amount of problem waste – for example, flue gas residues and boiler cleaning agents, both by-products of the power generation process – is nevertheless unavoidable. Another form of problem waste, oil, is trapped by numerous separators located on the airport campus. Waste of this kind is disposed of by GSB, a waste management operator specializing in problematic materials.

Hazardous goods and materials

Hazardous materials and safeguards against environmental accidents

The term hazardous materials in this context denotes substances potentially hazardous to water (as defined in Germany's Water Resources Act, Bavaria's Water Resources Act, and the Ordinance on Installations for Handling Water-polluting Substances and on Specialist Companies), hazardous substances (as defined in the Hazardous Substances Ordinance), combustible fluids (as defined in the Ordinance on Industrial Safety and Health), and hazardous goods (as defined in the Hazardous Materials Ordinance). Within the airport, hazardous materials are transported either via pipe systems or by special vehicles that meet current safety regulations. These in-company transports are not subject to the regulations laid out in Germany's Hazardous Materials Ordinance. Hazardous materials are stored in special hazmat stores and in silos and tanks that comply with the relevant statutory regulations. Transports are subject to spot checks to ensure that they meet legal requirements.

Filling stations

There are two campus filling stations supplying diesel and regular and premium gasoline. Company cars and ramp service vehicles can fill up there. Since 2006, the campus filling station on the apron also has rapeseed fuel. The campus filling station in the car hire center, rebuilt in 2006, is FMG's responsibility up to a defined point. All these installations are subjected to official requirements laid down in the zoning approval process and in other statutory regulations. FMG's fulfillment of its supervision obligations is documented in the register of plants and installations. Bioethanol distillate, like rapeseed oil, is a renewable fuel that is used at the airport and is available at the filling station in the airport's technical area.

Fuel supply system safety

Flughafen München GmbH has a fuel farm for storing fuel at the airport; this is operated and maintained by a company called Skytanking. The operating agreement between FMG and Skytanking transfers to the operator the responsibility and thus the liability for any dangers associated with ownership and operation of the fuel farm and the underfloor hydrant system at Munich Airport.

Munich Airport maintains sufficient stocks of kerosene to cover roughly three to five days' demand. The fuel farm's five aboveground tanks can hold around 27,000 cubic meters. Kerosene is delivered to the airport via a specially built pipeline and by rail. Fuel is pumped down underground pipes to filling points on the apron known as fueling pits.

The entire fuel supply system is designed to ensure that kerosene cannot leak into the ground at any point. The tanks are double-walled, so in the event of a leak in the inner wall, the outer wall will contain the fuel; they have double floors protected by a leak detection system; and they are fitted with floating roofs to prevent kerosene vapor from escaping. The fuel delivery system, which uses pipes that are specially coated inside and out, is tested daily using a fully automatic pressure measuring system. In addition, a highly sensitive electronic monitoring system triggers an alarm at the slightest indication of a possible leak. Designed by an FMG employee, this leak detection system, complete with wireless LAN support, has been granted a patent.

Emergency management

Munich Airport's fire service, which belongs to Flughafen München GmbH, has been officially authorized as an industrial fire service by the Freising district administrative office. Among other things, the authorization documents detail requirements regarding organization, manpower, training, vehicles, machinery, equipment, fire stations and the fire service control center. The airport fire service's tasks include the following: firefighting and technical rescue for aviation and its installations in accordance with International Civil Aviation Organization (ICAO) guidelines; firefighting and technical rescue in connection with buildings, facilities and installations in the area of the airport as defined by local fire service law; assistance outside the airport campus on request as defined by local fire service law; fire safety duty; and support for emergency medical services.

The airport fire service is responsible for fire prevention and firefighting in the following areas:
- Terminals 1 and 2
- Apron towers for the east and west aprons
- Baggage sorting hall between the east and west aprons
- Airport control tower
- Transit railway tunnel
- All aircraft maintenance hangars
- Cargo terminal
- Fuel farm

International fire regulations

The ICAO issues aviation fire regulations. These regulations assign airports to ten separate categories depending on the number and size of the aircraft that use them. Munich Airport is in category 9, the second-highest. This means keeping three vehicles at the ready equipped with 24,800 liters of water for generating aqueous film-forming foam for delivery at a rate of 9,000 liters, plus 450 kilograms of dry chemical powder. In an emergency, the fire service must be at the scene within 180 seconds, visibility and road conditions permitting. In other words, they must be able to reach any point on the airport's flight operations areas in just three minutes.

On the scene in three minutes

To meet this requirement, the airport fire service has two separate stations on the campus: the south fire station and the north fire station, each equipped with a full complement of the required category 9 extinguishing media.

Munich Airport is equipped with 50,000 automatic and manually operated fire alarms, located all over the airport campus. The location of any alarm that is activated can be identified in the command center by means of ELIS, a command and control information system.

Planning and construction

All forecasts indicate that air traffic will continue to grow rapidly in the years ahead. Munich Airport has expansion plans that will enable it to make the most of the opportunity to remain one of the most efficient aviation hubs in Europe, to continue to grow rapidly, and to remain competitive in the international aviation arena.

