Our climate, our contribution

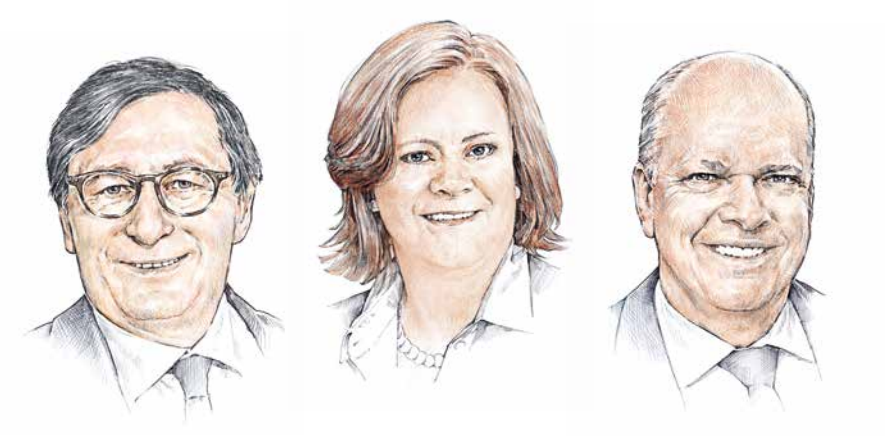
The environment at Munich Airport

Living ideas – Connecting lives

Go CO_2 neutral

How green can an airport be?
Munich is making great progress toward becoming
Germany's first climate-neutral airport.

FOREWORD



Dear Reader,

Climate protection concerns all of us. That is why the entire aviation industry is committed to meeting climate targets and reducing emissions caused by aviation. Munich Airport also helps protect the climate with innovative technological solutions. Since 2009, we have planned to achieve climate-neutral growth by 2020. In 2016, however, we decided to pursue a new and even more ambitious climate strategy, not only to meet the resolutions adopted in the Paris Agreement on climate change, but also to live up to our own mission: making Munich Airport carbon-neutral by 2030. To achieve that goal, we will reduce our CO_2 emissions by 60 percent, despite a further increase in traffic, and compensate for the remaining 40 percent by means of suitable climate projects, where possible in the region. An amount totaling €150 million will be invested in this ambitious climate protection program. That means Flughafen München GmbH is virtually earmarking an entire year's profit solely for climate protection. We are thus launching a voluntary climate protection program, without any statutory or official obligation whatsoever to do so, and thereby underscoring just how committed Munich Airport is to effective climate protection. By focusing rigorously on resource-saving operation of our airport, we can reconcile the challenges of a dynamically growing traffic infrastructure with the demands of a corporate policy geared to sustainability.

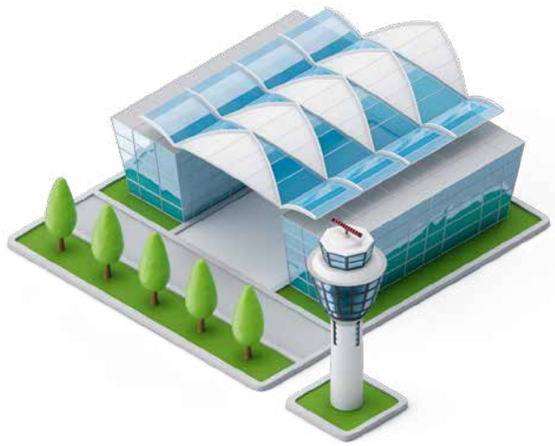
Dr. Michael Kerkloh
President and CEO,
Personnel Industrial Relations Director

Andrea Gebbeken
Chief Commercial
and Security Officer

Thomas Weyer
Chief Financial Officer,
Chief Infrastructure Officer

CONTENTS

Munich Airport started operating at its new location in the Erdinger Moos region, with one terminal and two runways, on May 17, 1992. It has kept on evolving since then and, with two terminals and an additional satellite, is now Germany's second-largest airport and one of Europe's busiest. At the beginning of 2015, Munich was named the first 5-Star-Airport in Europe. It was awarded that coveted title again in the spring of 2017.



394,000
AIRCRAFT MOVEMENTS

334,000
TONNES OF AIRFREIGHT

35,000
EMPLOYEES ON CAMPUS

MORE INFORMATION
can be found at:
www.munich-airport.com

1,575
HECTARES TOTAL SURFACE AREA, OF WHICH 2/3 ARE GREEN AREAS

42.3 million
PASSENGERS

Figures for 2016

100
AIRLINES

73
COUNTRIES

257
DESTINATIONS

PROFILE OF MUNICH AIRPORT

1
BIRD SANCTUARY

WITH

40
ENDANGERED BIRD SPECIES

374
HECTARES OF COMPENSATION AREAS

37%
FEWER CO_2 EMISSIONS PER PASSENGER SINCE 2005

150 million
EUROS IN INVESTMENT IN CLIMATE PROTECTION BY 2030

MORE THAN
250
MEASURES TO REDUCE CO_2

24
MW OUTPUT FROM THE CHP PLANT

155 million
KWH OF HEAT FROM THE CHP PLANT

150 million
KWH OF ELECTRICITY FROM THE CHP PLANT

The heart of Munich Airport's energy supply is its own block heat and power (CHP) plant. There, the airport generates more than half of its on-site energy requirements using environmentally-friendly natural gas. The plant's waste heat alone almost covers all the airport's heating and cooling needs – without any additional use of energy. That reduces CO_2 by almost 50,000 tonnes a year compared to other methods of generation – the amount emitted by a city of over 40,000 inhabitants.

2.55 PERCENT

↓

The share of global CO_2 emissions due to air transport

CLIMATE PROTECTION

Munich aims to become a carbon-neutral airport by 2030. To achieve this ambitious climate protection goal, Flughafen München GmbH will invest a total of €150 million between 2017 and 2030 – a sum corresponding to the profit it generated in 2016.

CLIMATE PROTECTION STRATEGY 2030

A large traffic infrastructure naturally has an impact on the environment. That is why Munich Airport pursues an ambitious climate protection strategy that goes far beyond what the law requires.

8 — 13

CLIMATE PROTECTION AT THE AIRPORT

The CO_2 emissions from an international airport equal those of a small city. That means it is all the more important to avoid and reduce negative effects as far as possible by means of smart CO_2 management.

14 — 17

General political framework for climate protection

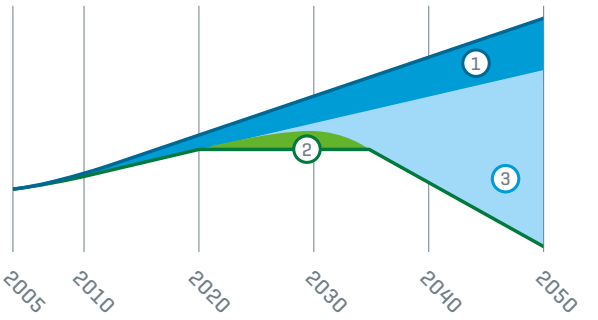
Climate change does not halt at national borders. It is a global challenge that calls for international solutions and cooperation between all nations. International climate policy addresses the issue of what measures can ensure effective protection of our climate.

CORSIA

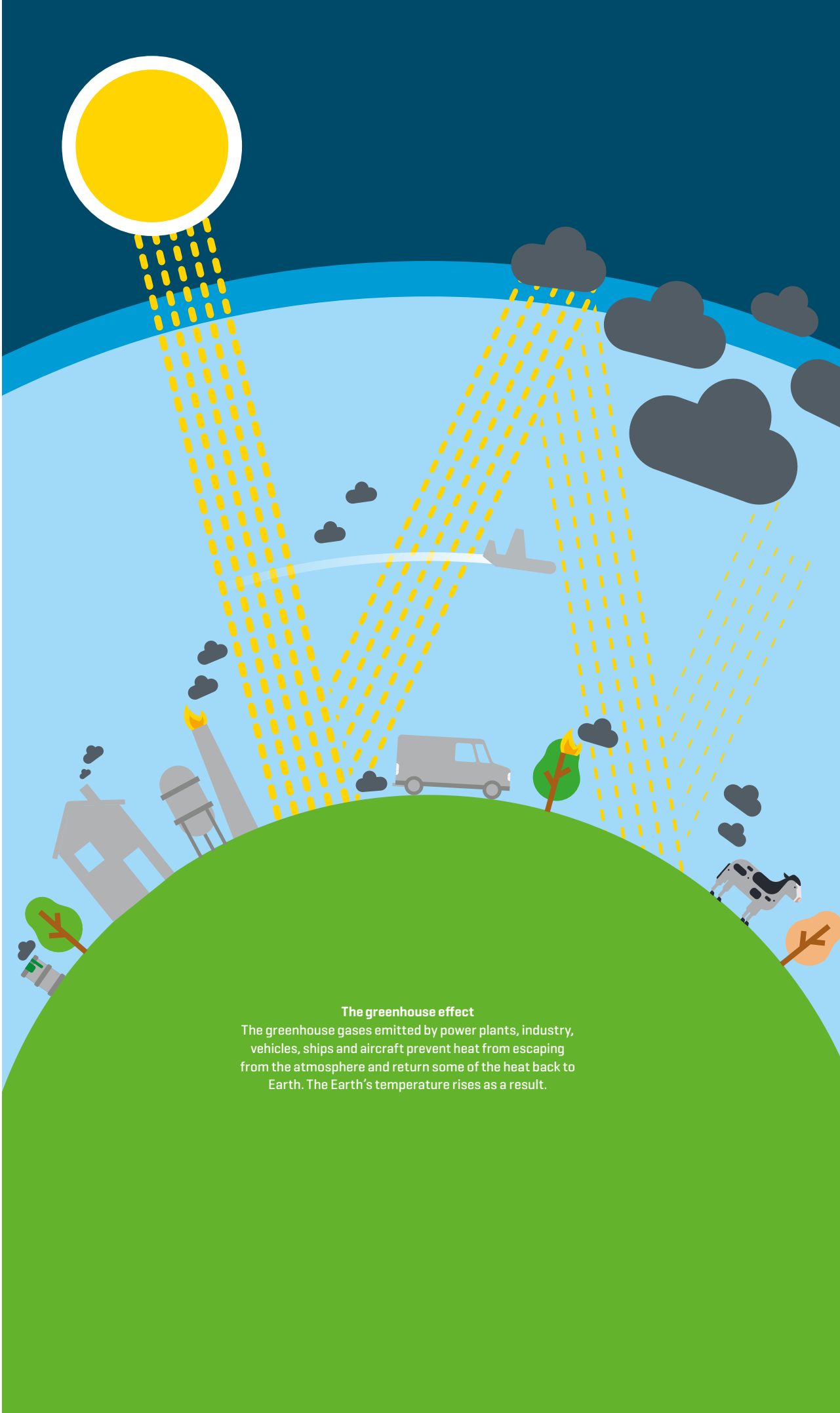
Forecasts assume that global air traffic will grow by around five percent per annum. The anticipated increases in efficiency from advances in aircraft technology will probably not be enough to compensate for the rise in CO_2 emissions (1). The airlines, through the ICAO (International Civil Aviation Organization), have therefore drafted a proposal on offsetting emissions on international routes. On October 7, 2016, the international community agreed to this proposal on UN level in Montreal. That means: Offsetting of growth-related CO_2 emissions will be gradually introduced by airlines as of 2020 using the CORSIA system (2). After the interim goal of «climate-neutral growth by 2035» has been reached, CO_2 emissions are to be halved by 2050 through the development and introduction of alternative fuels and drive systems (3).

