

ISSUE 2

**SUSTAINABILITY
REPORT**



**A FEW
SUSTAINABLE FACTS**

100%

RENEWABLE
ELECTRICITY

700 ha

BIOMONITORING
BY BEES

30%

RECOVERY
DE-ICING WATER

11,600 m²

DEDICATED
TO BIODIVERSITY

125 t

OF RECYCLED
WASTE IN 2022

-56%

CARBON FOOTPRINT
REDUCTION BY 2021

**ROADMAP
TO NEUTRALITY**

**NET ZERO BY
2030**

**BUILDING
TODAY
THE GREEN
AIRPORT OF
TOMORROW**



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It is a great pleasure to be able to present you with our second environmental report, filled to the brim with numerous initiatives and environmental projects. I would like to express my heartfelt thanks to all those involved.

We recognise that airports have a considerable impact on the environment, and we have made it a priority to reduce this impact through a range of initiatives on our journey to becoming net zero by 2030.

Environmental protection and sustainability are now firmly anchored in the company, and are not just the responsibility of a dedicated department. Moreover, we enjoy the full backing and support of our shareholders, politicians and neighbours.

All of this reinforces our drive to become even more environmentally-friendly and provides us with the optimum conditions to do so.

Alexander Flassak

CEO / CFO, lux-Airport



In the context of climate change, the transition is a reality for all airports. At Luxembourg Airport, we are strongly engaged with this community to work towards more sustainable operations through improvement projects and innovative solutions.

The management of the environment and sustainable development at Luxembourg Airport may seem ambitious, but our roadmap towards net zero in 2030 is defined and all means will be progressively implemented to achieve it on time. The implementation of concrete projects to reduce our impact is a real step forward.

This report details those projects and gives an insight into our ever-increasing commitment. We remain motivated and confident.

Sandrine Trapp

Environmental Manager,
lux-Airport



Environment and airports seem to be fundamentally opposed subjects. However, it is our job to try to reconcile the two! We work every day to reduce the impact of the airport's activities on its environment, and we are proud to present our latest achievements here. Of course, we are not stopping there, and still have many projects aimed at improving our environmental management and meet legal and other requirements. Our motto: we can always do better!

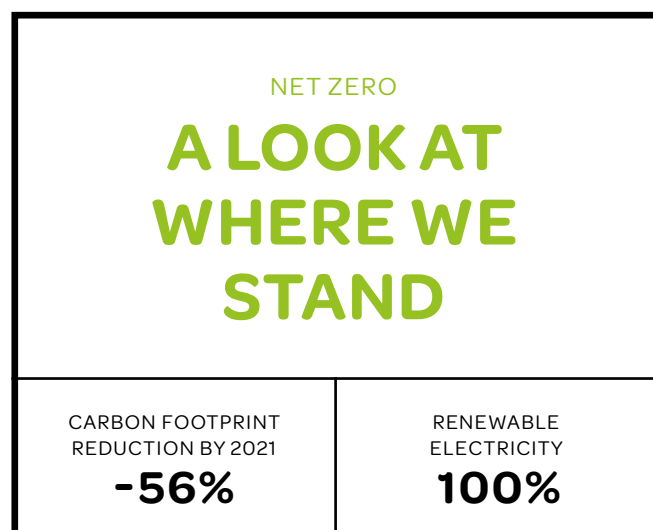
Anne Boussert

Environmental Coordinator,
lux-Airport



NET ZERO 2030 COMMITMENT

REDUCING OUR
CARBON FOOTPRINT



AIRPORT CARBON ACCREDITATION LEVEL 3+

LUX-AIRPORT WENT DIRECTLY FROM LEVEL 2 TO LEVEL 3+ OF THE AIRPORT CARBON ACCREDITATION DEVELOPED BY ACI

Airport Carbon Accreditation is the global standard for carbon management in the airport industry. The aim of this programme is to encourage and enable airports to implement best practices in carbon management, with the ultimate objective of becoming net zero. The certification programme is part of the global airport industry's response to the challenge of climate change.

lux-Airport reached level 2 Airport Carbon Accreditation in January 2020. Since then, the health crisis has greatly affected the aviation sector and, in particular, airport operations.

Despite this, lux-Airport has continued its efforts to reduce its carbon footprint and reach level 3+ on 1 February 2022.



Celebrating the ACA level 3+: lux-Airport shows a selection of its electric vehicles exclusively charged with 100% hydropower.

LEVEL 3: ACTIONS TAKEN

To achieve level 3 certification, lux-Airport has continued to reduce its relative carbon footprint, and at the same time has worked with the airport's main partners, in particular those that make a significant contribution to the airport's carbon emissions. Together, they have developed a common carbon footprint management system and have defined an action plan with measures to be applied in order to reduce this footprint.

KEY ACTIONS



REGULATING ENGINE USE DURING TAXIING (LTO = LANDING-TAKE-OFF CYCLES)



REGULATE APUS USE ON THE APRON

Energy efficiency

Some partners, such as Cargolux, have invested in renewing their fleet with more energy-efficient aircraft. The main handling company, Luxair, is also planning to transition to electric GSEs wherever possible.

Green electricity

In addition, the main players at the airport only use electricity produced from 100% renewable sources based on hydroelectricity. As a result, all electric charging stations are supplied with renewable energy.

LEVEL 3+ OFFSETTING PROJECT

Level 3+ represents the carbon neutrality achieved by lux-Airport by financially compensating for its carbon footprint with a project certified by recognised international organisations.

KUBRATOVO WASTEWATER TREATMENT PLANT

The project chosen to offset our 2020-2021 emissions is a combined methane emissions reduction and energy production project in Bulgaria. Methane produced in the Kubratovo wastewater treatment plant is captured in tanks and supplied to a CHP gas engine for electricity and heat production.



Kubratovo wastewater treatment plant

THE IMPACT

- **Dramatically reducing methane gas emissions**
- **Reducing volume of sludge that needs to be transported**
- **Electricity and heat production on-site, replacing supply from the grid and diesel usage**

GOAL
2025

TRANSITION

LEVEL 4+

Offsetting residual scope
1 & 2 emissions

TRANSFORMATION

LEVEL 4

Extended carbon footprint, absolute emissions
reductions in line with Paris Agreement,
enhanced 3rd party engagement

ACHIEVED

NEUTRALITY

LEVEL 3+

Offsetting own scope
1 & 2 emissions

OPTIMISATION

LEVEL 3

Engaging 3rd parties and
measuring their emissions

REDUCTION

LEVEL 2

Managing and reducing
footprint

MAPPING

LEVEL 1

Carbon footprint

NO REASON TO REST

ACI has developed new certification levels: levels 4 and 4+. The introduction of these two new levels marks a shift in the ambition of the programme. The set of stringent requirements include alignment with the Paris Agreement, the inclusion of additional emissions sources, in particular all significant operational emissions from third parties, and enhanced stakeholder engagement.

2022

Achieved
level 3+

HEADING INTO THE FUTURE: LEVEL 4/4+

With its new levels 4 and 4+,
ACI has developed new levels of
certification. lux-Airport aims
to reach level 4+ by 2025.

BY
2025

Level 4: Transformation

At Level 4, airports are required to align their carbon management ambition with global climate goals and transform their operations with absolute emissions reductions in mind, while strengthening their stakeholder engagement.

Level 4+: Transition

At Level 4+, airports are asked to offset the residual carbon emissions over which the airport has control, using internationally recognised offsets.

ISO 14 001:2015 — A STANDARD DEDICATED TO THE ENVIRONMENT

I

n order to be even more efficient in our environmental management at lux-Airport, we have decided to structure our approach based on the principles of the international standard ISO 14001.

ISO 14001 is a standard dedicated to the environment, which helps companies to manage their environmental impacts.

Its role is to provide a guide for environmental management in business, to help improve environmental performance, and also to offer a competitive advantage and strengthen the confidence of stakeholders.

Within this framework we began the journey to obtain ISO 14001 certification in 2019.

A NECESSARY FRAMEWORK TO EVOLVE

Electric vehicles, recycling waste and cigarette butts, new sorting bins, managing environmental emergencies — many initiatives have been implemented in our daily work, which must be integrated in a documentation system.

CONTINUOUS IMPROVEMENT

ISO 14001 certification is the goal, but not the only one. Certifications and awards are a good way to structure our work and our projects in a specific approach. We have already obtained

some of them (such as the Lean & Green Award) and we are continuing to work on others (such as Airport Carbon Accreditation). This proves that our environmental efforts are part of a process of continuous improvement. In addition, all lux-Airport staff are involved in the process and the success of the certification. In November 2021, after an external audit, our organisation was deemed to meet the requirements of the ISO 14001 standard and we obtained certification for 3 years.

But that doesn't mean we're going to rest on our laurels. Firstly, because we will be audited every year and secondly, because certification is not an end in itself.

Indeed, from now on, we must continue our actions to seek to improve ourselves on an ongoing basis, that is to say to reduce our impact on the environment.



Left to right: René Steinhaus — former CEO lux-Airport, Anne Boussert — Environmental Coordinator, Sandrine Trapp — Environmental Officer lux-Airport, Alexander Flassak — CEO lux-Airport. January 2022

A HIGHER LEVEL OF SUSTAINABILITY: LEAN & GREEN



LEAN AND GREEN IS AN INTERNATIONAL STIMULATION PROGRAMME FOR BUSINESSES AND GOVERNMENT AGENCIES, IMPLEMENTED BY CONNEKT: A DUTCH NON-PROFIT NETWORK FOR SUSTAINABLE MOBILITY.

The programme aims to encourage businesses and government agencies to move to a higher level of sustainability by taking measures that not only yield cost savings, but reduce the burden on the environment at the same time. The LEAN and GREEN label was launched in Luxembourg on 25 June 2014.

The Ministry of Sustainable Development and the Cluster for Logistics collaborates with Logistics in Wallonia to implement the label for logistics companies in Luxembourg. Each year, the Lean & Green Awards honour companies participating in the Lean & Green programme that have achieved their sustainable development objectives during the previous year.



On October 13th, 2020, the efforts of lux-Airport were rewarded at the Lean & Green Awards 2020 ceremony — Claude Turmes, Minister for Energy and Spatial Planning, with Sandrine Trapp, Environmental Officer lux-Airport.



1ST STAR

In 2020, lux-Airport was one of the companies that achieved their goals! Along with 7 other companies in Luxembourg, lux-Airport has officially joined a club of more than 200 companies in Europe which have succeeded in reducing their CO₂ emissions by more than 20% in 5 years. It is a recognition of all our efforts and achievements in reducing our carbon footprint.

Luxembourg Airport is the second airport in Europe to receive Lean & Green certification.