Munich Airport will continue to fulfill its role as an economic powerhouse and job engine, safeguarding the region's prosperity and driving growth. At the same time, FMG is fully aware of its responsibility to grow sustainably and is committed to balancing environmental, economic and societal interests.

The third runway

Two runways are not enough

Based on its past rate of growth, Munich Airport will reach its capacity limits in the foreseeable future. Capable of handling 90 movements an hour, the current two-runway system with parallel, independently operable strips is already working at maximum capacity for several hours each day. The two-runway system is at its limits; no significant capacity increase is possible.

Boosting capacity from 90 to 120 movements

Achieving the planned capacity target of at least 120 movements an hour is the only way to meet aviation's future needs. Given that forecasts predict Munich will handle 607,000 aircraft movements annually by 2020, it is clear that the airport can only meet the challenges of the near future by building a third runway. The new capacity target of 120 movements an hour was set by comparing a number of others airports that typically handle a high volume of international transfer traffic.

In total, 31 possible locations for a third runway were considered. The new runway needs to be a full-capability addition to the existing system, and must be 4,000 meters long – sufficient to enable any type of aircraft to take off on it, even during peak busy times. Furthermore, it is important that if a runway has to be closed, the airport will still have two runways capable of handling a total of 90 movements an hour. And lastly, the flexibility benefits for operating procedures and safety issues favor a 4,000-meter strip.

A review of the potential locations based on these criteria identified just six that were feasible. These six were assessed by experts with regard to the following:

- Third-party land requirements
- Noise nuisance for local communities
- Land usage and environmental impacts
- Capacity-relevant additional factors

Variant 5b proved to be the best fit. The site is located at a distance of 1,180 meters from the current north runway (centerline to centerline) with a runway threshold offset of 2,100 meters to the east. This is the only variant that ensures the least impact on the local population and environment while providing the requisite capacity.

Involving the region

FMG places considerable importance on involving the airport's region in its expansion project by engaging in an open and constructive dialogue. To address local community interests, the expansion project was overseen from the very beginning by the Communities Council, a body that brings FMG together with local councilors, mayors, and representatives of local interest groups, the aviation industry, and the local business community. The Council provides stakeholders with information on the status of the airport's expansion plans continuously and punctually. The Communities Council also unanimously passed resolutions to improve the airport region's transport infrastructure.

Low-carbon construction project: The satellite

When Terminal 2 opened in 2003, the baggage hall on the adjacent apron area also went online. The baggage hall has a footprint measuring 600m by 52m and has three stories. The building is fully equipped and houses much of the baggage system that provides most of the east apron's baggage handling capacity; it is also linked with the baggage system in Terminal 2. From the outset, plans were in place to expand the baggage sorting hall into a satellite (an ancillary terminal building without independent passenger access) at some time in the future.

Against the political backdrop of the Meseberg Program, we can assume that similar carbon targets will apply to Munich Airport as have already been set for Germany in general. This means that by 2020 the airport will have to reduce carbon emissions by 30 percent measured against the base year 1990. Because 1990 is not a viable base year for Munich Airport, carbon saving targets are computed on the basis of output figures for 1993, the airport's first full operating year at its current location in Erdinger Moos. To achieve this target, FMG has decided to optimize the new satellite building's carbon footprint during construction and future operation.

The focus from early on during the planning has been on achieving low power, heating and cooling requirements. Conserving resources through low primary energy consumption during the building's operating life is crucial, for economic as well as environmental reasons. Proposals for incorporating renewables and innovative energy systems were an express requirement when the planning of the satellite was put out to tender, and a special planning tool was developed to support the process of carbon footprint optimization from the start of the planning all the way through to the building's eventual inauguration. The development of this tool was sponsored by Bavaria's State Ministry for Economic Affairs, Infrastructure, Transport and Technology.

On account of the requirements stipulated, the results of the competition for the satellite produced a range of ideas, including exploiting geothermal energy and constructing a snow and ice melting system to reduce the need for primary energy to heat and cool the building. In addition, in an effort to achieve the goal of minimizing the building's carbon footprint, planning offices are currently assessing the potential of ideas for a heavily insulated building shell, efficient sun protection, heat recovery, exploitation of groundwater, ecological building materials, and a system for making the most of daylight.

Conservation

The need for land for the third runway will inevitably impact on the airport's animal and plant life. To compensate, FMG will engage in a variety of mitigative environmental measures. In the past, the company has undertaken extensive renaturalization work, and the compensatory areas at the airport, currently around 350 hectares in size, have now been populated by numerous species of endangered animals and rare plants.

More than half of the airport campus is green

A good 60 percent of the airport campus – close to 1,000 hectares – consists of areas of parkland. Depending on their location, these areas serve different purposes. Grassland near the flight operations areas, for example, has to fulfill specific requirements: It must be capable of bearing weight and inexpensive to maintain. The lines of trees along the main access roads also have a practical purpose in that they ease orientation and guide traffic. More than 6,300 mature trees have been planted at the airport, primarily basswood, maple, cottonwood, oak and ash.