The international Paris Agreement in December 2015 laid the foundations for global climate protection in the coming decades so that global warming can be limited to well below two degrees Celsius and where possible to 1.5 degrees. Under the United Nations Framework Convention on Climate Change, net greenhouse gas emissions are to be reduced to zero between 2045 and 2060. At the climate change conference in Paris, the Airports Council International (ACI) announced that 50 airports in Europe are to be carbon-neutral by 2030. This voluntary commitment was doubled to 100 climate-neutral airports in Europe by 2030 on June 13, 2017. The Paris Agreement came into effect on November 4, 2016. Subsequently, the UNO agreed to a proposal by the International Civil Aviation Organization (ICAO) on a global climate agreement for aviation in Montreal in 2016. Under this agreement with the name CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation), carbon-neutral growth in international aviation is to be achieved from 2020 on and its CO_2 emissions are to be reduced by half by 2050.

Climate protection plan of the international aviation industry



SOURCE: WWW.BDL.AERO



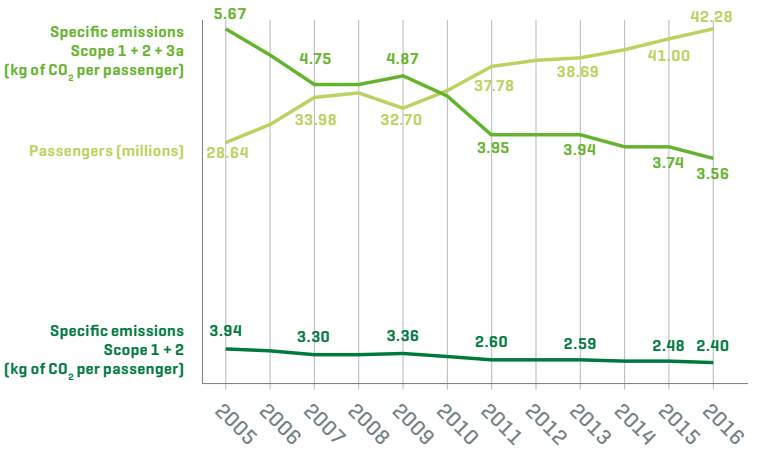
The greenhouse effect
The greenhouse gases emitted by power plants, industry, vehicles, ships and aircraft prevent heat from escaping from the atmosphere and return some of the heat back to Earth. The Earth's temperature rises as a result.

CLIMATE PROTECTION STRATEGY 2030

The start: carbon-neutral growth by 2020

Munich Airport's commitment is reaping success: CO_2 emissions per passenger have fallen by 37 percent since 2005.

Munich Airport: CO_2 emissions and passenger numbers



SOURCE: ANALYSIS BY FLUGHAFEN MÜNCHEN GMBH

Munich Airport adopted a climate strategy in 2009. The focus back then was on achieving the ambitious goal of carbon-neutral growth by 2020. That means specifically: Despite the rising volume of traffic and related expansion measures, CO_2 emissions must not exceed the yardstick from the base year 2005 (162,000 tonnes) in this period of time. The airport has succeeded in that to date: Its carbon footprint in 2016 was only around 150,000 tonnes of CO_2, despite the fact that its gross floor space increased by around seven percent and the number of passengers by some 29 percent between 2009 and 2016. In all probability, the airport's carbon-neutral growth will continue up to 2020 and it will then emit less than 162,000 tonnes of CO_2.

Munich Airport: Share of emissions by scope in 2016 →
The CO_2 emissions attributed to the airport are divided into three different sources (scopes).

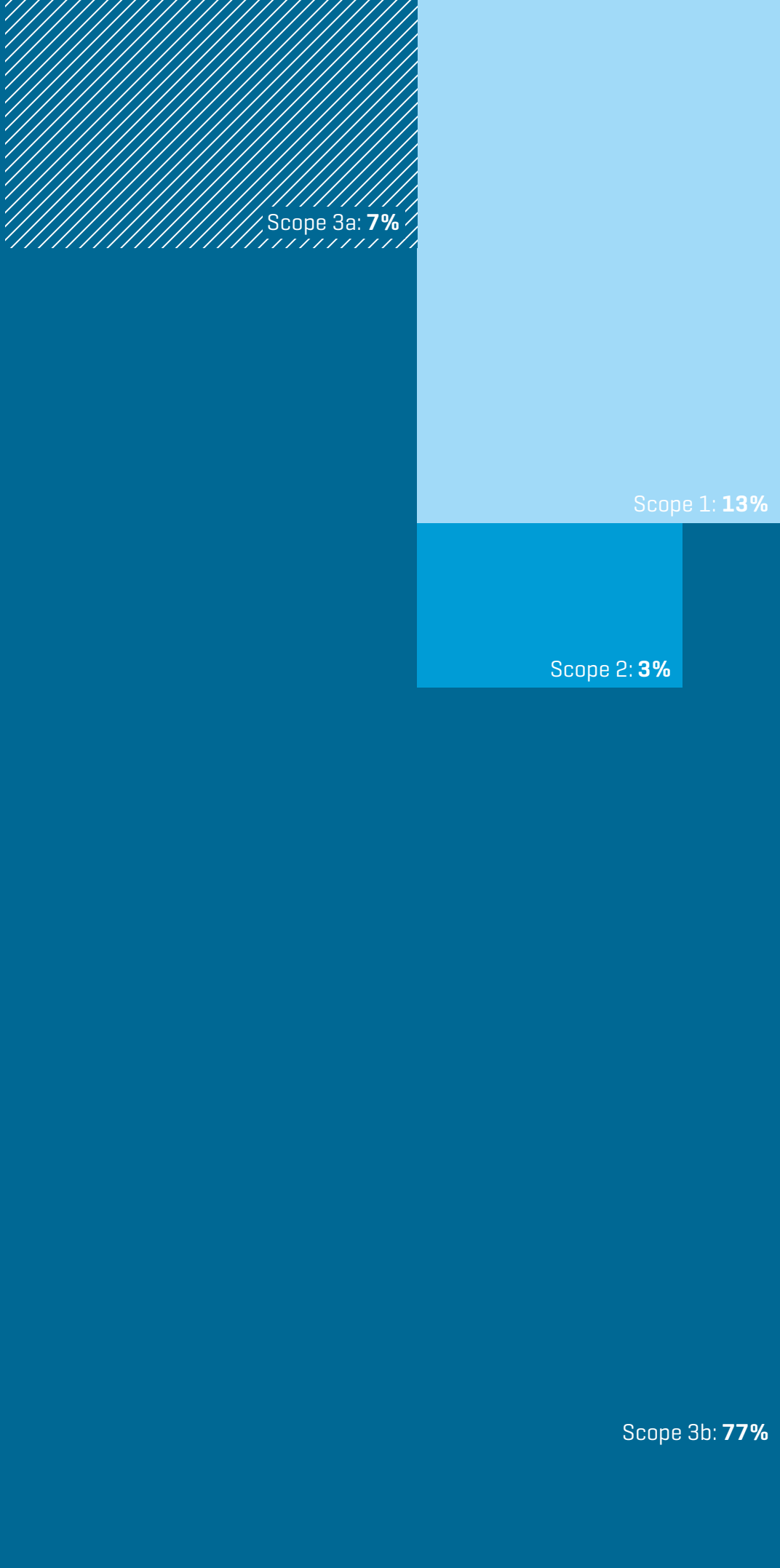
Scope 1
Direct emissions of the airport: energy production for its own needs and transportation – around 85,000 tonnes of CO_2

Scope 2
Indirect emissions of the airport: energy purchased for its own needs – around 17,000 tonnes of CO_2

Scope 3a
Emissions that are not caused by the airport, but can be influenced by it: electricity, heat, cooling, fuel from external companies – around 51,000 tonnes of CO_2

Scope 3b
Emissions that cannot be directly influenced by the airport: aircraft and public transport – around 490,000 tonnes of CO_2

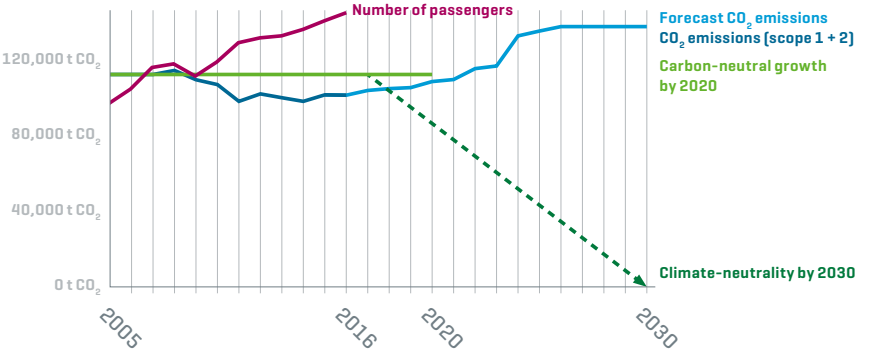
More information can be found on pages 14/15.


Scope 3a: **7%**
Scope 1: **13%**
Scope 2: **3%**
Scope 3b: **77%**

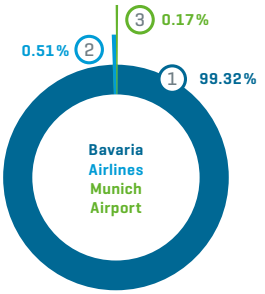
The challenge: CO_2-neutrality by 2030

Munich Airport will be climate-neutral as of 2030.
It intends to invest a total of up to €150 million by then
to achieve that climate protection goal.