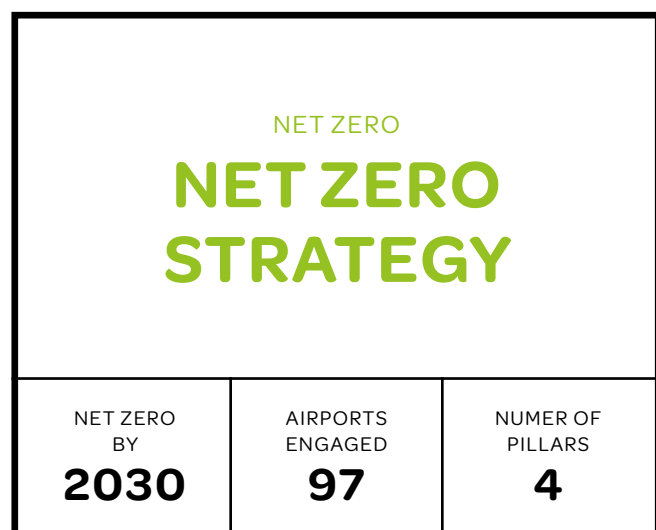
lux-Airport was awarded the “Lean & Green – 1st Star” prize in the presence of Mr Turmes, Minister for Energy and Spatial Planning. The prize is synonymous with a reduction in CO₂ emissions of more than 20%. Consequently, this has given us real motivation to continue this work and perhaps to obtain the 2nd star in the years to come.

26 %

REDUCTION IN CO₂ EMISSIONS
IN 2019 COMPARED TO 2016



As part of the Lean & Green programme, lux-Airport has implemented several sustainability measures that have enabled the company to reduce emissions.



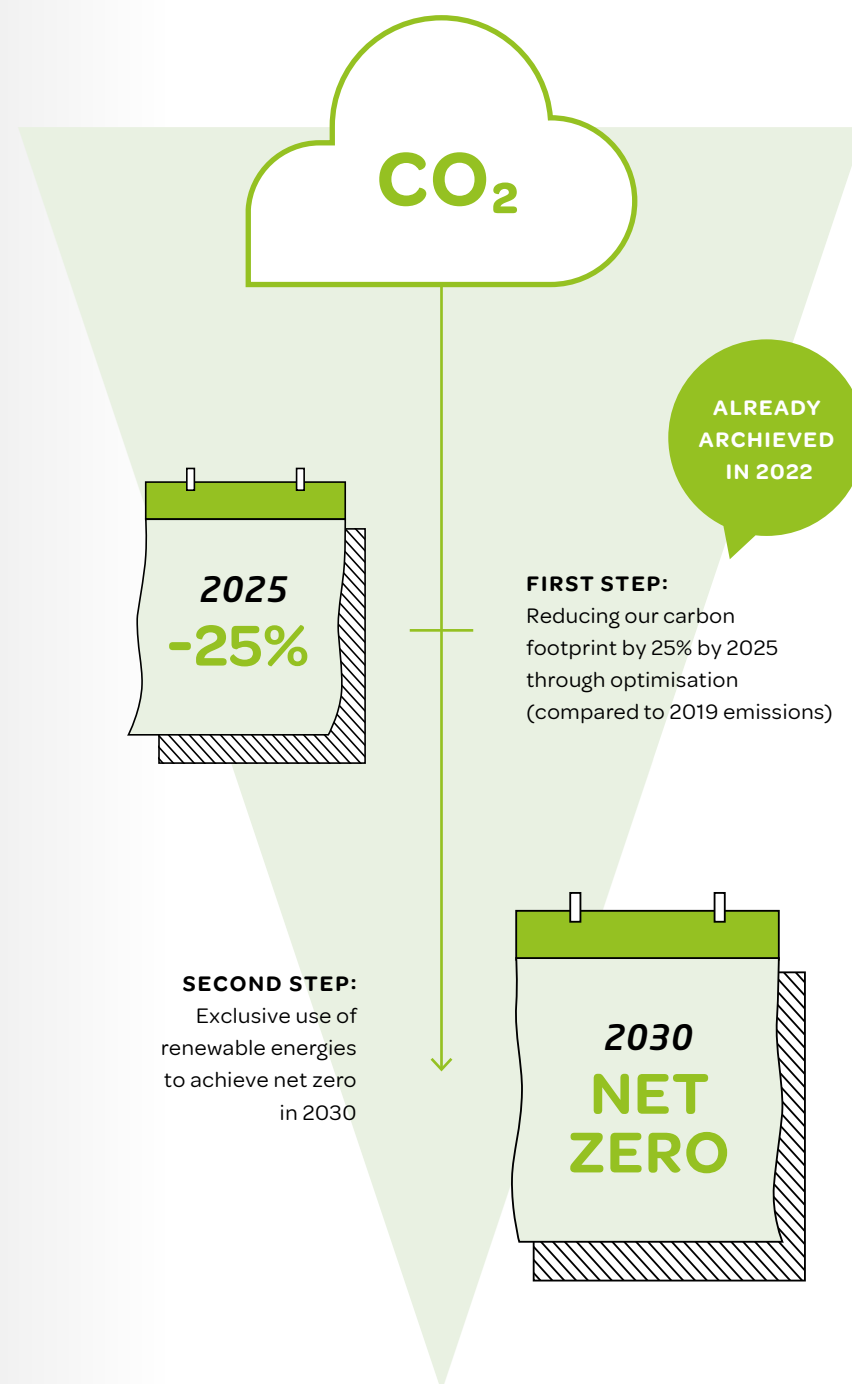
COMMITTING TO NET ZERO BY 2030

LUX-AIRPORT IS ONE OF 97 AIRPORTS THAT HAVE COMMITTED TO ACHIEVING NET ZERO, ABSOLUTE CARBON NEUTRALITY, BY 2030.

In order to avoid the most acute repercussions of climate change, our civilisation needs to reach “net zero carbon emissions” by 2050 at the latest. Net zero as defined by the IPCC is that state “when anthropogenic CO₂ emissions are balanced globally by anthropogenic CO₂ removals over a specified period.”

In other words, to achieve this, we either need to stop producing new CO₂ or compensate for any emissions by removing existing emissions from the earth’s atmosphere.

OUR GOALS:





Number of airports that have committed to net zero by 2030

IN GOOD COMPANY: EUROPEAN AIRPORTS ARE PULLING TOGETHER

Airports have bold ambitions on their journey to becoming carbon-neutral, with experience in carbon management built up over more than a decade. In their landmark resolution adopted in June 2019, they committed to net zero carbon emissions from operations fully within their own control by 2050 at the latest. **lux-Airport is one of 97 airports that have committed to achieving net zero, absolute carbon neutrality, by 2030.**

EMISSION INVENTORY AND DEFINING TARGETS

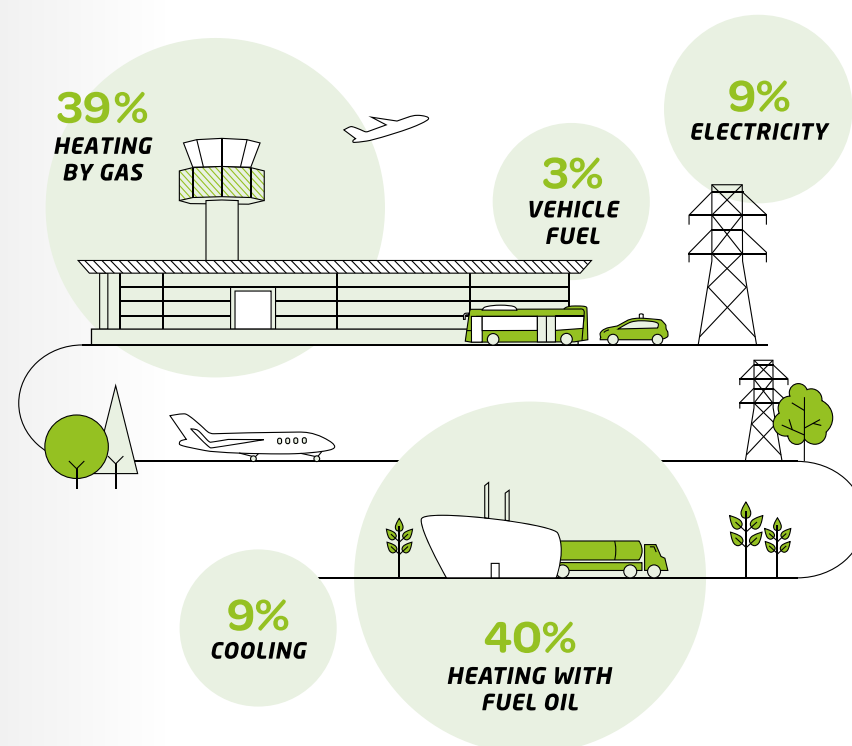
CARBON FOOTPRINT BASELINE ASSESSMENT

2019 was chosen as the baseline year for the road map. This decision was based on clear data availability for electricity, heating, cooling and vehicle fuel.

Once the baseline had been decided, a detailed analysis of emission sources was prepared to understand where the major opportunities for improvement at the airports are.

An extensive list of solutions used at other airports and in other industries has been studied and the potential of their application to lux-Airport has been analysed in detail. With this approach, the different opportunities available to reach net zero, their potential impact and the challenges involved have been analysed. From this, the list of possible solutions applicable to lux-Airport has been extended.

OUR CARBON EMISSIONS SOURCES (reference year 2019)