A boundary zone between the airport and the open country

The airport's boundary zone provides a transitional area between the airport campus and the open countryside. This is a 250-hectare environmental buffer zone, rich in animal and plant life, between the extensive monoculture of the airport campus and adjacent tracts of land devoted to agriculture. Around 87 hectares of woodland and 104 hectares of grass and meadowland were created here, along with roughly 13 hectares of maintenance and service tracks and 46 hectares of other space, including the fire service training area, the rainwater retention basin, and other areas, some of which are covered in low-nutrient grass. The hedgerows and copses are populated with local species of trees and shrubs ideally suited to the area, including downy birch, various willow species, ash, different types of poplar, and black alder. To reduce the risk of bird strike, only a few of the varieties planted produce berries. The bands of trees and shrubs screen off the neighboring communities of Schwaig, Hallbergmoos, and Attaching, and protect the farmland from wind erosion. They also encourage a greater variety of plant and animal species to populate this habitat.

The airport's boundary zone contains a number of watercourses created as part of the airport's water management program. These include the northern flood ditch, built to trap floodwater and channel it into the Isar river to the north of the airport; it was designed to have a near-natural look, with a gently meandering streambed. The bends along its course provide wetland habitats for rare and protected plant, insect and bird species. Large areas of low-nutrient grass on the embankments and a manmade gravel berm offer ideal conditions for plant and animal communities that favor a dry habitat.

Mitigative and compensatory areas in the airport's green belt

Mitigative environmental measures in the airport's broader surrounding locality currently span an area measuring some 5,000 hectares. Actual compensatory areas measure around 347 hectares, including 62 hectares of hedgerows and woodland, 203 hectares of open grassland, 79.5 hectares of succession areas, and around 2.5 hectares of water. Overall, this adds up to around a quarter of the airport's total area. There are also 66.3 hectares of mitigative areas where environmental work has been carried out, and 3.3 hectares of land to compensate for built-up areas. In total, the airport cares for and maintains 666.6 hectares in outer areas with a view to conservation.

These compensatory areas have been united to form a green belt around the airport connecting existing conservation and landscape preservation areas, including Isarauen, Viehlassmoos, Freisinger Buckel, Eittinger Weiher, Oberdinger Moos, Notzinger Moos, Schwaiger Moos, and Zengermoos – an initiative that is facilitating the spread and proliferation of typical regional animal and plant life.

This system of interconnected biotopes comprises corridors of meadowland with low-nutrition grass, succession areas, shrub land, wetland areas with reed beds and newly created amphibian spawning grounds, parcels of woodland, and areas of dense undergrowth. Extensive and carefully maintained buffer zones protect ponds and streams from pollutants – fertilizers and crop sprays – originating from intensive agriculture on neighboring land. Continued efforts to landscape and maintain these buffer zones in line with the countryside typical for the surrounding area will help to preserve and stabilize the remaining core sections of Erdinger Moos. The widening of watercourses and excavation of groundwater have created 70 ponds ranging in size from 200 to 500 square meters. These have become new feeding and breeding grounds, not just for amphibians but also for many mollusks, beetles, dragonflies, grasshoppers, and birds.

Success tracking: Endangered species are back

In recent years, FMG has worked closely with environmental agencies to survey the effectiveness of the compensatory areas that have been created. The surveys have shown that the airport's mitigative and compensatory initiatives have become a significant factor for the region in the protection of plant and animal species and their habitats. A study in 2007 showed that amphibians like grass frogs, marsh frogs and common toads have populated the majority of pools and built up stable communities. The tree frog, too, is becoming increasingly widespread and is gradually forming more permanent populations.

Large numbers of rare butterflies have settled in these areas, in some cases with high population counts. Not only has the variety of bird species increased, numbers of breeding pairs have also risen, creating stable populations. Species include the rare bluethroat, and among the ground-nesting birds, lapwings have recovered the most rapidly.

These conservation successes show how important it is to maintain and develop highly variegated landscapes, with hedgerows, copses and individual trees as well as a mix of mesic, wet and low-nutrition areas, marsh meadows, ponds, and extended ditches. Regular care and maintenance work in green areas, including cutting back shrubbery, cleaning up watercourses and mowing, is also important.

Reducing bird strike risk

A bird strike is a collision between an aircraft and one or more birds. To avoid this type of hazard and the problems it can cause, timely precautions are required.

To lower bird strike risk, FMG developed an environmentally compatible system of biotope management. This consisted of creating green areas at and around the airport that were unattractive to specific "dangerous" species of bird to create a passive deterrent. The measures specifically include low-nutrient grassland with infrequent high-mowing, and no extensive areas of open water. Undesirable bird species are also actively deterred by means of pyro-acoustics. Flughafen München GmbH's bird strike office is responsible for implementing suitable initiatives and is in regular contact with the relevant local and national authorities and organizations.