The CO_2 target of Flughafen München GmbH (FMG)



SOURCE: OWN CALCULATION



CO_2 emissions by Munich Airport relative to those for Bavaria in 2013

CO_2 emissions for Bavaria excluding Munich Airport **99.32%** (1)

CO_2 emissions by the airlines attributed to the airport (FMG footprint, scope 3b) **0.51%** (2)

CO_2 emissions by Munich Airport (FMG footprint, scope 1 + 2 + 3a) **0.17%** (3)

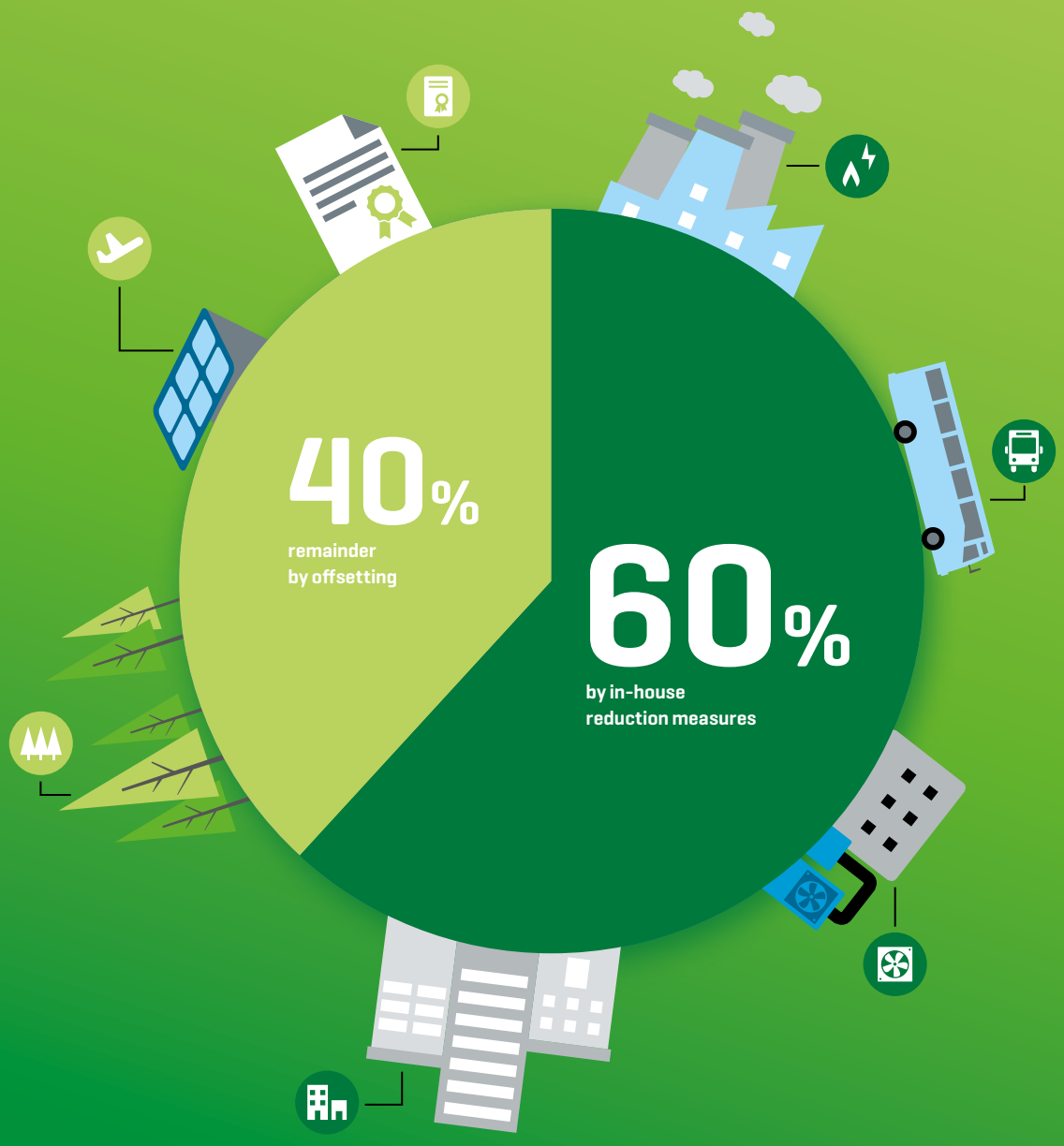
So as to be able to live up to its own mission as a 5-Star-Airport in view of the rapid changes in political climate protection targets, Munich Airport aims to become climate-neutral by 2030. That goal is far more ambitious than the previous objective of carbon-neutral growth.

Reduction first, then local compensation

The climate goal for 2030 is to be achieved primarily by the airport reducing its own CO_2 emissions. Munich Airport is therefore striving first of all to cut its greenhouse gas emissions by around 60 percent by means of technical measures. The remaining CO_2 emissions that cannot be reduced in that way are then to be compensated for, preferably by domestic offsetting. In addition, Munich Airport supports its customers and partners in reducing their own greenhouse gas emissions. One example is the emission-dependent landing charge at Munich Airport, which creates an incentive for airlines to use aircraft with even lower emissions.

First reduce emissions, then compensate for them

Munich Airport is to reduce the forecast for CO_2 emissions for 2030 by 60 percent using technical measures. The unavoidable remainder of around 40 percent is to be compensated for, preferably by regional offsetting measures.



High-quality emission reduction certificates (e.g. in accordance with Gold Standard)

In-house climate projects around the airport

Climate projects in Bavaria and Germany

Energy supply

Vehicle pool | mobility

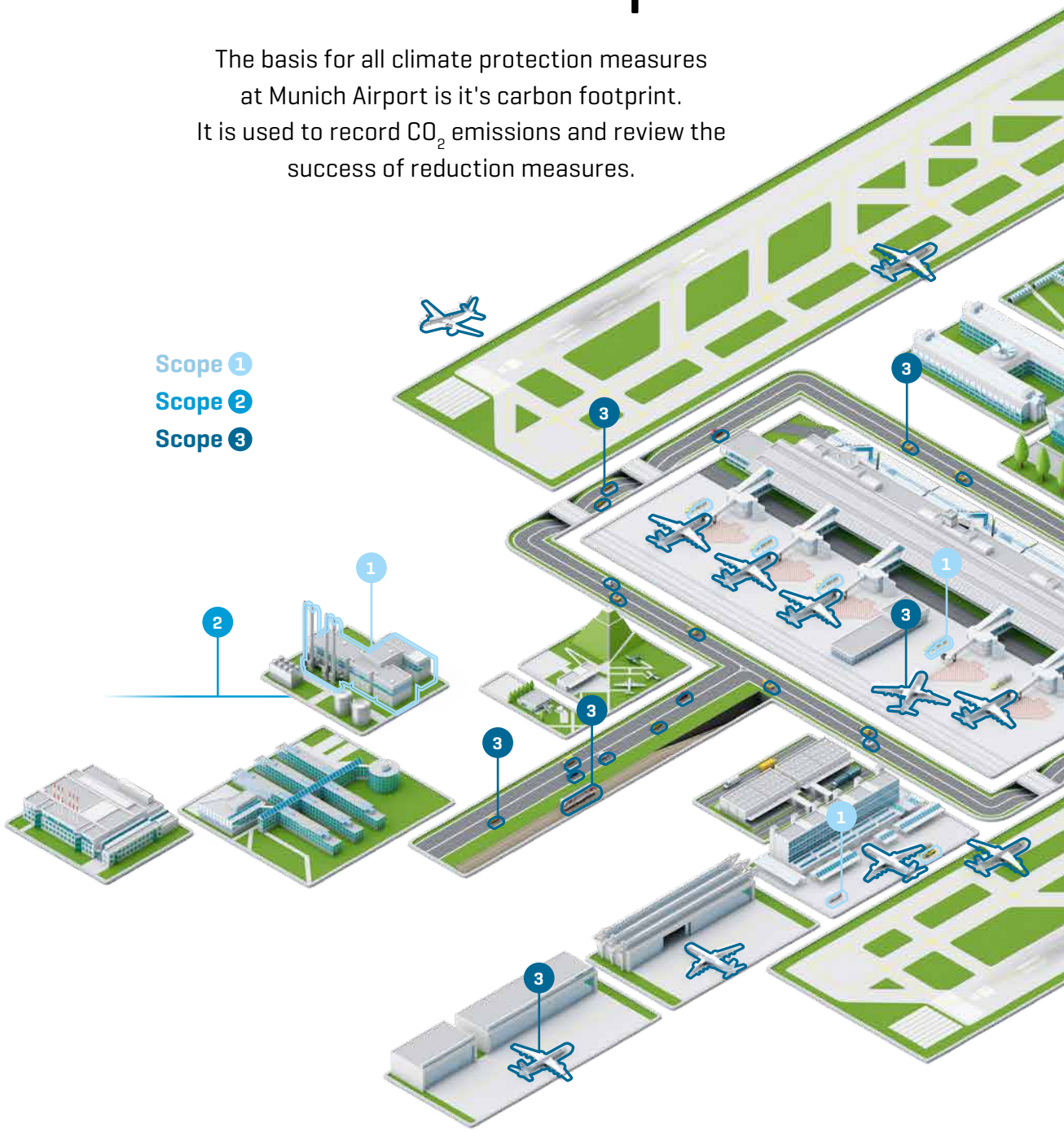
Airport-specific equipment

Building technology

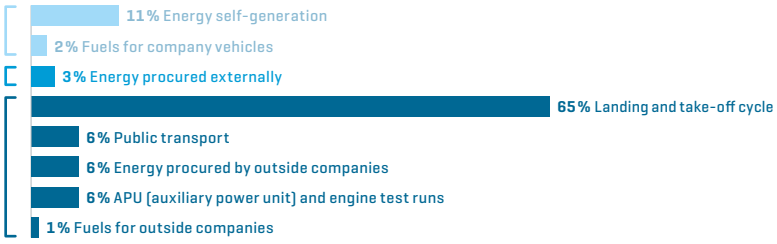
CLIMATE PROTECTION AT THE AIRPORT

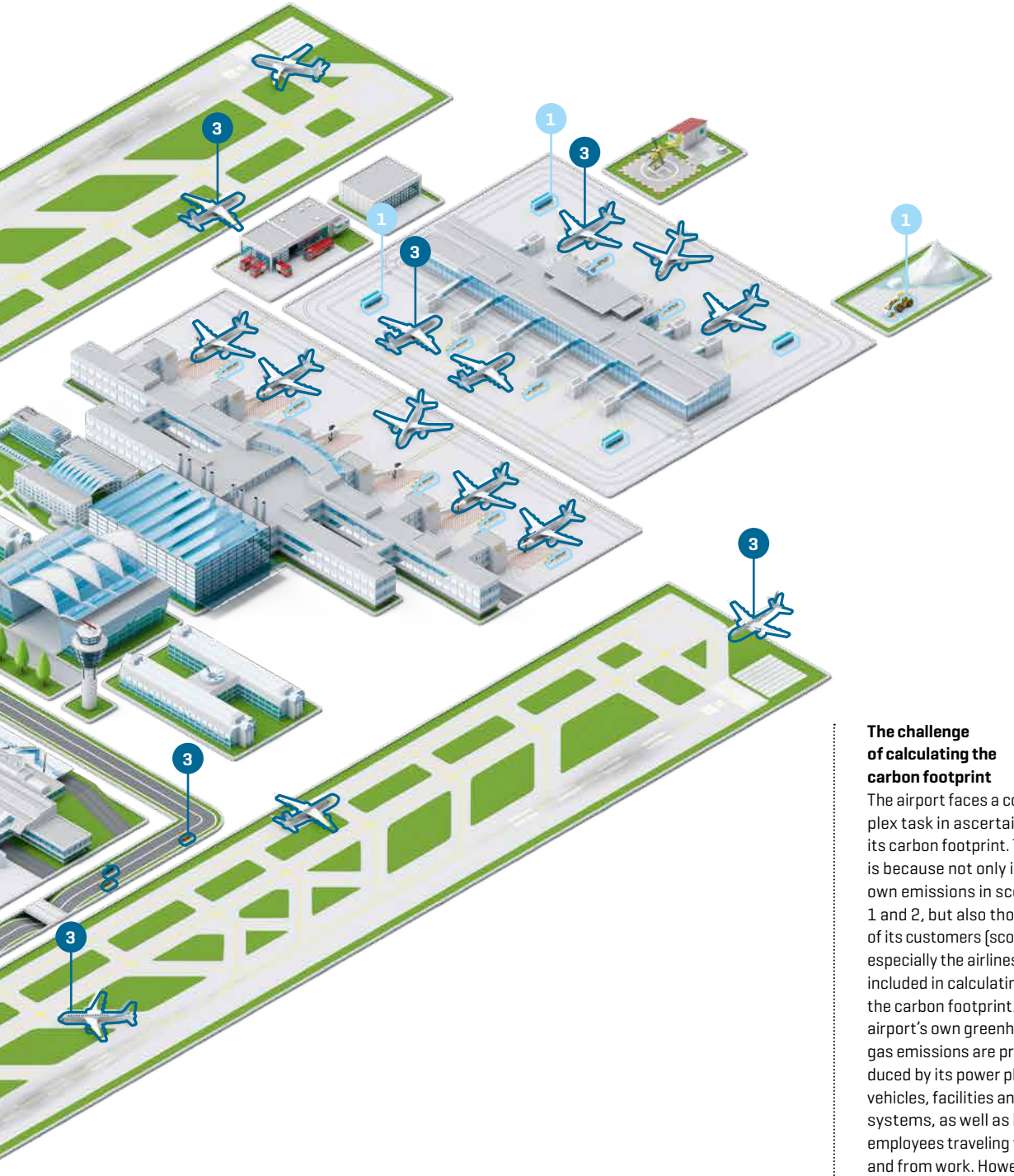
The carbon footprint

The basis for all climate protection measures at Munich Airport is it's carbon footprint. It is used to record CO_2 emissions and review the success of reduction measures.