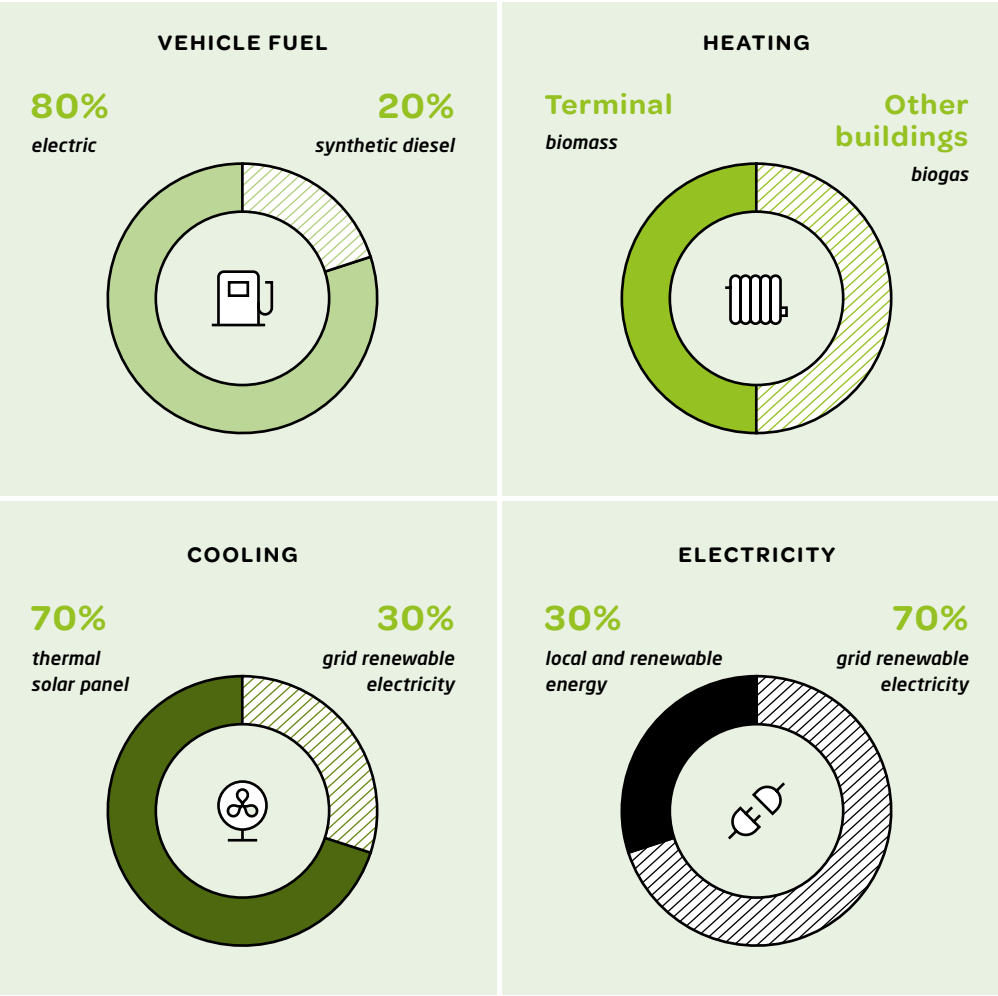


TARGETED SCENARIO: 4 PILLARS

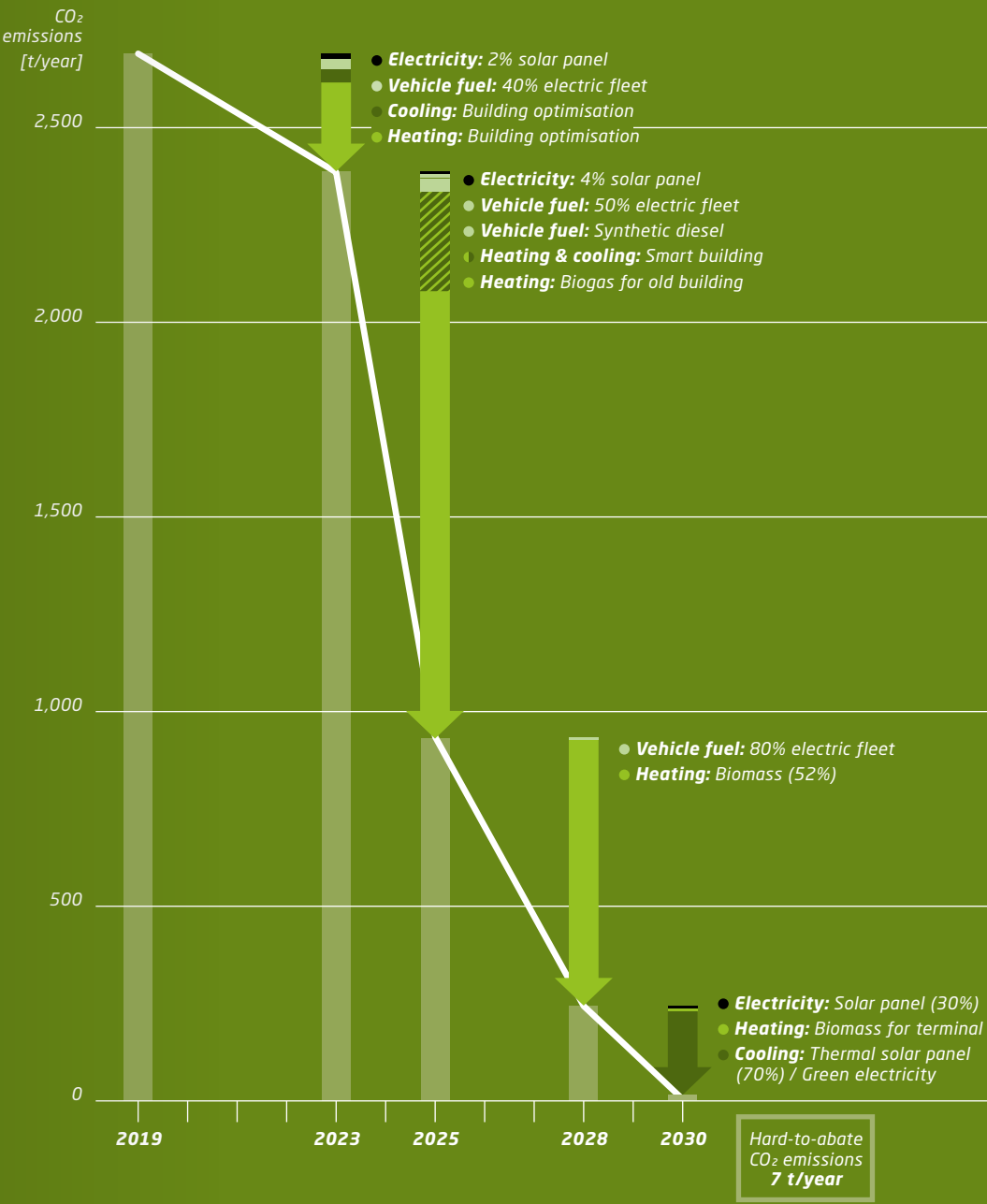
Our approach is to create an emission inventory (reference year: 2019) and establish a baseline emission forecast to cover the period from now until 2023.

We consider four pillars: vehicle fuel, heating, cooling and electricity. For each of these main pillars, we will develop and assess possible measures, including a technical feasibility check, an assessment of possible CO₂ reductions, as well as a timeline and cost estimation (CAPEX/OPEX).

The resulting feasibility/scenario matrix will determine our actions.

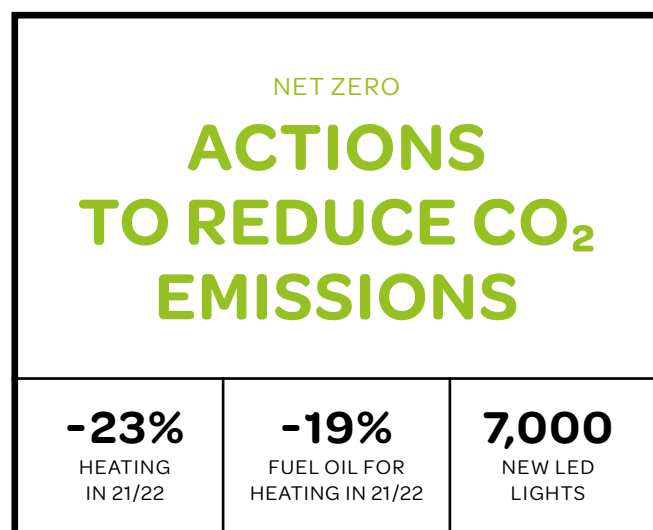


FINAL PATHWAY



HARD-TO-ABATE EMISSIONS

Although the developed scenarios describe pathways that aim to ensure lux-Airport becomes a net zero carbon airport, a few hard-to-abate emission sources are expected to remain. lux-Airport will choose a solution compliant with the requirements, such as carbon capture and storage or other local nature generation.



ENERGY OPTIMISATION

Since July 2014, lux-Airport has been supplied exclusively with green electricity via Enovos. The renewable energy certificates are issued by the Institut Luxembourgeois de Régulation (ILR) and also validated by the European Energy Certification System (EECS). Our electricity mainly comes from hydraulic energy. Since 2020, the gas used to heat the terminals has also been climate-neutral.

Nevertheless, energy is too precious to be wasted, even if it comes from renewable sources.

For this reason, after a general audit, we are currently working to optimise the use of energy in terminals A and B. Several projects were already carried out in 2021, such as replacing the energy meters (hot/cold), revising the set points, and replacing part of the lighting with LED.

In 2022, optimisations and adjustments continued with new parameters implemented for public and office areas, which allow some temperature variations, but significantly reduce overall energy consumption. For instance, in the offices, the air conditioning will start cooling only when the temperature reaches 24° according to the thermostat setting.

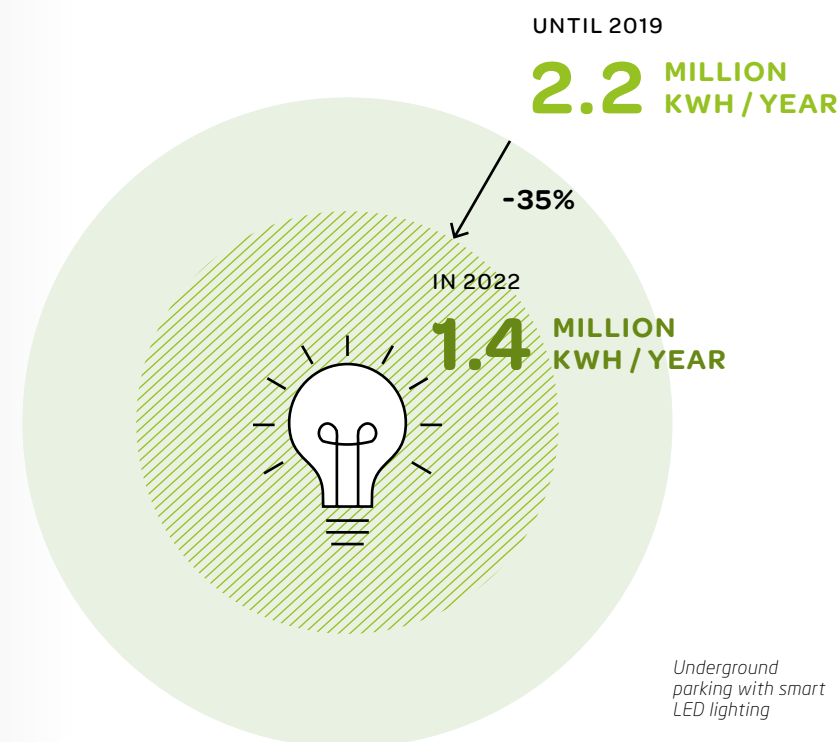
In 2023, this measure, among many others, will help us to reduce the energy consumption for **heating** the terminal by **more than 50%** and for **cooling** by **more than 30%**.

This system will be monitored, analysed and adjusted further during the coming months and seasons in order to bolster the overall effort required as much as we can.