Pulsatilla grandis (Pasque Flower)

Taragonolobus maritimus (Dragon's Teeth)

Gentiana clusii (Clusius's Gentian)

Environmental goals and initiatives

Completed projects

Strategic goal	Initiative	Status	Progress as at June 2008
Initiatives to improve the air pollution situation	Introduction of pollutant-based emissions charges	Completed	Emissions-based takeoff and landing fees were introduced in January 2008. The fees are levied on the basis of aircraft emissions of nitrogen oxides (NOx) and unburnt hydrocarbons (HC). The project is confined to a period of three years and aims to improve air quality in the airport's surrounding area by reducing emissions.
Creation of an installations catalog listing all hazardous material storage points and refueling systems	A graphical IT system will be adapted for the installations catalog (for storing information on the locations of refueling systems and hazardous material storage points). This will speed up access to information on installations and the supervisors responsible for them.	Completed Will be expanded continuously	The installations catalog is updated constantly by FMG's industrial health and safety and technical documentation units.
Optimization of the information on emissions based on findings regarding the impacts of individual emitter groups	Pollutant screening: Recording of all pollutant sources on the airport campus	Completed	The process of recording all pollutant sources on the airport campus has been completed. Further analysis will be conducted continuously by pollution protection staff.
Energy savings and lower carbon emissions	Remediation of lighting in multistory parking facility car parks P1 through P20 by switching from T8 to T5 lighting.	Completed	Reducing lighting power requirements from around 1,000kW to around 640kW has saved roughly 3,168MWh/a.
Advancement of research into means of reducing aviation noise	Implementation of the German Aerospace Center's Quiet Air Traffic II project	Completed	The concluding report is available here: http://www.dlr.de/as/Portaldata/5/Resources/dokumente/abteilungen/abt_ts/Abschlussbericht_Wissenschaft.pdf
Better public relations work	Munich Airport has been a member of Bavaria's Environmental Pact since 2002. In 2007, the airport organized environmental tours of the airport site and visits to the combined heat and power plant.	Completed	As part of Bavaria's Environmental Pact program, FMG organized tours of the airport's combined heat and power plant. Four tours of Munich Airport, including visits to the CHP, were conducted; 63 people took part.
	Communications Office: Information on aviation noise and the Runway 3 Project for employees and local communities.	Completed	The Communications Office was set up in 2006 to inform Munich Airport employees about the Runway 3 Project. Other organizations on the airport campus can also contact the office for information on everything from the length of the runway to the project status, approach and departure routes, and the noise protection program.

Current projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Use of alternative fuels from renewable raw materials sourced locally in the airport's home region	Biogas to supplement natural gas in CHP and as vehicle fuel	End of 2010	Concept study completed, planning in progress	
	Utilization of airport biomass to produce biogas	End of 2009		An operating strategy has been defined.
	Biofuel: E85 and rapeseed oil as renewable fuels for vehicles	End of 2010	In process	
	Infrastructure and consulting on biofuel use on campus			
	Installation of a public biofuel filling station (rapeseed, E85, biomethane)	End of 2009		Consulting with LSG is in progress.
	Innovation and environmental award to promote new technologies in the field of aviation	Submissions by June 6, 2008, award presentation in Q3 2008		More information is available here: http://www.munich-airport.de/de/micro/mucaward/index.jsp
Reduction of the impact on groundwater from deicing agents	Development of biodegradation accelerator to reduce deicer impact on groundwater	Deployment scheduled for 2008/2009		A large-scale trial was completed in 2007/2008; the concluding report, calculations regarding everyday use, and an executive decision are expected by the summer of 2008.
	Development of ground filter as ground-based retention and absorption system for deicing agent	End of 2010		The final report was published in October 2006. Test fields were set up in 2007. A study was conducted in 2007–2009.
	Optimization of deicer deployment quantities by stepping up employee training	Ongoing	Target still valid	
	Construction of a collecting tank for aircraft deicer at deicing area	End of 2008	Under construction	Two additional collecting tanks are to be built at the southeast and southwest runway heads, each with a capacity of 200m^3
	Creating of additional storage capacity for reprocessed deicing agent in the recycling plant	End of 2008	Under construction	The tank has a capacity of 1,500m^3.
	Optimization of deicer deployment quantities by improving technology	End of 2009	One multirole vehicle already in service	Four multirole vehicles are to be in service by the end of 2009.

Current projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Integration of subsidiaries	Integration of selected subsidiaries into the environmental management system within three years of certification	End of 2008	Target still valid	The Hotel Kempinski received EMAS and ISO 14001 certification in 2007. Allresto was ISO 14001 certified.
Better public relations work	Publication of pollutant levels on the Web	End of 2009	Target still valid	
Termination of fire training exercises involving kerosene to eliminate having to process wastewater containing kerosene residues	Following are issues to be addressed in the planning of a gas-fueled fire training facility: • Alternatives to having a fire training facility at Munich Airport • Location of the fire training facility • Future utilization • Size, design and installations • Financial considerations	End of 2008		The project is still at the planning stage.
Reduction of local aircraft noise	Optimization of departure procedures in association with airlines and air traffic control	Ongoing	Target still valid	Planning has started for a research project into ways to reduce aviation noise (MASSIF) under the supervision of German Aerospace Center.
Reduction of drinking water consumption	Introduction of dry urinals	End of 2008	Reduction of drinking water consumption by 2,000m^3 a year	The pilot project in the Airbräu restrooms has been completed. The introduction of dry urinals at other locations is being reviewed.
Reduction of ramp service vehicle fuel consumption by 10 percent compared to 2005	Replacement of hybrid tugs with tugs with new electric drive technology. The new tugs are powered by a battery that is recharged continuously by a diesel unit, avoiding engine idling losses.	End of 2008		Twenty-five electric vehicles have been purchased. TOFU assessments will be published in 2009.
	Reduction of idle energy consumption by informing and motivating employees. A telematics system (TOFU) is used for data communication and vehicle location.	End of 2009	Partially implemented, target still valid	TOFU assessments will be published in 2009.
	Replacement of freight tugs with a new, lighter generation of tugs	End of 2008	Target still valid	
Reduction of overall diesel consumption by 5 percent	Procurement of natural gas-powered vehicles. A filling station for natural gas will be built on site, and part of the airport's vehicle fleet will be fueled with natural gas.	End of 2008	Partially implemented, target still valid	
	Conversion of diesel vehicles to run on rapeseed oil, conversion of gasoline vehicles to run on E85 (bioethanol)	End of 2009	3 percent	To date, 30 vehicles have been converted to run on biogenic fuels.