CO_2 distribution at Munich Airport in 2016





Munich Airport's carbon footprint is calculated in accordance with the regulations of the internationally recognized Greenhouse Gas Protocol. A distinction is made between three sources of emissions (scopes):

- **Scope 1:** direct emissions from the production of energy (electricity, heat, cooling) and from transportation of people and goods
- **Scope 2:** indirect emissions from purchased energy
- **Scope 3:** emissions resulting from the business activity of third parties on the campus (aircraft in the landing and take-off cycle and public transport serving the airport)

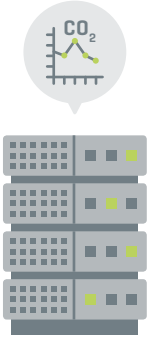
The challenge of calculating the carbon footprint

The airport faces a complex task in ascertaining its carbon footprint. That is because not only its own emissions in scope 1 and 2, but also those of its customers (scope 3), especially the airlines, are included in calculating the carbon footprint. The airport's own greenhouse gas emissions are produced by its power plants, vehicles, facilities and systems, as well as by employees traveling to and from work. However, travel by passengers and visitors to and from the airport, as well as running of the hotels, shops, restaurants, service stations, workshops and other companies, are included in calculating the figure. But the main sources are the airlines' aircraft when they take off, land, taxi and are handled – they are responsible for around two-thirds of the CO_2 emissions at the airport.

The heart: the CO_2 database

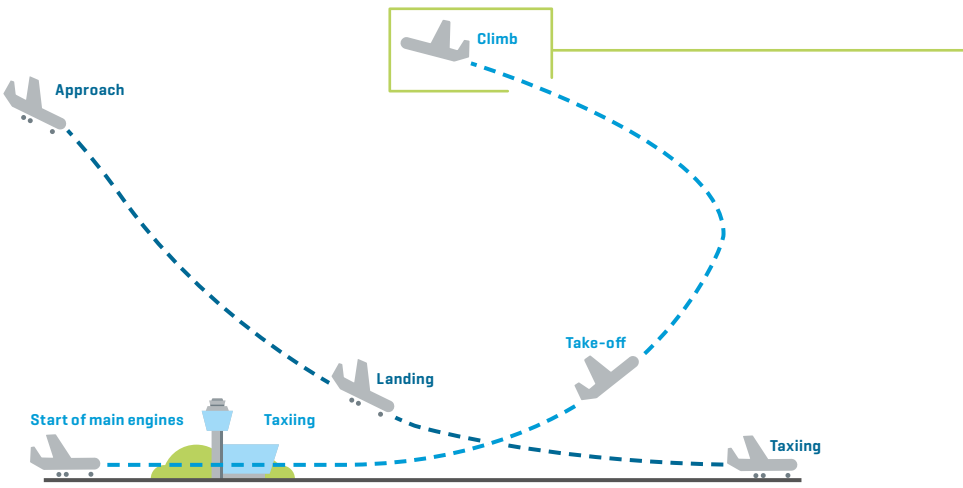
The main engines of aircraft during the LTO cycle account for almost three-quarters of the CO_2 emissions recorded in the database.

Masses of data
Data on all the CO_2 emissions and measures to reduce them is administered in Munich Airport's own CO_2 database. This database documents all activities relating to the issues of the carbon footprint, CO_2 reduction and energy efficiency and enables them to be controlled and monitored.



How are CO_2 emissions by aircraft ascertained so that they can be calculated in the CO_2 database?
An aircraft's emissions have only a very small or even no local impact at all at the airport and in its surrounding area above an atmospheric separating layer at an altitude of around 1,000 meters. Consequently, the quantity of greenhouse gases emitted by aircraft taking off and landing is only calculated up to that height in accordance with the ICAO. The fuel quantities used in the LTO (landing and take-off) cycle, i.e. when aircraft land, taxi, are handled, then taxi and take off again, are determined and the greenhouse gas emissions calculated from that. The data from the flight log, the technical design of each single aircraft and the emission factors are crucial in that. The aircraft's engine type, the distance it covers from gate to runway and the weather conditions, for example, are included in the calculation using the LASPORT program.

LTO cycle in accordance with ICAO 9889



SOURCE: ICAO DOC 9889 AIRPORT QUALITY MANUAL

LASPORT
The criteria cited on this page play a key role in the calculation of the emissions by LASPORT and so have a major impact on the recorded data.

40 PERCENT

↓

Terminal 2 satellite building: lower CO_2 emissions than in the existing terminals

MEASURES

Measures are carried out in many areas in order to achieve CO_2 neutrality. The focus is on the energy supply, climate-friendly building technology, a particularly eco-friendly vehicle pool, outside lighting, and further optimization of the power consumption of all facilities and systems.

CO_2 REDUCTION ON THE GROUND

Munich Airport aims to reduce the CO_2 emissions directly attributable to its operation by 60 percent until 2030 using a broad range of technical measures.

20 — 23

CO_2 REDUCTION IN THE ENERGY SUPPLY

Cogeneration of heat and power or photovoltaic systems ensure energy efficiency. Munich Airport itself produces most of the electricity and heat it needs from its combined heat and power plant, for example.

24 — 29

CO_2 REDUCTION IN THE AIR

The airport is hardly able to influence the emissions of aircraft that take off and land. However, it works with air traffic control and the airlines to support optimization measures during their approach or on the apron.

30 — 35

CO$_2$ REDUCTION ON THE GROUND

Economical drive systems in the vehicle fleet

As part of its climate protection program, Munich Airport uses alternative fuels from renewable energies in its vehicle pool.

LOW-EMISSION APRON BUSES

32

HYBRID TOW TRACTORS

84

ELECTRICAL HANDLING EQUIPMENT

162

E-CARS

11

NATURAL GAS VEHICLES

31

E-mobility

Munich Airport is expanding the share of e-vehicles in its fleet massively. 121 cars that run on gasoline or diesel are to be replaced by e-vehicles within three years. More than 280 vehicles and items of handling equipment at the airport are already powered by electricity. However, e-cars are not just an issue the airport is addressing in its own fleet: Passengers and visitors can recharge their e-cars at currently 85 public stations in the parking garages and 200 further charging stations are to be added in the next three years. The electricity used for that comes from the efficient block heat and power plant.

Alternative drive concepts

Munich Airport has used alternative fuels from renewable energies («biofuel») since 2007. 22 vehicles that run on bioethanol and 31 natural-gas driven ones are currently helping to improve its climate footprint.

Low-emission drives
32 apron buses with particularly low noise and pollutant emissions carry passengers and crews between the terminals and aircraft stands. Half of the bus fleet has been awarded Germany's environmental label, the «Blue Angel», and meets the EEV (Enhanced Environmentally friendly Vehicle) exhaust emission standard. Compared to conventional vehicles, these buses only emit a fraction of the air pollutants, such as soot particles, carbon monoxide and nitrogen oxide. They are also very quiet, since their noise level must not exceed a limit of 77 dB(A). There are also strict environmental regulations on the buses' paintwork: It must be free of lead, chromium and cadmium, for example.

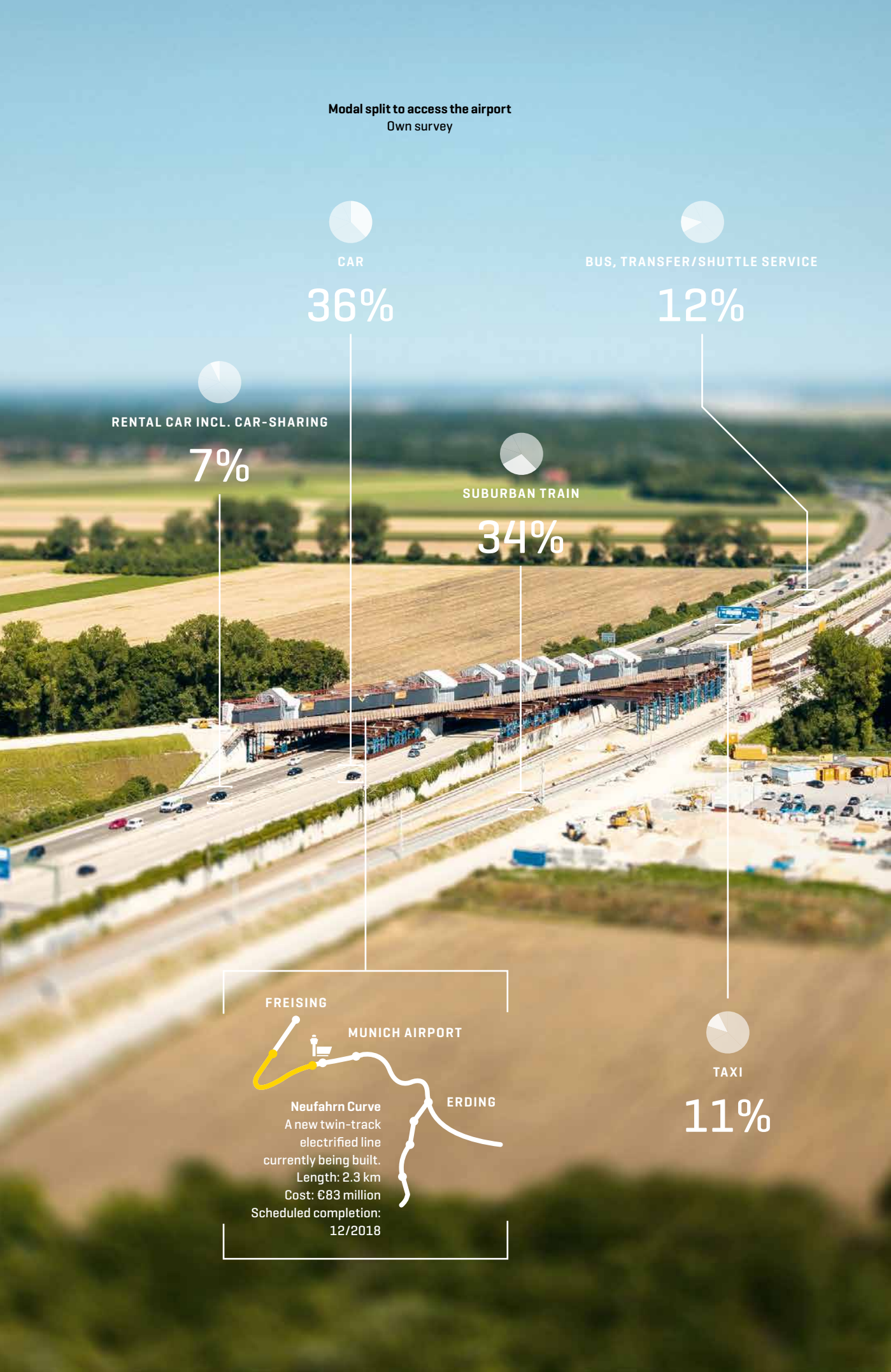
Interview with Günther Schmitz
Head of Vehicle Management at Munich Airport