LED DIMMING AT UNDERGROUND PARKING

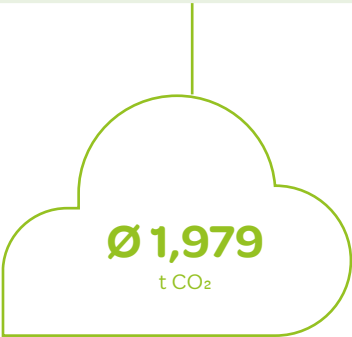
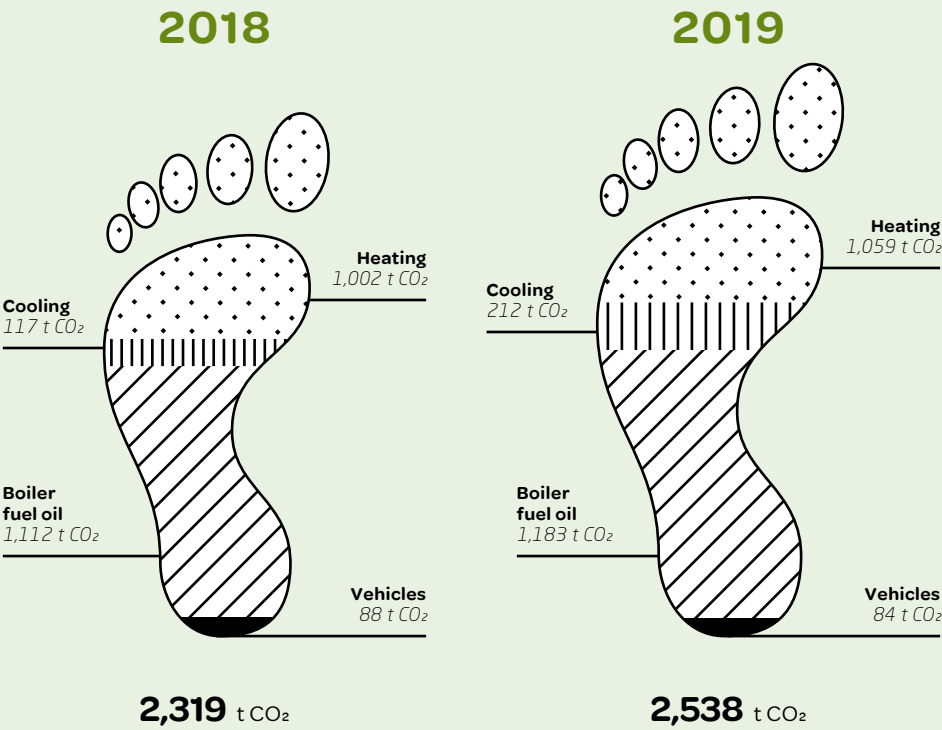
The car parks used to remain lit 24/7, resulting in high energy consumption and high operating costs. We had to balance two issues: remaining consistent with our overall approach to reducing environmental impacts while ensuring the safety of pedestrians and drivers. Approximately 5,500 lights and 1,500 emergency lights were replaced with new LED lights, offering a better quality of lighting with a longer life span. These

LED lights are “smart” because they are coupled to presence detectors, which allow the lights to dim the light in areas where there are no users and turn them up to maximum brightness instantly. For this work, we have been able to save more than 750,000kWh since installing the new lighting, which is equivalent to a **35% reduction in the overall electricity consumption** of the car park.



RESULTS OF CARBON FOOTPRINT REDUCTION

To calculate the market-based carbon footprint, airports use the emission factor derived from the energy attributes specified in their contracts.



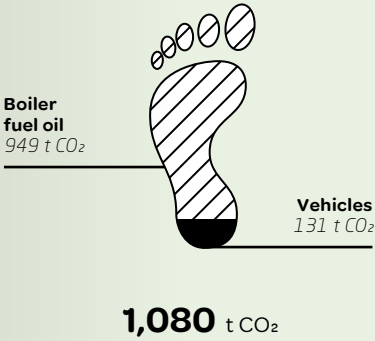
At lux-Airport, both our electricity and gas sources are carbon-neutral:

- **Electricity (including cooling):** Ecomix Hydro green energy from Enovos, which comes entirely from renewable sources (hydroelectric plants).
- **Gas heating:** Naturgas is 100% climate-neutral and offsets its greenhouse gas emissions through high-quality development projects.

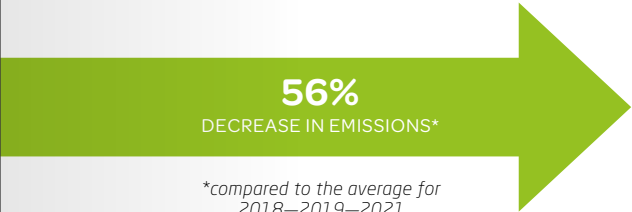
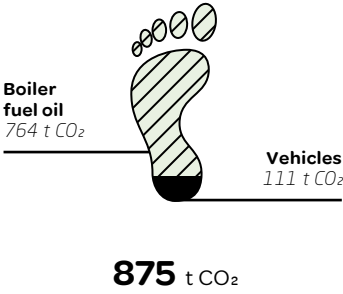
2020

not included in the calculation due to pandemic

2021



2022



GREEN MOBILITY

NEW BIKE ROOM FOR STAFF

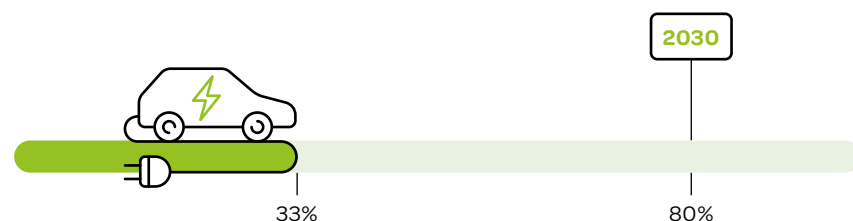
As an initiative to facilitate eco-friendly mobility, we now have a bike room! It has been installed for the airport's staff at the main airport entry point. With this infrastructure, lux-Aiport wants to increase the number of people working at the airport who choose the bicycle as a means of transportation.

The locker is installed in a public area, next to E20. It is equipped with photovoltaic panels for lighting, door opening and charging stations. There are 19 "bike" spaces, 4 of which are equipped with recharging stations for electric bikes.



NEW ELECTRIC VEHICLES

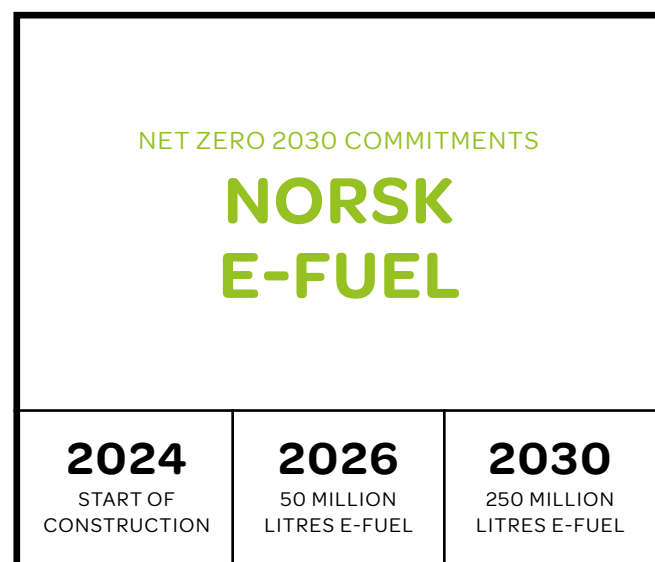
Since 2020, we have bought two new electric vehicles to replace old thermal ones, which means that one third of our vehicle fleet is now electric – a first step on the journey to reaching an 80% electric vehicle fleet.



CHARGING STATIONS: STAFF PARKING

While electric mobility is booming, it does raise some organisational issues. In order to encourage green mobility at the airport site, lux-Airport has just installed five terminals, each of which has two fast-charging units for electric vehicles in the staff car park near the airport. Two other terminals are being installed for the car park at the main access point to the airport.

Thanks to the 'Chargy' system, employees can now charge their electric vehicles at one of the available charging points. This service for staff complements the service offered to passengers and car rental companies. There are currently 6 charging points for passengers and 8 for car rental companies in the underground car park. We are working on a mobility concept to further enhance this offer.



The need to rapidly reduce GHG emissions has never been as urgent as it is today. The world needs renewable energy carriers to take on the greatest challenge of our time – the climate crisis. International scientists and councils, such as the IEA, the IPCC and the World Economic Forum agree that e-fuels offer unique advantages and are a necessity for industries, such as aviation, to meet global climate ambitions.

DEFINITIONS

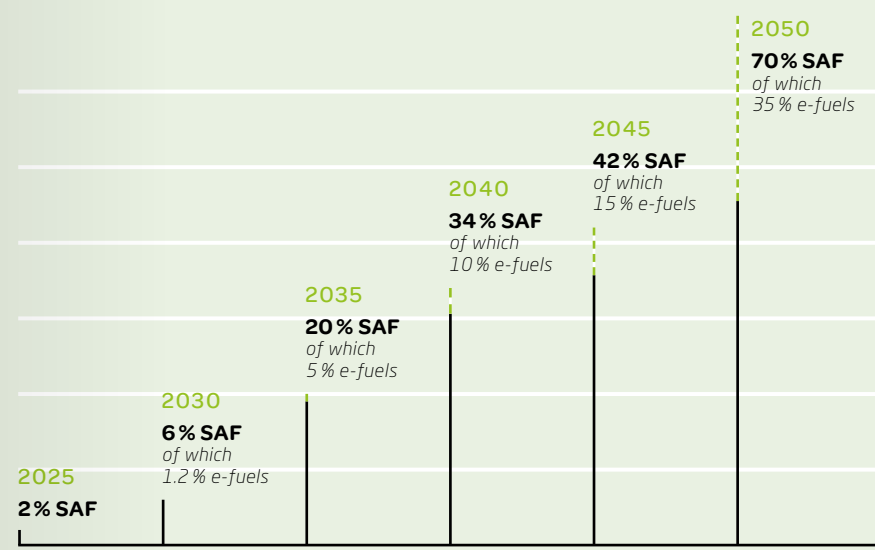
SAF	Sustainable Aviation Fuel
e-fuels	Synthetic fuels, produced from power, water and CO ₂
PtL	Power to Liquid

FRAMEWORK

The EU has set ambitious and rigid targets for accelerated decarbonisation. One essential element of the European Commission's **Fit for 55** package is the "regulation for ensuring a level playing field for sustainable air transport" (**ReFuel EU Aviation**). The Grand Duchy was among the seven co-signatories of an open letter to the European Commission proposing more ambitious national blending mandates:

- Obligation to steadily increase the SAF share
- Targets to be met at every EU airport with more than 1 million passengers or 100,000 t cargo per year by 2030
- Obligation on airport operators to provide the necessary fuel supply infrastructure

CONTINUOUS INCREASE IN SAF SHARE



E-fuels are certified for use today and do not result in a need to build new aeroplanes or change international refuelling infrastructures. Existing planes, pipelines and distribution channels are already available worldwide.

UNIQUE ADVANTAGES OF E-FUELS



**8x more efficient
use of land area**

*compared to biological
alternatives*



**95% lower water
consumption**

*compared to biological
alternatives*



**Clean
combustion**

*No sulphur content and
reduced particle emissions*



**Zero infrastructure
costs**

*by using existing
assets*



**Certified for
use in aviation**

*up to 50% reduction
according to ASTM D7566*

By using recycled CO₂ from biogenic sources and direct air capture, e-fuels reduce the emissions of a plane by up to 100% in comparison to fossil fuels. In addition, they burn more cleanly, have no sulphur content, reduce particle emissions and result in fewer contrails.

LUX-AIRPORT AND NORSK E-FUEL

In March 2022, lux-Airport contributed to the start of Norway's first production facility for sustainable aviation fuel with a ground-breaking investment. In doing so, as an actor from the aviation sector, we have officially shown our confidence in Norsk e-Fuels technology. As a shareholder in Norsk e-Fuel, we have helped to launch the first production facility, with production planned to start in 2024.

lux-Airport's investment in e-fuel production underlines our strong commitment to supporting the goals of a climate-neutral aviation sector. Contributing to the EU's "Fit for 55" goals is one of the key elements of our sustainability initiative, and we will focus our investments on projects that support this initiative.

NORSK E-FUEL PROJECT

ABOUT NORSK E-FUEL

Norsk e-Fuel AS, founded in 2019 as a project development company, is a leading industrial consortium that has joined forces to create a sustainable fuel that will make a climate-neutral transport sector a reality, especially in industries that are difficult to electrify such as the aviation industry.