Current projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Increase in the combined heat and power plant's annual efficiency through heat pump operation	An absorption refrigeration machine is to be converted into a heat pump to exploit the low-temperature heat from engines that would otherwise dissipate into the environment (up to 1.5 percent higher energy utilization, depending on weather conditions)	End of 2008	Implementation in progress	Preparations are in progress for preliminary work at the point of integration.
Introduction of a supplier audit system in the company	Identification of risk-relevant processes and products at FMG that can be influenced by suppliers	Mid-2009	On schedule	Application for project is to be submitted by the end of July.
Systematic process optimization with a process analysis system	Use of "Prometheus" to systematically track and analyze processes	End of 2008	On schedule	The system is in its pilot phase and will be deployed in our engineering and aviation units by the end of 2008. There are plans to expand it to include other units.
Reduction of water consumed by the combined heat and power plant	Deicing water in winter and rainwater in summer to be processed by means of reverse osmosis and used to supply the CHP	No time frame defined as yet	Study in progress	The study's finding are due to be published by the end of 2008.
	Elimination of the sulfuric acid tank used to soften water, reduction of sulfuric acid consumption	No time frame defined as yet	Dependent on the outcome of the study on reverse osmosis	The study's findings are due to be published by the end of 2008.
Energy savings and reduction in carbon emissions	Energy transparency for buildings through airport-wide network: Introduction of centralized meter management	End of 2009		Energy savings of 3 percent compared to the base year 2006 are planned.
	Conversion of safety lighting over-/under-voltage relays on Levels 1 and 2 in Terminal 1 and the Central Area	Mid-2008		An energy saving of 560,000 KWh/a (= 312t/a carbon reduction) is planned.
	Reduction of pump power in the air-conditioning system: Replacement of old pumps with modern, more efficient circulating pumps	Mid-2008		The old pumps are oversized and inefficient. The modern pumps have ratings of 25-60 watts, compared to 80-150 watts for the older pumps. The new ones no longer have a step switch and operate like a permanent magnet rotor.
	Better room climate in administrative buildings through installation of solar protection foils	Mid-2008		Solar protection foils have been fitted to windows on the side corridors. The center corridor (the foyer area) will be fitted with foils shortly.

Current projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Energy savings and reduction in carbon emissions	Reduction by 50 percent of power consumed by IT equipment through automated power-saving measures	Mid-2008	Target still valid	IT Engineering [ITNP-Win] is due to begin technical implementation. Tests with a new type of PC have been a success.
	Replacement of PCs with models with half the power requirements	Mid-2008	Target still valid	The program has been completed and will be followed by similar initiatives. Power savings to date amount to 230MWh.
	Measuring of IT equipment's power consumption, trials of new equipment	Ongoing	New equipment: Target achieved Old equipment: 20 percent	All new IT products are subject to power tests. Measurements are being carried out for products already deployed; around 20 percent have been tested to date.
	Heat recovery in the data center, assessment of scope for reducing or exploiting waste heat	Mid-2008	Project has started	Implementation of cold aisle containment has started; the next step is heat recovery.

New projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Reduction of carbon emissions by 30 percent per workload unit by 2020	Analysis of carbon emissions by sources and consumer groups by 2020	Completion by end of Q1 2008		Completed
	Definition of a strategy for achieving climate-neutral growth by 2020 with emphasis on: - Utilization of innovative technologies (e.g., biogenic fuels) - Assessment of opportunities for reducing consumption through remediation of buildings and installations - Opportunities for reducing consumption by changing users' behaviors	End of Q4 2008		Implementation of carbon reduction targets set for 2008.
	Strategy for carbon-neutral expansion – construction of satellite and third runway	End of Q4 2008		
	Utilization of renewable energies, assessment of pilot installation for solar thermal cooling	End of Q4 2008		