Mr. Schmitz, why is the airport investing millions in expanding e-mobility?
The way many pool and workshop vehicles are used on the campus means that combustion engines are poorly suited. Frequent short trips and engines that don't get the chance to warm up result in extra consumption and higher emissions. In addition, there's the problem of battery weakness due to frequent starting and inadequate charging during short journeys, especially in the cold season. Electric vehicles don't have those disadvantages. And, of course, e-mobility fits perfectly with our future plans to cut emissions and become a climate-neutral airport in 2030.

How cost-effective is e-mobility?
Compared with vehicles with combustion engines, electric ones are far more expensive to purchase. However, their maintenance and running costs are a plus point. Moreover, the charging infrastructure has to be established for the «first wave» of e-vehicles, which requires additional investment. However, the pace of technical advancement in components, such as batteries and engines, is rapid and so the price of e-cars will continue to fall.

What proportion of the airport's fleet do you believe will be e-vehicles in the medium to long term?
We're currently pressing ahead with expanding the charging infrastructure for our fleet and at the car parks for passengers, visitors and employees. Electric vehicles will account for a large part of our fleet by 2030. We're not yet able to estimate the extent to which hydrogen in conjunction with fuel cells would then also be used to power e-vehicles. Only vehicles used for longer trips and heavy handling equipment will still be fitted with combustion engines. I can also imagine us having more vehicles that run on biogas.

Modal split to access the airport
Own survey



Neufahrn Curve
A new twin-track electrified line currently being built.
Length: 2.3 km
Cost: €83 million
Scheduled completion: 12/2018

CO$_2$ REDUCTION ON THE GROUND

Mobility: as networked and sustainable as possible

As befits its tradition, the airport is committed to increasing e-mobility in its own fleet. However, it also supports better transport links via road and rail.

← **Better rail connections from 2019 on**
The first sod was turned for the Neufahrn Curve on October 27, 2014. This 2.3-kilometer construction project will link the rail network from Eastern Bavaria directly to Munich Airport with a twin-track electrified line. Travelers from and to Regensburg, Landshut, Moosburg and Freising will then reach the airport directly and quickly with an hourly service without having to switch to the bus. The link is to start operating when the new timetable comes into effect in December 2018. The Neufahrn Curve is the first stage in construction of the Erding Ring Closure. Subsequently, the route is to be continued from the airport to Erding and from there via Walpertskirchener Spange in the direction of Mühldorf and Salzburg. The total cost will be €83 million, of which the German government will assume €41 million and the Free State of Bavaria around €42 million.

4,600,000

PASSENGERS USED SUBURBAN TRAIN FOR TRAVELING TO THE AIRPORT IN 2016

Road and rail connections
As the number of passengers and employees increases, the issue of getting to and from the airport plays an ever-growing role in relation to CO$_2$ emissions from transport. The objective here is to combine the particular strengths of the different means of travel with each other to the benefit of the system as a whole. Consequently, Munich Airport's main focus is on networking road, suburban rail and long-distance rail transport attractively. Alternative means of travel, such as car-sharing, are also to be addressed to a greater extent in future so that passengers and employees can reach the airport by road faster and with more energy efficiency. At the same time, Munich Airport is strongly committed to improving rail connections.

Creating incentives for employees
To make using public transport more attractive, Munich Airport grants all group employees an allowance of ten percent toward the cost of the «IsarCard» pass from the local transport company Münchner Verkehrs- und Tarifverbund.

CO$_2$ REDUCTION IN THE ENERGY SUPPLY

Highly efficient cogeneration of heat and power

1 × a city

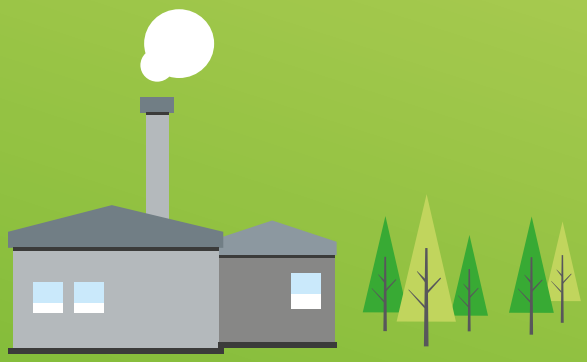
THE CO$_2$ REDUCTION THANKS TO THE AIRPORT'S OWN CHP PLANT IS AS HIGH AS THE CO$_2$ EMISSIONS OF A MEDIUM-SIZED CITY

Photovoltaic system
The photovoltaic system on the roof of Terminal 2 was the largest ever erected at an airport when it was built in 2003. Since then, the system feeds around 445,000 kilowatt-hours a year into the public grid – enough to supply around 155 households with electricity for a whole year. CO$_2$ emissions will be reduced by a total of around 8,000 tonnes over the plant's anticipated service life of 30 years.

Solar cooling
A solar sorption supported air-conditioning system has been responsible for cooling and dehumidifying the freight canteen since 2009. It reliably helps reduce CO$_2$ emissions by up to 25 tonnes a year compared to a conventional air-conditioning system.

FMG has a block heat and power (CHP) plant. This cogeneration of electricity and heat means that the base load of electrical and thermal energy can be provided to FMG and its subsidiaries in an efficient and eco-friendly way. Munich Airport produces around 75 percent of the heat and 60 percent of the electricity it needs with the CHP plant. A good part of the remaining heat the airport requires is supplied as district heating from a biomass-fired thermal power plant. As a result, Munich Airport reduces its CO$_2$ emissions additionally by almost 3,500 tonnes every year. The CHP plant was expanded in 2015 to supply Terminal 2 and its satellite building with electricity and cooling. Its total output is thus 24 megawatts – theoretically enough to supply a city of 40,000 inhabitants with electricity.

The efficient power plant cuts CO$_2$ emissions by 46,000 tonnes
Thanks to its completely refurbished CHP plant, the airport cuts its CO$_2$ emissions by around 46,000 tonnes a year compared to conventional power plants – 25 percent more than previously. The airport has invested around €60 million in the new plant on its campus. The CHP plant now produces a total of some 150 million kilowatt-hours of electricity a year. Six large combustion engines powered by natural gas each drive a power generator round the clock. The resultant waste heat is used for heating in the cool season and also for cooling in the summer after it has been converted in an absorption chiller.



3,500 t

in CO_2 emissions: the annual reduction at the airport thanks to district heating from a biomass-fired thermal power plant

445,000 kWh

are fed into the public grid every year by the photovoltaic system installed at Terminal 2

40%

less CO_2 thanks to sustainable building

46,000 t

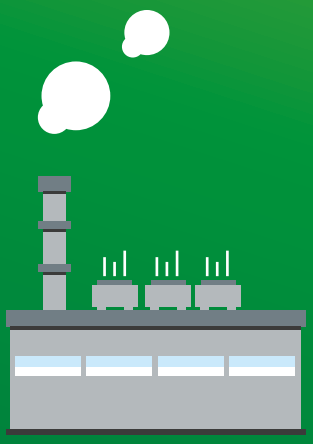
fewer CO_2 emissions due to the CHP plant