NORSK E-FUEL SHAREHOLDERS

The joint venture consists of five partners:

- **Sunfire GmbH** – the world's leading PtL technology provider
- **Climeworks AG** – the pioneer in CO₂ air capture technology
- **Paul Wurth SA** (SMS group) – a leading international EPC company for steelmakers
- **Valinor** – the Norwegian Clean-Tech investment company, the parent company of Norsk Vind
- **lux-Airport** – airport operator of Luxembourg Airport

The goal is to always use the most efficient technologies available on the market. The licences for the technology set-up will be provided by this strong network of partners. Affiliating with the shareholders brings the important advantage of having direct access to core technologies. Reputable partners in the field will complete the technological composition of our plant design.

TURNING CO₂ AND WATER INTO SUSTAINABLE FUEL

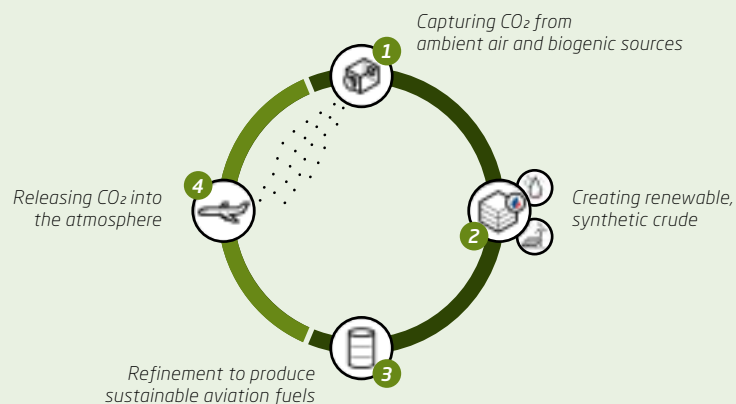
Norsk e-Fuel aims to preserve our climate and make aviation sustainable by providing renewable, synthetic fuels to the aviation industry. Norsk e-Fuel integrates all the steps required to provide ATM-certifiable fuel.

The production process is based on Power-to-Liquid technology and focuses on the Fischer-Tropsch pathway. The underlying process chain comprises the whole carbon cycle from CO₂ capture to fuel combustion. The project combines versatility in technology use and development potential to achieve the highest conversion efficiencies.

UNIQUE POWER-TO-LIQUID PROCESS

CLOSING THE CARBON CYCLE

The carbon cycle shows how it is possible to produce unlimited renewable fuels without releasing more CO₂ into the atmosphere from fossil sources.



1 / Recycling CO₂ from air and biogenic sources:

In the first step, CO₂ is extracted from the air using innovative direct air capture (DAC) systems. Together with recycled CO₂ from biogenic waste gas streams, which will initially complement the CO₂ supply, it is one of the main feedstocks for the second process step.

2 / Creating renewable, synthetic crude:

In the second process step, syngas is produced from CO₂ and water by using renewable electricity. This can be achieved either via high-temperature co-electrolysis or via a technology combination of low-temperature electrolysis for hydrogen production coupled with a Reverse-Water-Gas-Shift reactor.

The syngas, a mixture of hydrogen and carbon monoxide, is then converted into hydrocarbons of different chain lengths in a Fischer-Tropsch reactor which is

exposed to pressure, temperature and catalysts. A synthetic, renewable crude oil equivalent is produced. The waste heat generated during synthesis is captured as steam and can be used as input for the co-electrolyser to increase process efficiency or district heating.

3 / Refining to create sustainable aviation fuel:

In the third process step, the renewable synthetic crude can be refined to form the required products, such as kerosene, diesel, petrol, waxes and other chemicals. However, chemistry dictates that there will be some limitations with regard to the achievable fractions.

Norsk e-Fuel is optimising its processes and products for the aviation industry where they are most needed. Today, the company is able to convert 70-80% of its products into e-kerosene which can be used in existing infra-structures and meets ASTM standards.

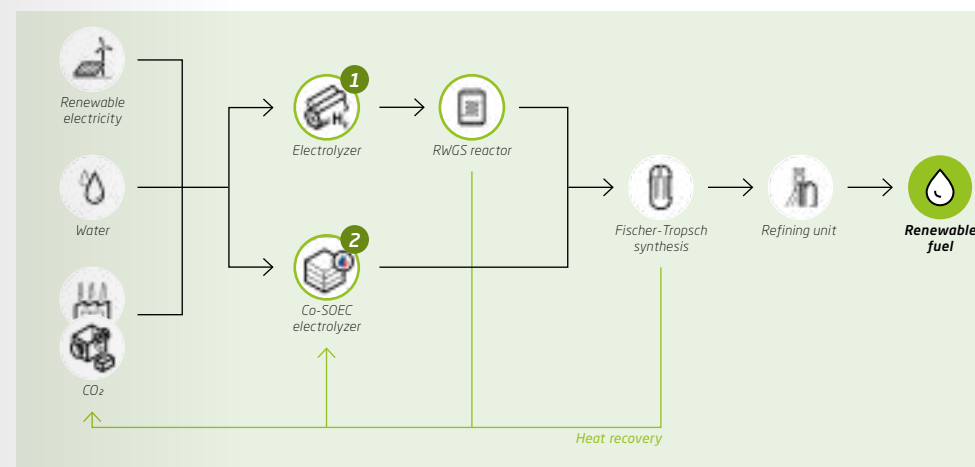
4 / Using the e-Fuel and releasing the CO₂ into the atmosphere:

In the fourth step, the sustainable aviation fuel is transported to the airport. The carbon included in the fuel gets released back into the atmosphere in the combustion engine of the plane.

At this point, we close the cycle when we again capture the CO₂ by DAC. When steps 1 to 4 are included, the process is entirely circular and enables unlimited renewable transport without releasing more CO₂ from fossil sources into the atmosphere.

THE NORKS E-FUEL VALUE CHAIN

There are two technological approaches to producing syngas. Norsk e-Fuel will leverage the individual advantages of both technologies by validating both approaches in the first plant. This allows synergies to be utilised and simultaneously proves to be the most promising and efficient pathway for producing e-fuel.



1 / Innovative state-of-the-art approach:

The production route via the low-temperature electrolyser for hydrogen production and the Reverse-Water-Gas-Shift reactor for syngas production is based on well-known and proven technology units. These lower the technological risk that is inherent to all first-of-a-kind industrial projects. And while the technologies are scaled, ready-to-use and reliable, they offer great potential for technological improvements. In addition, they are available on the market today in

larger quantities and allow us to scale up production quickly.

2 / Cutting-edge approach:

The process based on a high-temperature co-electrolyser for syngas production in one single step allows us to produce e-fuels at higher efficiencies.

Not only is this important for reducing electricity demand and the impact on the environment, but also for cost-effectiveness. Less electricity means lower costs of production, which again leads to lower prices for the e-fuels.

THE DIFFERENT TECHNOLOGIES

1 / DIRECT AIR CAPTURE TECHNOLOGY BY CLIMEWORKS

Climeworks direct air capture technology captures carbon dioxide directly from the air. The machines consist of modular CO₂ collectors that can be stacked to build machines of any size. They are powered solely by renewable energy or energy from waste. The CO₂ collectors selectively capture carbon dioxide in a two-step process. Firstly, air is drawn into the collector by a fan. Carbon dioxide is captured on the surface of a highly selective filter material that sits inside the collectors (“adsorption”).

Secondly, once the filter material is full with carbon dioxide, the collector is closed. The temperature is increased to between 80 and 100 °C – this releases the carbon dioxide (“desorption”) and it can be collected at a higher purity and concentration. The air-captured carbon dioxide can either be upcycled into climate-friendly products, such as carbon-neutral fuels and materials, or completely removed from the air by storing it safely.



2 / ELECTROLYSER TECHNOLOGY

Sunfire-SynLink SOEC[®] (Solid Oxide Electrolyser Cell) is the world-leading high-temperature electrolysis solution based on solid oxide cells. The electrolyser uses steam and CO₂ as feedstock to produce renewable syngas in just one process step. Smart integration of waste heat and CO₂ sources reduces electricity demand. For example, the integrated process reuses process heat from the Fischer-Tropsch reactor to create the steam needed for the electrolysis process.

This increases the output of the plant, resulting in 30% more product from the same electricity input in comparison to production via a gas-fired RWGS pathway.



3 / PARTNER FOR REVERSE-WATER-GAS-SHIFT (RWGS) REACTOR, FISCHER-TROPSCH REACTOR AND UPGRADING UNIT

Norsk e-Fuel will use the latest RWGS technology in combination with electrical heating developed by their partners. Instead of burning additional, precious green hydrogen or natural gas, Norsk e-Fuel is able to increase the conversion efficiency significantly whilst remaining 100% renewable.



THE LOCATION OF THE PRODUCTION FACILITY: MOSJØEN IN NORWAY

Mosjøen is the preferred site for the production facility:

- Easy access to abundant low-priced renewable electricity
- Industrial history and traditions provide a basis for integration know-how and synergies
- Further growth and scaling potential
- Most advanced in the development of CO₂ clusters/hubs

ALPHA PLANT, MOSJØEN NORWAY

Production volume	50 million litres (40,000 tonnes)
Start of construction	2024
Full-scale production	2026

In 2030, Norsk e-Fuel will supply the market with more than 250 million litres of renewable fuels by establishing three industrial-sized e-fuel production plants. The plants will be optimised for e-kerosene production, which will enable up to 80% of the product to be allocated to the aviation industry.

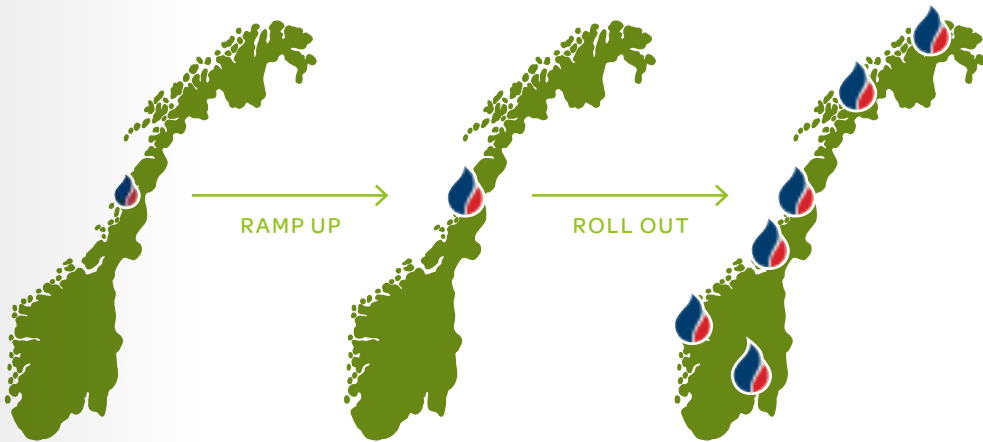


“We are proud that, with this investment, lux-Airport is demonstrating its confidence in our technology and production plans. Together, we will create a sustainable fuel that will make a climate-neutral transport sector a reality.”

— Karl Hauptmeier
General Manager, Norsk e-Fuel.