New projects

Strategic goal	Initiative	Time frame	Status	Progress as at June 2008
Reduction of carbon emissions by 30 percent per workload unit by 2020	Study into scope for utilizing geothermal energy at Munich Airport	End of 2008	Study completed No decisions reached as yet	A brief study into the utilization of geothermal energy at Munich Airport has been completed. The study reviews the potential, the costs, and system integration.
	Minimization of escalator motor operation time by deploying chargers with higher hourly output ratings	End of 2008		The chargers were ordered by mid-2008 and should be installed by yearend. An assessment based on production operation will be completed by the end of 2008.
Assessment of potential for extreme convection events in southern Germany through to 2030	Participation in the RegioExAKT project. Funded by the Federal Ministry of Education and Research, the RegioExAKT project was primarily set up to assess the anticipated occurrence and threat from extreme convection events and, building on this, to develop adaptation strategies on a scale appropriate for the region for key users (Munich Re, Munich Airport).	End of 2009		Launched in January 2007, the three-year project builds hydrometeorological and insurance-relevant extreme weather scenarios with regionally focused climate and vulnerability projections based on regional climate change.
Compliance	Ensure that the system identifies legal requirements and implements them appropriately within the organization in the form of rules, regulations and oversight. Proof of implementation in operational processes. Assessment of action areas.	Assessment of current status between October 2007 and May 2008. Evaluation and analysis by end of September 2008.		An assessment of the current status has been completed. Analysis and coordination initiatives are due to be completed by September 30, 2008.
Study into the use of preconditioned air on the apron	Preparation of a feasibility study	End of 2008		

Environmental data

Category	Indicator	Units	2006	2007	2006/2007	Remarks
Traffic and infrastructure data						
Traffic	Aircraft movements	No.	411,335	431,815	+ 5.0%	
	of which in commercial traffic	No.	399,460	419,977	+ 5.1%	
	Passengers (total)	No.	30,778,352	33,979,904	+ 10.4%	
	Passengers (commercial traffic)	No.	30,757,978	33,959,422	+ 10.4%	
	Freight carried by air	t	240,409	251,075	+ 11.9%	
	Total air freight	t	404,409	451,075	+ 11.5%	
	Air mail	t	13,672	14,532	+ 6.3%	
	Workload units	WLU	33,060,565	36,549,232	+ 10.6%	
Infrastructure	Employees at airport	No.	27,400	approx. 27,400	-	2006 workplace survey
	FMG employees	No.	4,747	4,644	- 2.2%	
	FMG Group employees	No.	7,186	7,389	+ 2.8%	
Areas	Non-paved	m^2	9,502,979	9,491,086	- 0.1%	
	Paved	m^2	5,589,209	5,596,452	+ 0.1%	
	Built up	m^2	631,426	654,176	+ 3.6%	
	Total	m^2	15,741,614	15,741,714	+ 0.1	
Environmental data						
Aviation noise	Achering measuring station	dB(A)	56	58	+ 3.6%	Annual values, LEQ
	Attaching measuring station	dB(A)	57	57	-	Annual values, LEQ
	Eitting measuring station	dB(A)	54	54	-	Annual values, LEQ
	Hallbergmoos measuring station	dB(A)	57	57	-	Annual values, LEQ
	Pulling measuring station	dB(A)	60	61	+ 1.7%	Annual values, LEQ
	Schwaig measuring station	dB(A)	60	60	-	Annual values, LEQ
Air quality	Airport NO measuring station	$\mu g/m^3$	14	8	- 42.9%	Annual mean values
	Airport NO_2 measuring station	$\mu g/m^3$	34	30	- 11.8%	Annual mean values
	Airport ozone measuring station	$\mu g/m^3$	41	48	+ 17.1%	Annual mean values
	Airport benzene measuring station	$\mu g/m^3$	1.3	1	- 23.1%	Annual mean values

Category	Indicator	Units	2006	2007	2006/2007	Remarks
Consumption data						
Energy	Gas	GWh/Ho	373.45	339.57	- 9.1%	
	Fuel	GWh/Ho	20.35	21.47	+ 5.5%	
	District heating (outside supply)	GWh/Ho	25.37	30.92	+ 21.9%	
	Power incl. renewables (outside supply)	GWh/Ho	102.32	106.25	+ 3.8%	
	Total energy consumed	GWh	521.69	498.21	- 4.5%	
	Energy consumption per WLU	kWh/WLU/a	14.5	12.5	- 13.8%	
Vehicle fuel	Regular grade gasoline	l	35,245	39,560	+ 12.2%	incl. FMG subsidiaries
	Premium grade gasoline	l	375,370	345,999	- 7.8%	incl. FMG subsidiaries
	Diesel	l	6,105,252	5,308,087	- 13.1%	incl. FMG subsidiaries
	Rapeseed	l	-	136,571	-	since 2007
	Bioethanol	l	-	10,120	-	since 2007
Fresh water and wastewater	Drinking water intake from mains	m^3	955,273	970,436	+ 1.6%	Total for campus
	Wastewater output to treatment plant	m^3	2,332,295	2,023,457	- 13.2%	Total for campus
Waste	Recycled waste	t	5,796	7,387	+ 27.4%	
	Industrial waste	t	2,364	2,711	+ 14.7%	
	Aircraft waste	t	3,819	3,520	- 7.8%	
	Waste requiring special treatment	t	2,879	2,068	- 28.2%	
	Waste requiring special monitoring	t	249	302	+ 21.3%	
	Construction waste	t	300	204	- 32.0%	
Snow and ice control	Aircraft deicing operations	No.	4,779	7,298	+ 52.7%	
	Type 1 deicer	m^3	2,180	2,214	+ 1.6%	1,332 cbm of Type 1 mix were recycled
	Type 4 deicer	m^3	465	519	+ 11.6%	
	Pavement deicer, total	t	1,133	1,239	+ 9.4%	
	Days snow and ice crews were deployed	No.	33	43	+ 30.3%	