60%

of the airport's electricity needs are covered by its CHP plant

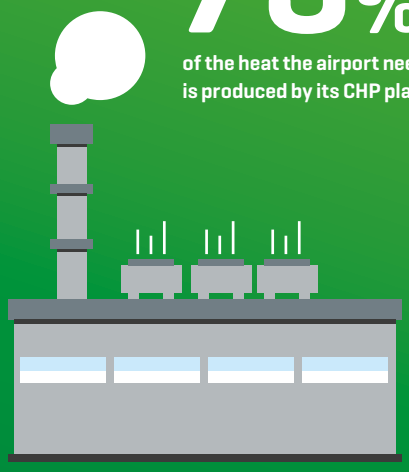
75%

of the heat the airport needs is produced by its CHP plant



24 MW

= the CHP plant's output



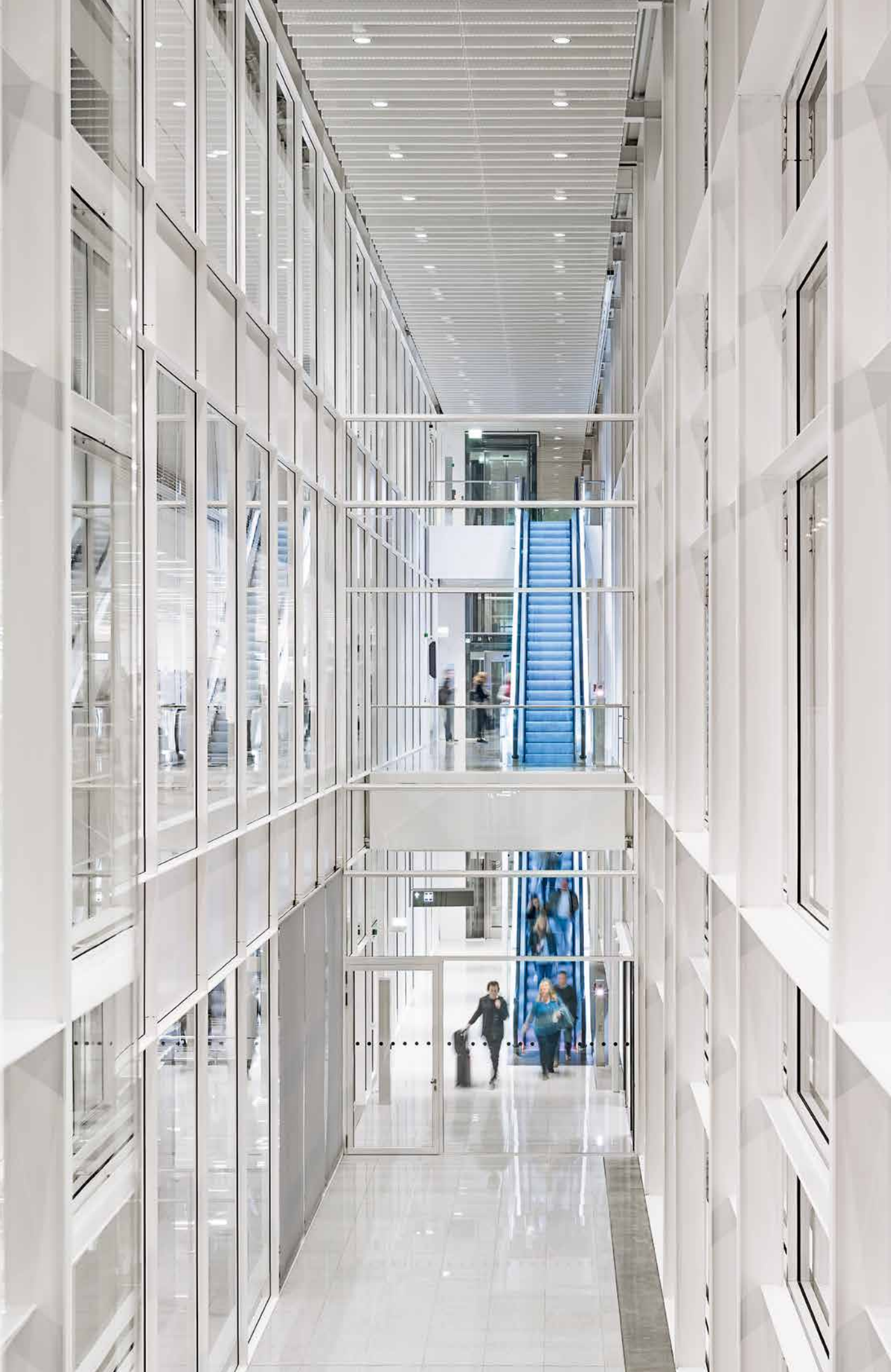
Energy-saving LED technology

Light-emitting diodes (LEDs) impress with a long service life, better luminosity and natural light, as well as minimum power consumption and maximum energy efficiency.

Lighting on the **west apron** (foreground) and the **east apron** (background). As can be seen clearly on this photo dating from 2014, no LED lights were yet installed on the east apron.

By comparison: white LED light at the front, yellow sodium-vapor lamps at the rear.

Munich was the world's first major commercial airport to use energy-saving LED technology to light its aprons. Switching to it has cut CO_2 emissions on the aprons and roads by more than 1,000 tonnes a year and by around 3,600 tonnes a year in the buildings since 2014. Converting the remaining apron and out-side lighting will achieve an additional reduction of some 4,000 tonnes of CO_2 per annum.



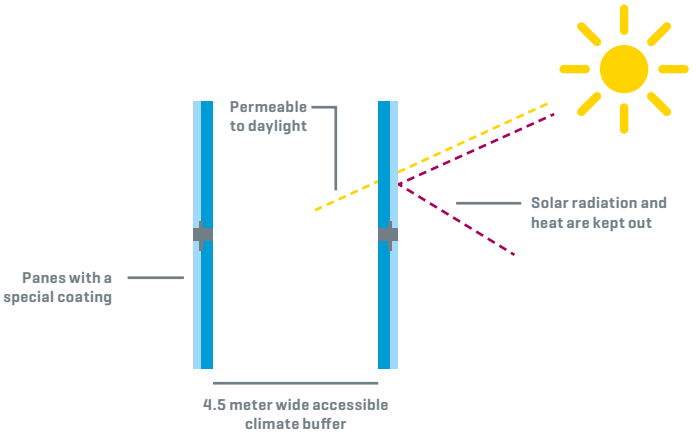
Innovative technologies

Flughafen München GmbH attaches great importance to the issue of sustainable building. That is why it is a member of the German Sustainable Building Council (DGNB).

The airport aims to cut CO_2 emissions at all new buildings by 40 percent compared to the level for existing ones. The same also goes for outside investors on the campus. FMG has already reduced CO_2 emissions by almost 19 percent between 2005 and 2016 by optimizing its existing building technology.

Climate facade at the satellite

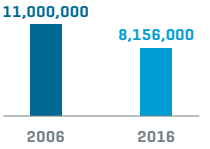
The satellite building at Terminal 2 sets new standards in ecology and energy efficiency: Thanks to cutting-edge construction materials and innovative technology, CO_2 emissions from the satellite are 40 percent lower than those from Terminals 1 and 2 combined. One aspect that ensures high efficiency is the climate facade: A 4.5 meter wide accessible climate buffer separating the building's air-conditioned interior from the outer facade has been erected on the longitudinal sides of the building, which is bathed in light and boasts impressive glass facades. It contains the escalators that convey passengers between the three levels. The layer of air provides better insulation of the building, similarly to the principle of a thermos bottle. The facade itself consists of a newly developed glass: It lets in daylight, but its special coating means excessive heating from solar radiation is prevented.



«Green» office

A number of data centers, more than 2,500 workstation computers with screens, several hundred servers, notebooks and printers – the airport faces challenges when it comes to saving energy. The increase in power consumption has been limited to three times the level since 2003 solely by constantly switching to the latest generation of storage systems at the data centers – despite the exponential 70-fold growth in storage capacities. Sustainability is also ensured not only concerning the equipment, but also paper. Recycled paper has now completely replaced the previously used fresh fiber paper, for example. That not only saves resources, but also reduces CO_2 emissions by around 8,700 tonnes a year. In addition, FMG has adjusted the default settings for its printers so that every sheet of paper is automatically printed on both sides.

Paper consumption



SOURCE: OWN CALCULATION

CO$_2$ REDUCTION IN THE AIR

Climate protection: a shared duty

Back in 2009, the airlines, aircraft manufacturers and airports worldwide agreed on concrete climate protection goals: CO_2 emissions in aviation are to be cut by 50 percent by 2050 compared to the 2005 level.

Environmentally-friendly approach
Munich Airport has supported a method called Continuous Descent Operations (CDO) since 2009. Pilots aim to achieve as even and energy-saving a descent as possible, leaving the engines in idle power for as long as they can so as to reduce fuel consumption and in the end CO_2 emissions. A continuous descent saves 50 to 150 kilograms of kerosene per approach (corresponding to a CO_2 reduction of between 160 and 470 kilograms), depending on the type of aircraft, route and weather.

Kerosene consumption during descent

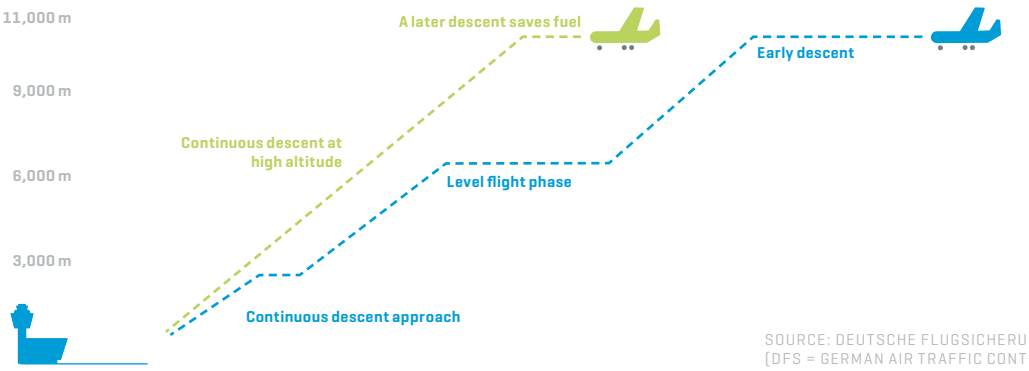
In 2016, German airlines consumed just 3.64 liters of kerosene per passenger and 100 kilometers. That record figure was calculated by experts for the annual Climate Protection Report of the German Aviation Association (BDL). That success is attributable to efficiency enhancement measures, in particular by German airlines, but also by airports and Deutsche Flugsicherung GmbH (German air traffic control). Despite high growth rates, aviation's share of global CO_2 emissions is falling continuously: from 2.81 percent in 2000 to 2.55 percent in 2014.

Climate alliances reduce CO_2

Safety has top priority in airside traffic. That not only comprises keeping aircraft in working order at all times, but also secure routing in airspace. Despite the high volume of traffic in German airspace, Deutsche Flugsicherung GmbH succeeded in 2015 in reducing CO_2 emissions by around 65,000 tonnes by avoiding detours and stacking[1]. Those savings would not have been possible without airports' involvement and support.

[1] BDL: 2016 CLIMATE PROTECTION REPORT

Optimized descent



SOURCE: DEUTSCHE FLUGSICHERUNG GMBH (DFS = GERMAN AIR TRAFFIC CONTROL)

Landing charges based on emissions

Other greenhouse gases apart from CO_2 are to be reduced as well. Since January 1, 2008, part of the landing charge at Munich Airport has consequently been calculated on the basis of the quantity of emitted nitrogen oxide (NOx). That means airlines whose aircraft emit less nitrogen oxide pay less. At the same time, they have a long-term incentive to invest in developing cleaner aircraft. The pollutant emissions from modern jet engines per kilogram of kerosene are composed as follows (the figures are rounded):

CARBON DIOXIDE	WATER VAPOR	NITROGEN OXIDES
3.15 kg	1.24 kg	6–20 g

SULFUR DIOXIDE	HYDROCARBONS	SOOT
1 g	0.1–0.7 g	0.01–0.03 g

SOURCE: GERMAN AVIATION ASSOCIATION (BDL)