The first plant will have a total production volume of 50 million litres. Based on the initial design of the plant, a blueprint plant with an annual production capacity of 100 million litres will be developed. One of these full-sized plants would effectively cut the current flight emissions of the top 5 most frequently serviced flight routes within Norway by about 50%. The modular approach of the blueprint PtL plant will lay the basis for quick and flexible replication across Norway and Europe.





20

WATER MANAGEMENT

PRESERVING GROUND WATER
AND IMPROVING
WATER MANAGEMENT

WATER MANAGEMENT		
DE-ICING RECOVERY		
RECOVERY RATE ADF* WATER 30%	START IN 2021	AREA COVERED 35 ha

ABOUT DE-ICING OPERATIONS

IN WINTER, AIRCRAFT DE-ICING AND AIRPORT SURFACE DE-ICING OPERATIONS ARE CRUCIAL FOR ENSURING THE SAFETY OF PASSENGERS AND FLIGHT OPERATIONS, REGARDLESS OF WEATHER CONDITIONS.

Snow and ice on an aeroplane can create a number of dangerous problems. The frozen contaminants can interfere with the aerodynamic properties of the airplane, causing it to lose lift and increase drag. This can be very dangerous during takeoff and landing, when the plane is already flying at a low speed. In addition, dislodged ice can damage the engines or other important parts of the airplane.

This is why it is important to de-ice aeroplanes during winter, as it can help make sure the aircraft can take off safely and prevent any potential damage caused by ice.

Aircraft de-icing is a process that is used to remove snow, ice or frost from the wings and fuselage of an aircraft. It is an important safety procedure that must be carried out before every flight during the winter months when icing, snow or slush are visible on aircraft surfaces, or when the risk of it building up is high.

Depending on the conditions (temperature, contamination level, aircraft type, and others), propylene glycol is mixed with a certain percentage of water. Using the right percentage is important for effective de-icing, as too much water can create ice instead of melting it. These days, modern de-icing trucks can automatically adjust the ratio according to the current outside temperature and weather conditions.

In Luxembourg, the more intensive de-icing season typically extends from November to April. Several factors influence the quantity and concentration of products applied, namely weather, (with precipitation or without precipitation), operational conditions, climatic variables including temperature, humidity, wind, solar radiation, etc.

WHAT HAPPENS TO THE DE-ICING WATER?

During dry weather, de-icing products remain on the runway, do not penetrate the rainwater collection system and may, depending on the duration of the dry weather, accumulate there in increasing volumes. In humid weather, two scenarios can be observed:

1. In the event of moderate precipitation and lower temperatures, the application of a high water/ADF* volume with a lower ADF* is applied;
2. In the event of heavy precipitation (snow, freezing rain, etc.) and lower temperatures, a high volume at a higher concentration of ADF* is applied.

The largest proportion of contaminated water is generated during de-icing operations in wet weather, while the highest load occurs at the onset of a rainy period after a prolonged dry period.



* Aircraft De-Icing Fluid

RECOVERY OF WATER FROM DE-ICING

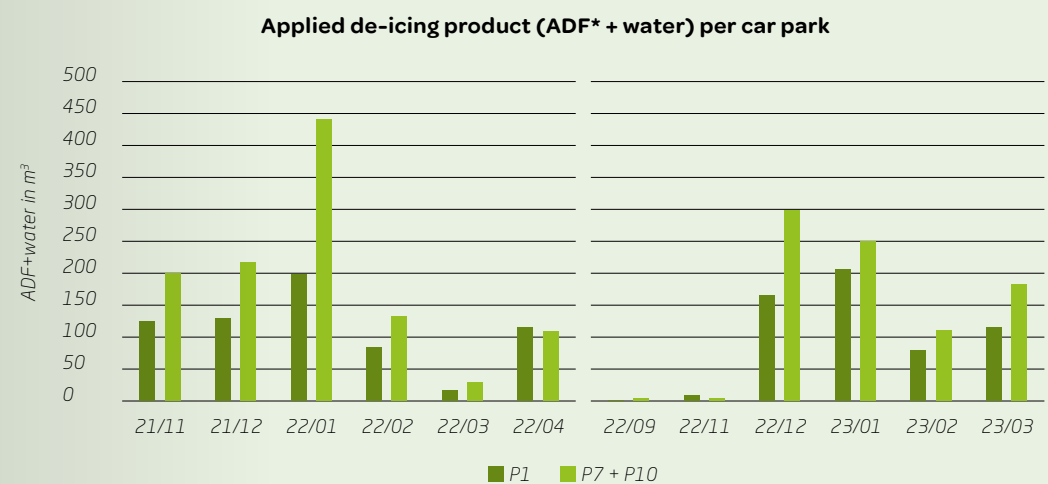
Aircraft de-icing consists of the preventive (anti-icing) or corrective (de-icing) application of ADF* products, generally composed of chemical agents based on propylene/ethylene glycol, which act by lowering the freezing point of the aircraft surface to prevent or melt ice, snow or frost until the moment the aircraft takes off.

Although essential for airport operations, de-icing products are also a major cause of organic loads in surface waters, which can have a negative impact on downstream infrastructure in the absence of adequate on-site evacuation and treatment measures.

As part of the efforts to ensure that the sanitation system at Luxembourg Airport complies with all requirements, new works and installations are being planned to collect, separate, store, evacuate and treat water from surfaces contaminated by de-icing operations. Given the scale of the work, it is currently estimated that the completion and commissioning of all the new infrastructure will take place between 2026 and 2028. In the meantime, we wanted to find an interim solution for the management of de-icing water.



In collaboration with SIDEST, Ponts&Chaussées and Luxair, a system for the collection, temporary storage, evacuation and treatment of de-icing water has been set up for the 2021/2022 winter season. In order to reduce the concentration of total organic carbon (TOC) in the run-off water from the freight and passenger car parks, we have set up a system to recover de-icing water from the aircraft stands on the passenger (P1) and freight (P7-P10) stands using sweepers. This recovery also took place during the winter of 2022-2023.



THIS MANAGEMENT SYSTEM HAS 3 STEPS:

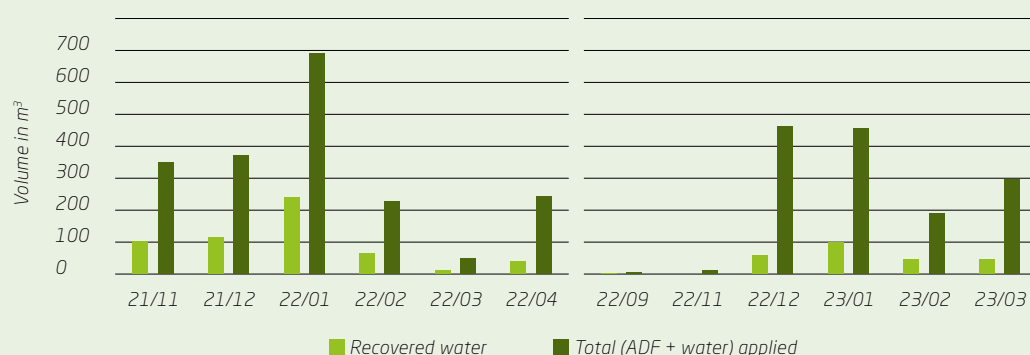
- 1. Removal:** Water is recovered by vacuuming with 2 sweepers (9 m³ capacity) directly on the aircraft stands after their departure and on the passenger and freight car parks. The frequency of the sweeping operations is coordinated with Luxair, the company responsible for de-icing. Once the sweepers have reached a certain level of filling, they empty the vehicles in the area set aside for this purpose.
- 2. Temporary storage:** Located in the north-west corner of P10, the dumping site consists of a 13m³ tank connected by gravity to the basin S2.
- 3. Transport and treatment:** All the water collected is stored during the winter season. In spring, the water is transported by truck to the Grevenmacher wastewater treatment plant where it is treated by anaerobic digestion in the sludge area.

A follow-up study was carried out to collect data to allow a quantitative assessment of the produced effluents to be made and to determine the capacity to recover contaminated water and the rate and responsiveness of the operational resources.

The average recovery rate is about 30% of the ADF-water mixture applied. Several factors have an impact on the re-covered volumes:

- the time that elapses between the de-icing operation and the mobilisation of the means of recovery (sweepers), particularly in the event of heavy rainfall, which causes the products flowing on the surfaces to move more quickly towards the collection networks (gutters, drains).
- the time taken by the sweepers to vacuum all the positions.
- the amount of ADF-water mixture left on the vehicle.

Applied products vs. recovered water



NOTE

It should be noted that winter 2021/2022 was the first time in the last 12 years that the Übersyren WWTP did not experience significant operational problems due to high organic loads from the airport.

The Partenariat de cours d'eau de la Syre welcomes the implementation of this project, which has made it possible to maintain good water quality.



POSITIVE IMPACTS

All these measures made it possible to collect a large quantity of water with a high organic content, thus reducing the load on the rainwater network (pipes and basins) and avoiding peaks in critical concentrations. Several positive effects have been achieved, namely:

- A reduction in the load to be treated in the Übersyren wastewater treatment plant, with a consequent reduction in the costs of aeration and oxygen injection, as well as maintaining the functionality of the biological treatment process
- Avoiding the risk of discharging water with a high concentration of de-icing products into the river in the event of tank S1 being completely filled
- De-icing water could be treated more efficiently in the sludge area
- As a side effect, a useful collection of data on the consumption of de-icing products, recovery rates and treatment possibilities could be compiled, which will serve as a basis for future projects concerning the management of this water.

In view of the considerable improvement in the management of de-icing water that the procedures applied in winter 2021–2022 have brought, lux-Airport has decided to continue this recovery for the coming winters.



Airport piezometer (red) and drinking water withdrawal point (blue)

WATER MANAGEMENT PIEZOMETER ANALYSIS

The airport is situated on several drinking water protected areas. Due to the vicinity of the Birelergrund springs, the airport has installed 9 piezometers to keep track of the groundwater's quality. Twice a year, we analyse the physico-chemical parameters, PAHs, PFAS, glycols and triazoles.

The results are transparently shared and discussed with the Administration de la Gestion des Eaux and Ville de Luxembourg. New parameters for monitoring water quality have been added as requested by the water management administration. In particular, these concern the impact of airport activities on the catchments of the Birelergrund area and cover perfluorinated surfactants (PFTs) and constituents of de-icing fluids (glycol, benzotriazol).

WATER MANAGEMENT DRY URINALS

DID YOU KNOW THAT SANITARY AREAS CAN REPRESENT MORE THAN 20% OF A BUILDING'S WATER CONSUMPTION?

F

aced with this observation, our Environment team has sought to propose a solution that is part of our overall approach to saving energy and resources.

And the result is now visible in the men's toilets in Terminal A/B, in the form of "waterless" urinals. A concept from the Luxembourg start-up Techno Green, these urinals work:

- without a flushing system
- without electricity

Produced in a CO₂-neutral manner, they are 100% recyclable and only use microbiological cleaning products. A deodourising cube coupled with a vertical membrane form the basis of the sanitary system, guaranteeing odour-free use.

Since we started the project, we have saved 12 m³ per day, or 4,270,000 litres per year of water in the terminal. This means a reduction of 20% of the water consumption per passenger.