Glossary

Aircraft noise law
Germany enacted legislation on aircraft noise in March 1971. The law covers the scope and definition of noise abatement areas, means of determining noise nuisance, construction bans (and compensation), noise protection, and the refunding of expenses arising from the installation of noise protection in buildings. Notes on implementing the statutory requirements issuing from this law were published in 1975 – one describing how to collect noise data (DES) and one containing instructions on how to define noise abatement areas at civil and military airports (AzB). The latter was last updated in 1984. Germany's aircraft noise legislation is in the process of being amended.

Anti-icing
A preventive measure designed to protect aircraft from a build-up of ice. This involves applying a special de-icing agent (type 4) to the plane. When snow is falling, the de-icer prevents snow from accumulating on the aircraft for a period of around 45 minutes.

Benzene
A ring-shaped hydrocarbon that makes up approximately 2.5 percent of gasoline by volume. Benzene is toxic, affecting the central nervous system, and is considered to be carcinogenic.

Bioethanol (E85)
Bioethanol is ethanol intended for use as a biofuel and produced entirely from biomass (renewable carbon sources) or biodegradable fractions of waste.

Biofuel
Biofuels are fuels produced from biomass for use in combustion engines or heating systems.

Biogas
Biogas generally refers to a mix of gases consisting primarily of methane and carbon dioxide, produced in special biogas plants.

Biogas plant
A plant or system that produces biogas from biomass. Residual substrate, a process by-product, is used as fertilizer. The gas from the plant is commonly used to generate power and heat in a downstream generating facility.

Biomass
Biomass is organic material that can be converted into fuel.

Biotope
A biotope is a defined geographical area with uniform biological conditions providing a natural habitat for plant and animal life.

BTX
BTX stands for benzene, toluene and xylene, three organic substances that are classed as carcinogenic. Their levels are monitored by taking air pollutant readings.

Carbon dioxide (CO_2)
Carbon dioxide is a colorless, odorless gas. It is a natural component of air and occurs in a concentration of around 0.04 percent. Carbon dioxide is created when substances containing carbon combust completely with sufficient oxygen is present; it is also produced by cell respiration in organisms. CO_2 is excreted by organisms when they exhale. Plants, some types of bacteria, and archaea (single-celled organisms) can convert CO_2 into organic materials through carbon fixation.

Carbon monoxide (CO)
Carbon monoxide is a colorless, odorless, tasteless gas that is toxic. It is created by the partial oxidation of substances containing carbon. For example, this occurs when such substances burn without sufficient oxygen present or at very high temperatures. Carbon monoxide is itself combustible and burns with a blue flame in the presence of oxygen, forming carbon dioxide.

Continuous noise level
Noise analysis not only takes into account the intensity but also the duration of noise, so the official practice in noise measuring and reporting is to recalculate noise as a continuous noise level for the same period. This figure is the equivalent continuous noise level, or LEQ4, which, in an aviation context, describes the burden of aircraft noise during a reference time frame.

Decibel
A unit of measure for noise, named after Alexander Graham Bell, the inventor of the telephone. One decibel dB(A) is the smallest change in volume that a human can register. The dB(A) scale is logarithmic. Thus, an increase of 10 dB(A) represents a doubling in the perceived noise level.

De-icing
The removal of snow and ice from aircraft with the aid of a heated mixture of glycol and water.

DFS
DFS, or Deutsche Flugsicherung GmbH, is Germany's air-traffic control operator and is responsible for guiding and coordinating the country's air traffic. The organization is also responsible for planning, deploying and maintaining all of the technical equipment and radio navigation systems needed by air traffic.

DIN EN ISO 14001
A standard created by the International Organization for Standardization (ISO). The standard establishes a foundation for certifiable environmental management systems.

Eco-Management and Audit Scheme (EMAS)
A directive issued by the EU in 1993 according to which companies can voluntarily have environmental management systems at their locations validated by an independent auditor. Details of participating companies' environmental policy, their industrial environmental protection initiatives and activities, and their environmental performance must be published in publicly available environmental statements. The goal of EMAS is to achieve continuous improvements in industrial environmental protection.

Equivalent continuous noise level (Leq)
When noise is analyzed, not just the intensity but also the duration, the frequency of occurrence and the peak level are taken into account. With the equivalent continuous noise level – measured in dB(A) – the noise registered at a particular location for a specific period is converted into an equivalent continuous noise.