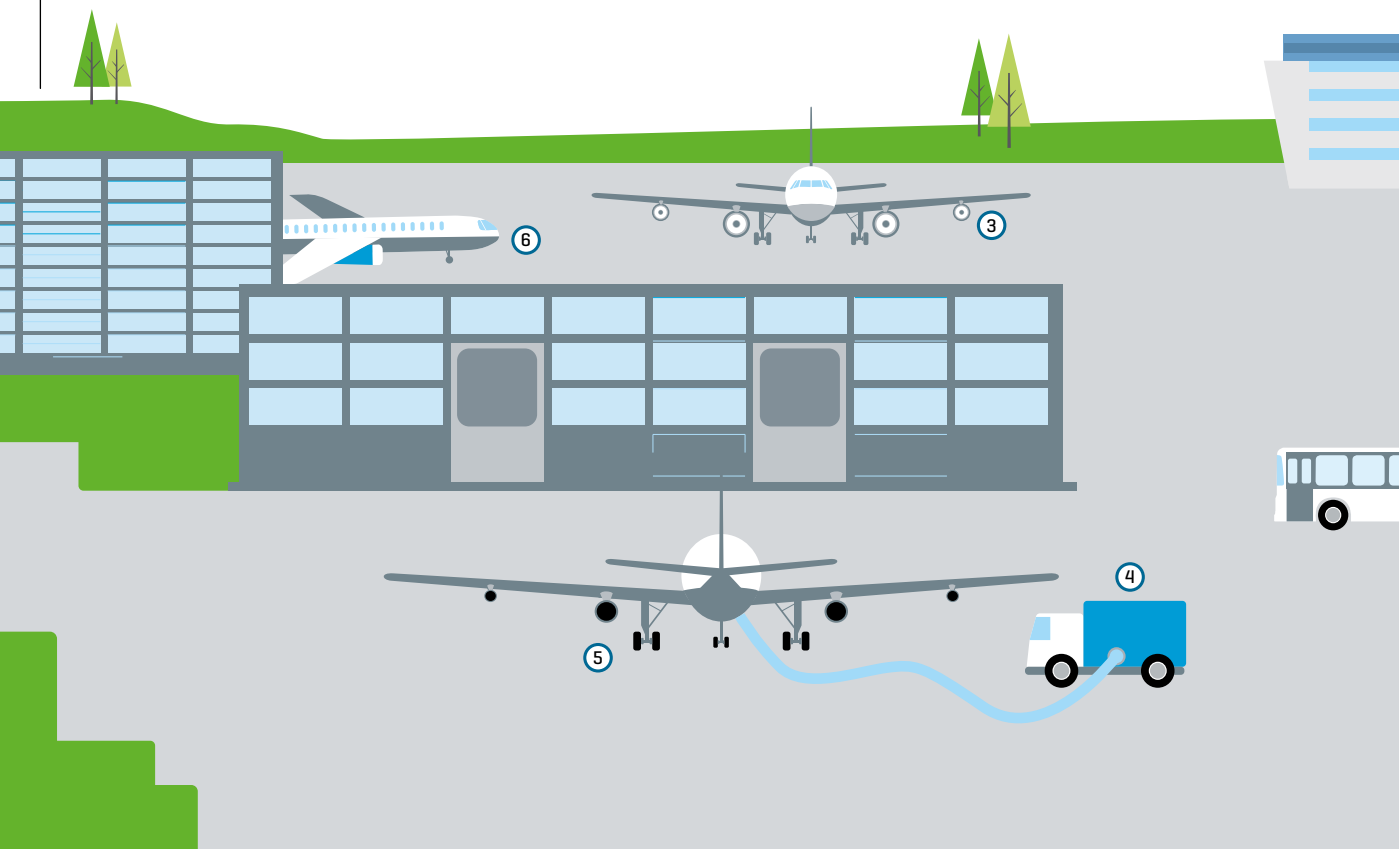
CO$_2$ REDUCTION IN THE AIR

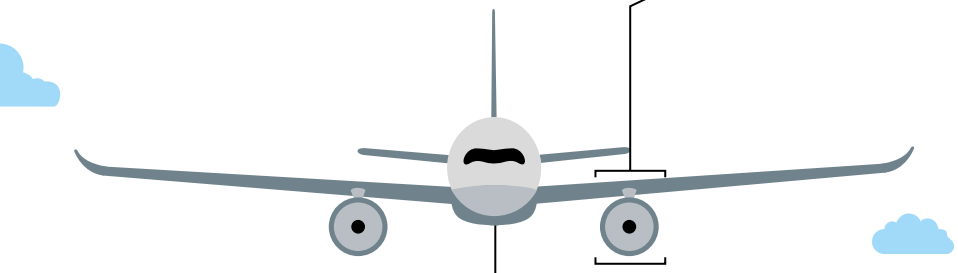
Airport Collaborative Decision Making

The airport operator, airlines and air traffic control pull together in ACDM to ensure that all operations as part of a flight are coordinated efficiently.

Aircraft also burn kerosene when they taxi from and to the runway. The CO_2 emitted in that is included in scope 3 of the airport's carbon footprint. FMG's traffic control unit has therefore developed a refined taxiway guidance system to ensure that the times aircraft taxi on the apron are minimized. Airport Collaborative Decision Making (ACDM) was introduced in 2010, with the aim of enabling the airport operator, airlines and air traffic control to coordinate all operations as part of a flight efficiently. They include (1) flight planning, (2) take-off and landing, (3) taxiing operations and (4) ground handling. A networked system infrastructure makes sure that the required data is available in full and simultaneously to all parties. As a result, the current situation can be ascertained down to the precise minute and (5) unnecessary engine running times and (6) tailbacks at the runways can be avoided.

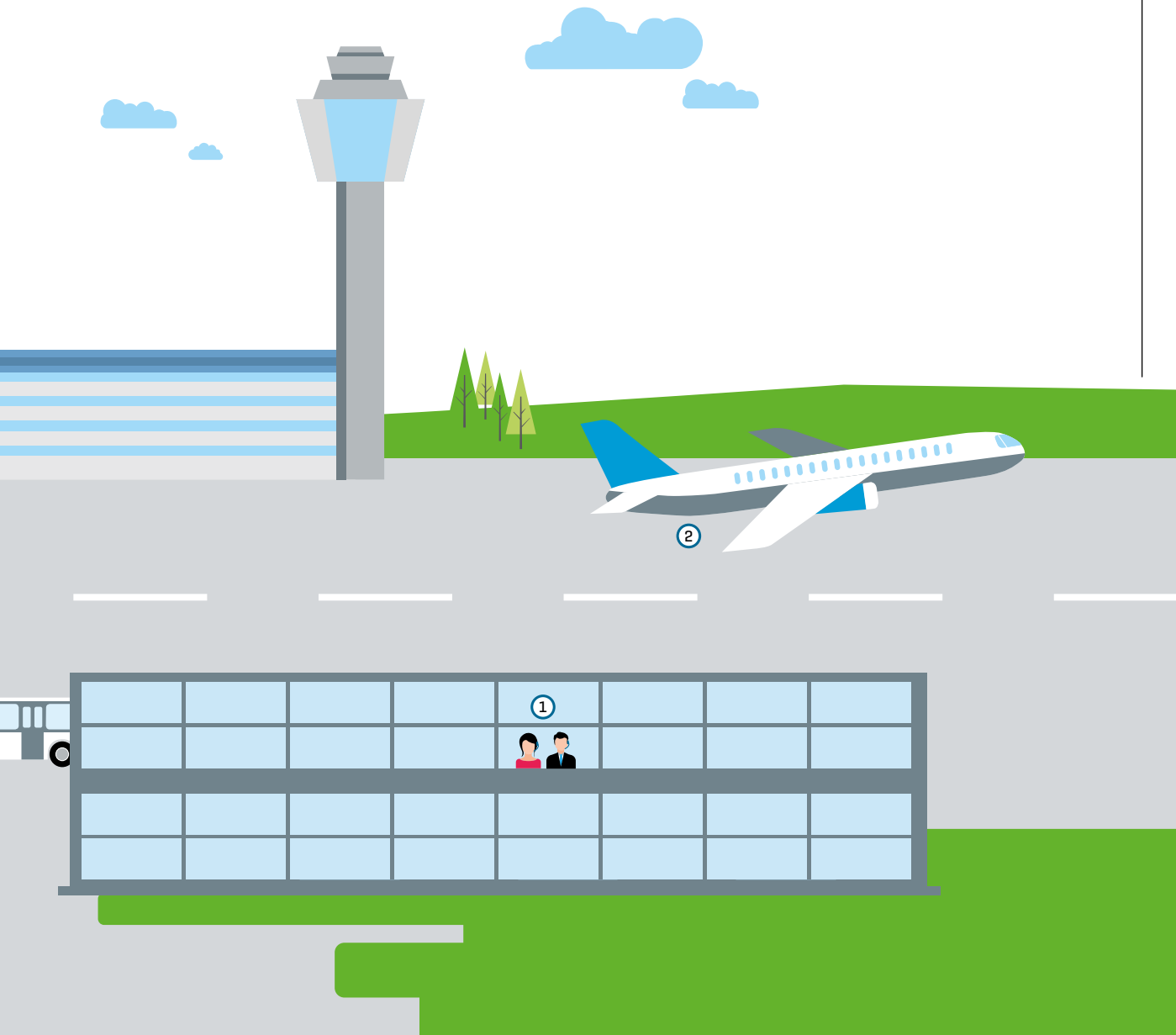
New technologies
Additional fuel savings can be achieved by using carbon fiber composites that are as light as possible. For example, an Airbus A350 with two Trent XBW engines consumes far less kerosene than its predecessor, the A340, with its four Trent 556-61 engines. The savings are not only because two engines are installed instead of four, but also due to the lighter construction materials and more state-of-the-art engine technology.





Low consumption
The A350s newly stationed at Munich Airport mark the introduction of the new two-liter class (2.9 liters of kerosene consumption per passenger and 100 kilometers).

State-of-the-art aircraft approaching
Steady advances are being made in engine technology. German airlines have reduced the specific consumption of their aircraft by 1.7 percent a year since 2009, for example. Overall, kerosene consumption per passenger and 100 kilometers has fallen by 42 percent since 1990 – average consumption is now just 3.6 liters. A further leap forward in drive technology is currently underway with rollout of Geared TurboFan (GTF) engines. In GTF engines, the rotational speeds of the turbine and rotors are decoupled, meaning they can both run in an optimum range. This new generation of engines is now being installed in the A320neo models currently being shipped. As a result, the fuel consumption and CO_2 emissions of a cutting-edge Airbus A320neo with a GTF engine are 15 percent lower than those of its older brother with previous engines.



CO$_2$ REDUCTION IN THE AIR

Commitment to research and development

The airport is committed to reducing CO_2 emissions in the air through its own ideas and specialist know-how.

CO$_2$ REDUCTIONS PER ANNUM WITH PCA

23,500 t

Pre-conditioned air

Pre-conditioned air (PCA) systems are currently being installed at all pier-side aircraft stands at Terminal 1, Terminal 2 and the T2 satellite building so that aircraft do not have to switch on their auxiliary power units. This innovative technology not only supplies parked aircraft with electricity, but also pre-conditioned air. In the final expansion stage, PCAs will reduce Munich Airport's CO_2 emissions by around 20,000 tonnes a year.

Biokerosene in the tank

Munich Airport is a founding member of aireg (Aviation Initiative for Renewable Energy in Germany e. V.) and so is also the only German airport operator in this initiative of the German aviation industry. It is made up of airlines, research institutes, the aircraft industry and other partners who aim to drive the development of biofuels in aviation. The goal of aireg is to increase the share of biofuels relative to kerosene used in Germany to ten percent by 2025. As a result, CO_2 emissions by civil aviation are to be reduced further, despite rising passenger numbers.

How PCA technology works
The air is treated in a compressor system directly at the aircraft stand and then fed into the interior of the aircraft via an insulated hose. The airport has developed a special device – called the Y-distributor – for wide-body aircraft. It supplies the conditioned air from the hose into the cabin via two connections on the aircraft. Control of the PCA system is fully automated. Thanks to an interface to the flight timetable data, the system can tell exactly which aircraft is currently on-block and supply the right volume.

Interview with Maximilian Hartwig
PCA system Project Manager at Munich Airport

Mr. Hartwig, what advantages does PCA technology offer compared to the use of auxiliary power units?
Our PCA systems enable airlines to dispense completely with auxiliary power units (APUs) during ground handling. APUs have a relatively poor efficiency and constantly run at full load – they're uneconomical, loud and produce exhaust gases. If the APUs are left off, they also don't use any kerosene. The noise pollution for employees of the ground handling service and for the direct environment of the airport is also reduced. The most important advantage for our carbon footprint, however, is the sharp reduction in CO_2 and nitrogen oxide emissions.