30

MANAGE WASTE

AVOID, REUSE, RECYCLE
AND RECOVER

AT LUX-AIRPORT, WE WANT TO ENSURE SUSTAINABLE DEVELOPMENT AND REDUCE THE ENVIRONMENTAL IMPACT OF OUR ACTIVITIES. THIS INCLUDES IMPROVING OUR WASTE MANAGEMENT.

In order to control the efficiency of our waste management measures, lux-Airport complies with the SuperDrecksKëscht® standard and has held this label since 2019, which is re-certified every year.

We also aim to increase the recycling rate of the airport's waste. To achieve this, we are constantly looking for and implementing new categories of waste to be sorted and recycled or recovered.

For example, the waste recycling rate for 2022 was 30%, which represents nearly 125 tonnes of recycled waste and 36 different sorting categories. However, we can still improve this rate, particularly by reducing the amount of residual waste we produce, for example by avoiding single-use plastics wherever possible.

125 TONNES
OF RECYCLED WASTE

30
%

RECYCLING

36
TYPES
OF SORTED
WASTE

WASTE MANAGEMENT

AIRSIDE WASTE MANAGEMENT STUDY

9

TYPES OF
WASTE

7

STAKEHOLDERS
INVOLVED

8

WAYS OF
IMPROVEMENT

LUXEMBOURG AIRPORT ASKED THE AVIATION CONSULTANCY TO70 TO PERFORM AN AIRSIDE WASTE STUDY IN ORDER TO IDENTIFY OPPORTUNITIES TO OPTIMISE THE MANAGEMENT AND THE COOPERATION BETWEEN DIFFERENT STAKEHOLDERS.

W

aste management at airports is primarily reliant on national and/or local regulations. Best practices may enhance the results achieved by meeting mandatory standards. Arrangements with stakeholders within the airport community are essential as the airport operator is not the only party producing waste.

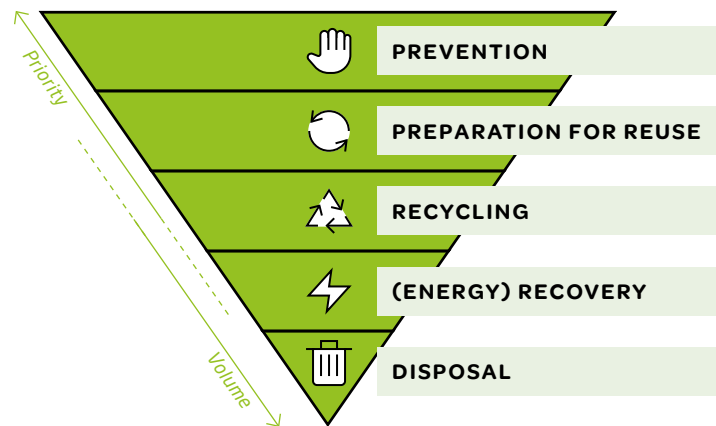
This first study has been performed to analyse the current situation and identify opportunities to optimise the waste management process at Luxembourg Airport.

Waste management is the process of handling the waste originating from inbound aircraft, terminal processes, cargo handling processes, aircraft maintenance, GSE maintenance, aircraft operations, airside operations, rescue and firefighting activities and offices.

While some waste materials (e.g. spillage from dangerous goods in storage) require specific, mandatory processes to be followed, the entirety of waste management is dependent on sound management principles such as those found in the ISO 14001 quality system.

WASTE HIERARCHY

From a material point of view, waste management is considered in a hierarchy that seeks to avoid, reduce, reuse and recycle waste. The study primarily examined reuse and recycling. Avoiding waste at the airside is a challenge as some activities, for example mandatory maintenance requirements, implicitly create waste.



LOCAL CONTEXT

One area Luxembourg focuses on is the circular economy. A national strategy study entitled "The Third Industrial Revolution" which includes a roadmap for optimising that particular economy has been developed. Luxembourg wants to take advantage of its reduced scale in order to be efficient and effective when implementing the circular economy.

The different types of waste are classified into 4 categories:



Most of the airside organisations are currently certified by Super-DrecksKesch. There are a number of organisations that produce/are responsible for waste at the airport and which formed part of this study. The most important organisations include:

- ANA
- Cargolux
- Luxair
- Ponts&Chaussées

AIRSIDE CHALLENGES

The requirements for and controls applicable to entry into the protected areas make it difficult for contractors to move throughout the airport freely for the purpose of collecting waste. The biggest restriction, aside from the time it takes to pass through each control, relates to the requirement for bringing empty vehicles (or as empty as possible) into the Yellow and Red areas.

ANALYSIS AND EVALUATION

Firstly, To70 noticed that the airside area was generally very clean. The airport appears to be succeeding with regard to its first airside waste management priority: the prevention of waste which could have an impact on airport safety (Foreign Object Debris or FOD). Bins were being used and the larger the waste container, the further away it was from the apron. With a prevailing east-west wind at the airport, light FOD is blown towards the eastern fences where little debris was noted.

To70 analysed the possibility to centralise waste collection and sorting at an individual point. But considering the business models of the different stakeholders, the logistics of the airside layout and the legislative environment, setting up a centralised waste collection system is not recommended.

The conclusion was that the level of recycling at Luxembourg Airport, including the activities of the stakeholders, is of a high quality – higher than the average that To70 sees elsewhere.

Despite the fact that stakeholders have different approaches to waste management, engagement appears to be cooperative and effective. It can be further improved by improving the compliance of staff at all of the stakeholder companies with regard to the requirements for separating and segregating waste through instruction and raising awareness. Some other recommendations were made such as considering the possibility of creating bio-methane from organic waste and old grass cuttings.

WASTE MANAGEMENT ZERO MEGO		
451 kg COLLECTED BUTTS	23 ASHTRAYS	15 YEARS TO DEGRADE IN NATURE

FIRST INTERNATIONAL AIRPORT TO START WITH ZERO MEGO IN 2020

IN THE SERVICE OF THE ENVIRONMENT

THE SELECTIVE SORTING OF CIGARETTE BUTTS HAS BEEN CARRIED OUT IN THE LUX-AIRPORT BUILDINGS AND THE MAIN SMOKING AREAS OF THE AIRPORT SINCE 2020.

T

ogether with Shime and MéGO!, lux-Airport has made it its mission to collect, sort and recycle cigarette butts around the airport. New ashtrays were provided to collect even more butts. Compared to the previous year, more than twice as many cigarette butts were collected and recycled in 2022.

	2020	2021	2022
Number of cigarette butts	440,000	835,880	1,805,000
Cigarette butts in kg	110	209	451
Produced standing seats	27	52	264

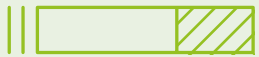


1,805,000

CIGARETTE BUTTS COLLECTED

IS EQUIVALENT TO

451.3 KG



902,500 m³

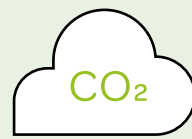
UNPOLLUTED WATER

*compared to discarding butts
on the ground*



4,950 kwh

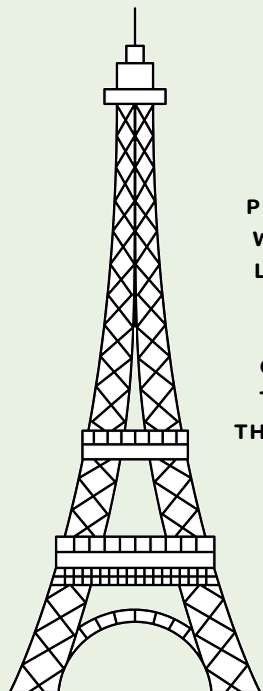
ENERGY SAVED



1,038 kg

CO₂ NOT EMITTED

compared to incineration



THE BUTTS
PLACED IN A ROW
WOULD COVER A
LENGTH THAT IS
150 x
GREATER THAN
THE HEIGHT OF
THE EIFFEL TOWER.

MONTHLY COLLECTIONS [KG]



SMALL WASTE – BIG POLLUTION

The filter surrounded by tobacco residue and paper is made of a cellulose acetate filter, a type of plastic treated with toxic substances. It contains more than 2,500 chemical components and takes 15 years to degrade in nature. If an uncollected cigarette butt ends up in a drain or natural waters, it will pollute the equivalent of 500 litres of water.



MAKING WASTE USEFUL

Even though we are already preventing water pollution by collecting cigarette butts, we are not stopping there. The butts are sent to a recycling company in France that has developed an innovative and patented process to clean and reuse the material. This recycling process is expensive, but worth the effort.

The process of cleaning and recycling cigarette filters has enabled the creation of a new, patented material: PlastiGO! This material will be used to make street furniture to be placed in smoking areas. In this way, the incentive effect of the project is reinforced (studies show a 30% decrease in discarded cigarette butts). PlastiGO! is inert and is provided as a deposit so that it can be recycled again and again. This makes it part of the circular economy.

Thanks to the 1,805,000 butts collected and recycled, 354 Olympic swimming pools were preserved and 264 MeGo! standing seats will be produced.





STOP SINGLE USE PLASTICS

In the waste prevention hierarchy, the first step is to avoid the production of waste. To this end, lux-Airport is currently seeking to eliminate single-use plastics. Now that we have eliminated cups, we are now also looking for a solution for gloves and plastic bags used by security agents at checkpoints.

As part of the new waste regulations, we will also work with the stakeholder in charge of catering at the terminals.



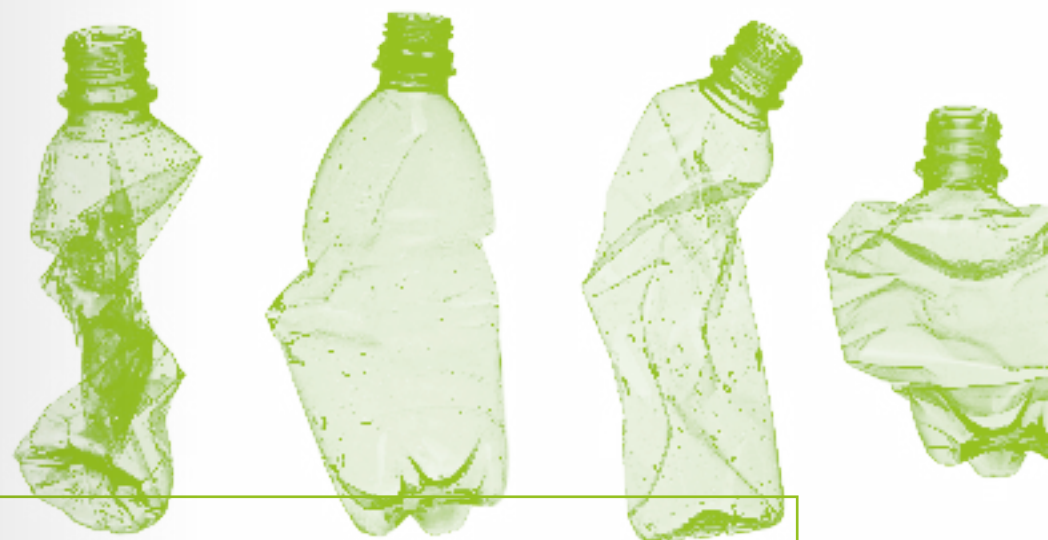
BENTO BOX

We also want to keep encouraging staff to reduce their consumption of single-use plastics. After providing them with the Gobi reusable bottle and the insulated mug, we offered our employees a Bento Box to encourage them to bring their meals from home and thus reduce single-use takeaway packaging.