Greenhouse effect
The earth's atmosphere consists of nitrogen (78 percent), oxygen (21 percent), and water vapor and trace gases (1 percent). Carbon dioxide, methane and numerous other trace gases let short-wave sunlight pass through yet retain the heat radiating back from the earth's surface. The natural greenhouse effect causes the mean temperature to be about +15°C; without it, the mean temperature would be –18°C. Due to combustion processes, intensive agriculture and other influences, a growing number of greenhouse gases are finding their way into the atmosphere, amplifying the natural greenhouse effect. This is causing the danger of an increase in temperature and an attendant rise in sea levels, as well as a risk of changes in climate processes resulting in increasingly extreme weather and climate events.

Glossary

Greenhouse gas
Greenhouse gases are gaseous substances of natural or anthropogenic origin that occur in the atmosphere and contribute to the greenhouse gas effect. These gases absorb part of the earth's infrared radiation that would otherwise escape into space. They emit heat (infrared radiation), and the part of that heat radiated back at the earth in the form of atmospheric counter radiation, together with sunlight, heats up the earth's surface. Disruption to the atmosphere's natural balance through damage to natural environments and through anthropogenic greenhouse gas emissions increases the natural greenhouse effect and leads to global warming, which in turn has far-reaching consequences.

Greenhouse Gas Emissions Trading Act (TEHG)
Germany enacted this law to establish a Community-wide foundation for the trading of greenhouse gas emission certificates for organizations with high GHG emissions. The law aims to help combat global climate change by reducing greenhouse gases cost efficiently.

Glycols
Liquid substances that can be combined with water and used as anti-freeze. Diethylene glycol and propylene glycol are commonly used to deice aircraft.

Jet A1 (kerosene)
Jet A1 is the type of kerosene used in civil aviation as fuel for today's jet and turboprop engines. Kerosene consists mostly of a number of different hydrocarbon compounds, but it also contains a number of additives designed to increase the safety of the fuel. The composition and the quality of kerosene is standardized internationally. In 2004, Lufthansa aircraft used 4.29 liters of kerosene per 100 passenger-kilometers. In general, the more modern an aircraft, the higher the load factor and the longer the distance covered nonstop, the lower the fuel consumption per 100 passenger-kilometers. When full to capacity on nonstop flights over distances of more than 10,000 kilometers, today's long-haul aircraft use roughly 3 liters per 100 passenger-kilometers.

Nitrogen dioxide (NO_2)
Nitrogen dioxide is a reddish-brown, pungent gas with an odor similar to chlorine. It liquefies easily and occurs as a trace gas in the atmosphere. Levels are highest close to the ground.

Nitrogen monoxide (NO)
Nitrogen oxide is a colorless gas. In combination with oxygen and other oxidants, it turns into brown nitrogen dioxide, which in water disproportionates to form nitric acid and nitrous acid.

Noise footprint
A noise footprint is the area on the ground in which an aircraft takeoff or landing causes a specific noise level. Older, noisier aircraft have a larger noise footprint than modern aircraft.

Ozone (O_3)
A gas whose molecule consists of three oxygen atoms. Ozone is highly reactive, looking for a means to release one of the oxygen atoms and to turn into molecular oxygen (O_2). The individual oxygen atoms (radicals) oxidize other substances, materials and surfaces (e.g., automobile tires, coloring agents, plants, and respiratory mucous membranes). For this reason and because ozone also damages forests and contributes to the greenhouse effect, high levels in the troposphere are bad. In the stratosphere – at altitudes above 25 kilometers – ozone accumulates in the ozone layer, which protects the earth against extremely short-wave, high-energy solar radiation.

PCA
A system that supplies preconditioned air to parked aircraft.

Peak noise level
The peak noise level (LASmax, based on the DIN 45643 standard, Part 1, Section 2) is the maximum sound pressure level produced by a noise event. Readings of peak noise levels are used to gauge the noise produced along an aviation route by different aircraft types.

PM10
PM10 stands for particulate matter < 10 µm and refers to fine dust particles with a maximum diameter of 10 µm.

Rapeseed oil
Rapeseed oil is a vegetable oil obtained from the seeds of certain approved types of rape and field mustard plants.

Renewable Energies Act (EEG)
A law enacted in Germany to promote renewable energies and encourage the introduction of energy supply facilities running on renewable resources. The law's main purpose is to control climate change. It is one of a string of legislative initiatives aimed at reducing dependence on fossil fuels such as oil, natural gas and coal and on energy imports from outside the European Union.

Reverse osmosis
A physical process used in the treatment of potable water to remove salts.

Solar power plant
A solar power or photovoltaic plant is a generating facility that uses solar cells to convert solar radiation into electric power.

Sulfur dioxide (SO_2)
Sulfur dioxide is created by the combustion of fuels that contain sulfur. In the atmosphere, it is converted into sulfuric acid and sulfurous acid, which contribute to the formation of acid rain.

Toluene
Toluene is a methyl benzene. It is used as an additive in motor vehicle fuels and is contained in exhaust emissions. It is less toxic than benzene.

Vegetable oil
Vegetable oil belongs to the group of fats and fatty oils extracted from oil-bearing plants.

WLU
Workload unit: 1 pax (passenger) or 100 kg of air cargo or mail.

Xylene
Xylene is a dimethyl benzene that commonly occurs in automobile emissions. It is less toxic than benzene.

Internet links

Munich Airport

www.munich-airport.de/de/company/umwelt/index.jsp
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