How high were the investments in the new technology?
You can assume total costs of around €500,000 per aircraft stand, giving a total investment volume of some €32 million. So that's a considerable amount of money FMG and Terminal 2 Gesellschaft are spending on this environmental and climate protection measure.

What are the special features of the PCA technology at Munich Airport?
Our systems are state-of-the-art. That means we're one of the world's few airports to actually be able to supply all types of aircraft, from a small regional jet to the A380.

150,000 TONNES

↓

Despite the airport's growth, CO_2 emissions have been reduced from 162,000 tonnes in the base year 2005 to a current level of around 150,000 tonnes

SUCCESSES

«As Europe's first 5-Star-Airport, we also have particularly high standards when it comes to climate protection. With our far-reaching climate objectives, we aim to do our bit to advance the airport's operation and development in a way that preserves opportunities and possibilities for future generations. We're pointing the way to sustainable, resource-saving aviation with our objective of making our airport CO_2-neutral.»

Dr. Michael Kerkloh
President and CEO,
Personnel Industrial Relations
Director

EXCELLENCE IN CLIMATE PROTECTION

Munich Airport aims to be a pioneer in protecting the environment. It has already won several international awards for its achievements in the field of climate protection.

38 — 39

TRANSPARENT COMMUNICATION

Not only to actively do something for climate protection, but also to report openly on the environmental situation at the location – that is the maxim of Germany's second-largest airport.

40 — 41

EXCELLENCE IN CLIMATE PROTECTION

Pioneer in protecting the climate

Munich Airport has won several awards for its achievements in protecting the climate.

Airport Carbon Accreditation
Munich Airport has been certified in accordance with the Airport Carbon Accreditation (ACA) program. This award is presented by the ACI (Airports Council International) to airports that reduce emissions effectively and sustainably and involve other partners at the location in these efforts. In 2010, Munich became the first German airport to achieve «Level 3: Optimization» out of four possible levels of certification. In 2016, Munich Airport's successful commitment in reducing CO_2 emissions was officially acknowledged again with the ACA seal of approval.

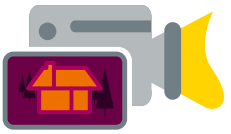
Environmental management
FMG meets the stringent environmental standards of the European EMAS Regulation and DIN EN ISO 14001. Its subsidiaries Allresto, aerogate and Cargogate are also certified in accordance with EMAS and DIN EN ISO 14001 and AeroGround expects to follow in 2017. An independent environmental auditor regularly examines whether FMG and the mentioned subsidiaries comply with the required environmental aspects. EMAS certification goes beyond the requirements of DIN EN ISO 50001 and means an energy audit as specified by the German Act on Energy Services and Other Energy Efficiency Measures (EDL-G) can be dispensed with. The indicators of the EMAS Regulation illustrate the contribution made by EMAS participants to international efforts to protect the climate (Kyoto Protocol).

Carbon Disclosure Project (CDP)
In 2013, FMG joined the CDP SME Initiative, the world's largest association of investors and companies in the battle against climate change. In its very first year as a member, FMG achieved the best result of all non-listed companies in German-speaking countries (Germany, Austria and Switzerland). The transparent presentation of the climate strategy, the climate data, and the quality and effectiveness of the measures to reduce greenhouse gases were assessed in that. In the 2016 Climate Change Report, Munich Airport was awarded the rating «B» and so the status of «Sector Leader Transportation». That means Flughafen München GmbH is one of the best companies in the transportation sector in Germany, Austria and Switzerland.

TRANSPARENT COMMUNICATION

Information over many channels

Munich Airport regards creating awareness for the interconnections relating to and opportunities for climate protection to be a key part of its climate protection strategy.



Creating climate awareness among employees
Munich Airport provides employees with a thermal imaging camera free of charge so that they can carry out thermographic examinations of their apartment or house as an initial guide. The images indicate where there are thermal bridges, which can then be eliminated or investigated in more detail by energy consultants.

Munich Airport constantly provides information on current climate protection measures on its websites. Further information on environmental protection at the airport is provided by regular measurement reports on air quality, press releases, climate protection and environmental tours, flyers and brochures on environmental and climate protection activities, and the airport's annual Environmental Statement, which summarizes all the measures taken.

EXPERTISE IN ENVIRONMENTAL PROTECTION

Reducing environmental impacts and at the same time monitoring environmental requirements: Various teams combining great expertise pursue the goal of minimizing the airport's effects on the ecology and surrounding countryside.

AIRCRAFT NOISE AND ITS ABATEMENT

Noise abatement plays a key role at the company. The prime objective is to reduce noise pollution from daily operations to an unavoidable minimum. The airport has already succeeded in ensuring that noise has not grown in line with the increase in air traffic by means of numerous measures.

ENVIRONMENTAL STATEMENT

Every year the airport publishes an overview of its environmental activities. The objectives and tasks are to promote and systematically improve ecological awareness and environmental management throughout the Munich Airport Group.

INTEGRATED REPORT

In its integrated report, Munich Airport provides information on financial and sustainability issues in one publication.

BIRD LIFE AND FLIGHT OPERATIONS

One special feature of Munich Airport regarding nature conservation is that it is located in the European bird sanctuary «Northern Erdinger Moos». FMG actively tackles the challenge of reconciling flight operations and bird protection.

Download publications
www.munich-airport.com/publications

GLOSSARY / IMPRINT

aireg — **Aviation Initiative for Renewable Energy in Germany e. V.**
An initiative of the German aviation industry that is committed in particular to promoting the development and introduction of biofuels in air transport

ACA — **Airport Carbon Accreditation**
An award presented by the ACI to airports that reduce emissions effectively and sustainably and engage other partners at the location in these efforts

ACDM — **Airport Collaborative Decision Making**
Flight planning, take-off and landing, taxiing operations and ground handling are coordinated as efficiently as possible

ACI — **Airports Council International**

CDP — **Carbon Disclosure Project**
The world's largest association of investors and companies in the battle against climate change

CORSIA — **Carbon Offsetting and Reduction Scheme for International Aviation**
A global climate agreement of the ICAO for international aviation

CDO — **Continuous Descent Operations**
A particularly energy-efficient method of descent

Scope — **Emission source**
Scope 1: direct emissions
Scope 2: indirect emissions
Scope 3: third-party emissions

EEV — **Enhanced Environmentally friendly Vehicle**

GTF — **Geared Turbofan**
An aircraft engine with a gearbox between the fan and turbine

GHG — **Greenhouse Gas Protocol**

ICAO — **International Civil Aviation Organization**
The international authority responsible for civil aviation

LTO-Zyklus — **Landing and take-off cycle**
All aircraft movements below an altitude of 3,000 feet (around 1,000 meters)

PCA — **Pre-conditioned air**
A system for supplying parked aircraft not only with electricity, but also pre-conditioned air, so that they do not switch on their auxiliary power units

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Responsible
Dr. Josef Schwendner
Authorized representative and Senior Vice President of Legal Affairs, Committees, Compliance and Environment
Hans-Joachim Bues
Senior Vice President Corporate Communications

Technical management
Hermann Blomeyer
Senior Vice President Project Team Capacities and Environmental Affairs

Technical support
Corporate Development
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Get in touch with us
If you have any questions or suggestions on the subject of climate protection, please do not hesitate to contact:

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Hans-Peter Melzl
Air pollution control/ climate protection
Phone: +49 89 975 404 60
E-mail: hans-peter.melzl@munich-airport.de

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natureOffice.com | DE-137-370656
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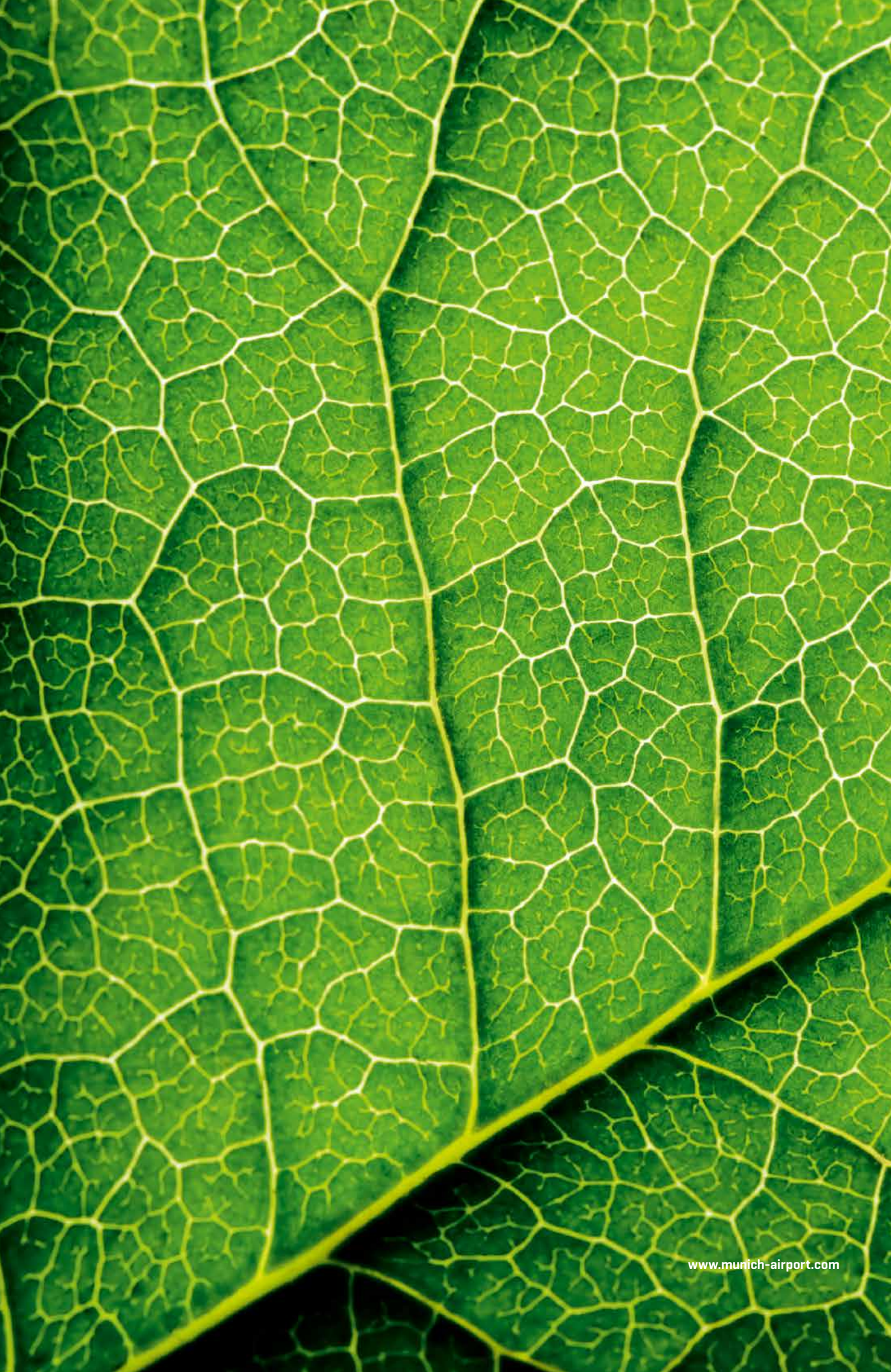
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