PRESS FOR PLASTIC BOTTLES

Among our latest initiatives, we have installed a bottle press, the purpose of which is to compact plastic bottles while recovering the liquid. The reason is that the majority of plastic bottles sorted by passengers still contain a significant amount of liquid. This device saves time for the staff who manage the waste because the bottles can now be thrown away full of liquid.

Compacting also significantly reduces the volume of bottles to be stored before they are removed and optimises transport and recovery. Thanks to the hydraulic cylinder which has a compression force of 25 tonnes, **a single bale can contain up to 2000 PET bottles.**



WHAT HAPPENS TO OBJECTS PROHIBITED ON BOARD AND LEFT BY PASSENGERS BEFORE BOARDING?

Rather than being thrown away with the rest of the waste, they are included in our waste sorting process! They are first sorted into 5 categories according to type and stored in a secure wired room before being transferred for processing through specific channels. For security reasons, they cannot be reused and we must ensure that they are destroyed.



SOIL MANAGEMENT

SOIL CONSERVATION AND
RENATURATION PROGRAMME

SOIL MANAGEMENT RUNWAY SANITATION

WORK DURATION
IN YEARS

2

DRILLING
POINTS

50

REUSED SOIL
IN M³

155,000

IMPROVED STABILITY FOR MORE SAFETY

AS PART OF THE RUNWAY RENOVATION PROJECT,
WE NEED TO REMOVE THE TOPSOIL IN ORDER TO
STABILISE THE STRIPS IN ACCORDANCE WITH EISA
SAFETY REQUIREMENTS.

T

he strip portion of a runway should extend a minimum of 75 m from the centreline of the runway and its extension. It should be prepared in a manner that minimises hazards arising from variations in the maximum load of the aircraft for which the runway is intended. The graded strip of the runway should be appropriately sloped to prevent the collapse of the aircraft's nose gear. The surface must be prepared to provide adequate friction for the aircraft, and there should be sufficient load-bearing capacity beneath the surface to prevent damage.

Aircraft manufacturers have determined that the maximum depth to which the nose gear can sink without collapsing is 15 cm. Therefore, the existing topsoil needs to be excavated, the sub-grade compacted, a suitable stabilising material added, and then the topsoil returned and seeded.

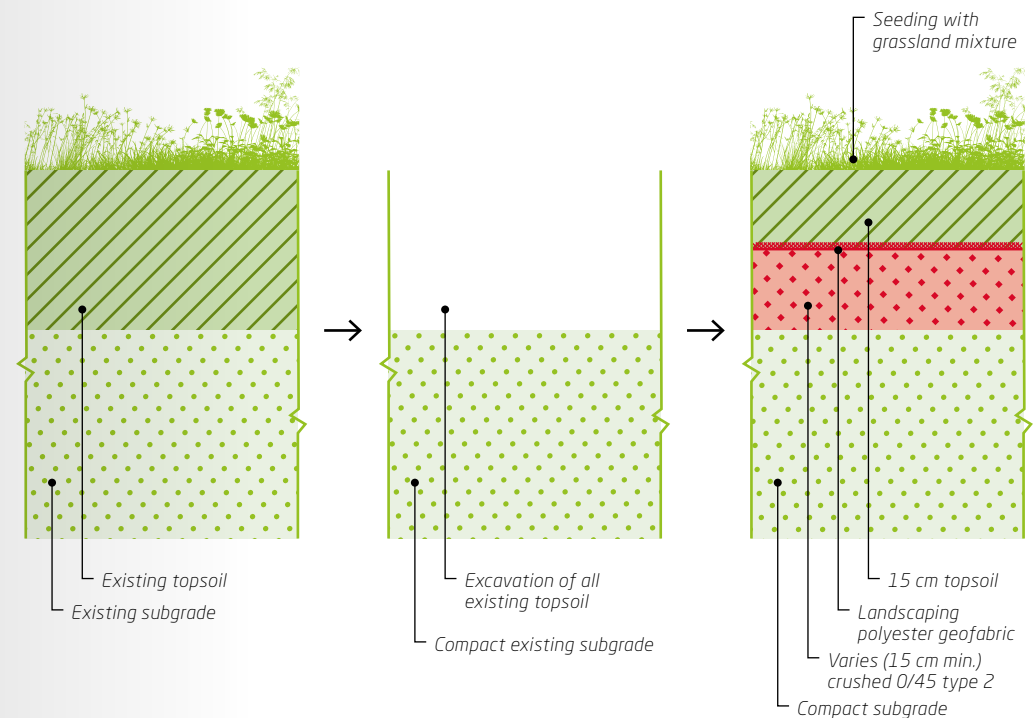
Two preliminary soil analyses were conducted to determine the composition and quality of the soil.

lux-Airport, in collaboration with the Administration de l'Environnement and the Administration de la Gestion de l'Eau, is developing a land use plan for different zones. This plan will facilitate the implementation of necessary anti-pollution measures to ensure a healthy environment and prevent contamination. Soil quality is analysed and restoration is undertaken for each project.

Initially, a pre-analysis campaign was carried out on 10 borehole samples, which did not exceed the limits for Type A inert waste landfills. Subsequently, an additional campaign involving approximately 40 boreholes was conducted to validate these findings and assess the suitability of reusing the topsoil.

Continuous analysis was carried out throughout the project to ensure soil quality and an accredited company monitored the work. Any uncontaminated

surplus arable land was then deposited on-site in an area authorised by the relevant authorities, thereby reducing the volume of traffic and congestion in the already saturated landfill sites. The designated area for material storage, vehicles, and waste was secured in compliance with the requirements of the Administration de la Gestion de l'Eau and the Administration de l'Environnement to mitigate the risk of soil contamination.



SOIL MANAGEMENT

CADASTRE OF POLLUTION RISKS

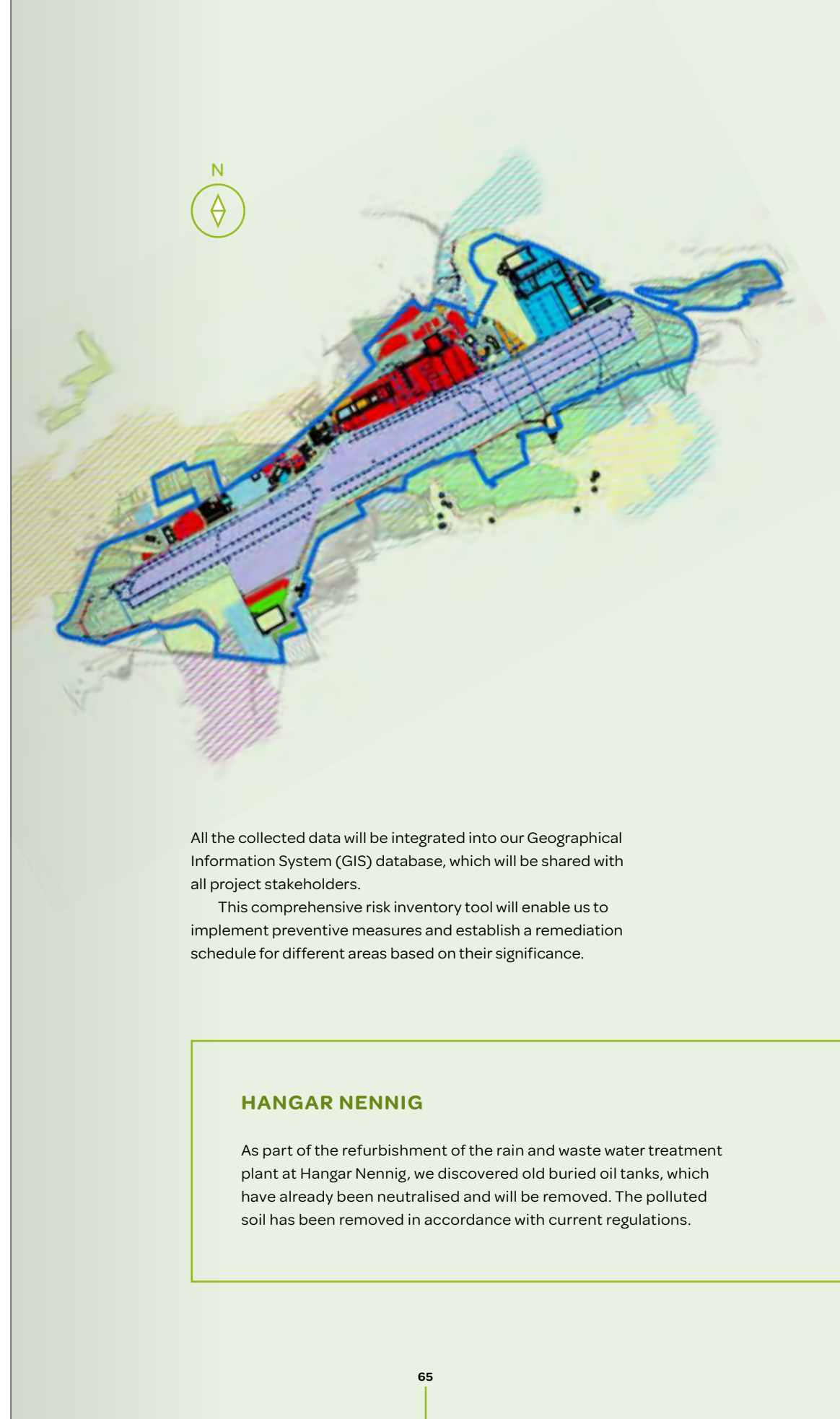
358 ha <small>AREA</small>	23 <small>LAYERS</small>	3 years <small>LONG-TERM PROJECT</small>
--------------------------------------	------------------------------------	--

The airport soil cadastre project is being carried out by lux-Airport with the support of the Administration de la Gestion de l'Eau (AGE) and the Administration de l'Environnement (AEV). The aim is to map the activities and equipment on the airport site that pose a risk to the soil and therefore to the groundwater accurately. We have gathered all the relevant information in order to create an evolving map of the airport site.

The airport site is divided into several defined areas based on the POS Findel. These areas encompass potential pollution risks such as specific land usage, activities carried out in each area, historical data on embankments and activities, storage of hazardous substances, and the sewerage network.

Additionally, the cadastre includes information on the natural environment, such as groundwater levels, protected areas, and vulnerable zones. It also incorporates other data like CASIPO, geotechnical studies, and rainfall analyses conducted on-site. In total, the database comprises over 23 layers.

The next step involves conducting on-site inspections in order to identify all elements and potential risks. Thanks to the cooperation of various stakeholders at the airport, each building is visited to assess risks associated with the storage of hazardous products, installations, and activities that may lead to pollution incidents during abnormal operations. An evaluation grid, defined by AGE, will help to classify the risks and determine the necessary preventive and remediation measures.



All the collected data will be integrated into our Geographical Information System (GIS) database, which will be shared with all project stakeholders.

This comprehensive risk inventory tool will enable us to implement preventive measures and establish a remediation schedule for different areas based on their significance.

HANGAR NENNIG

As part of the refurbishment of the rain and waste water treatment plant at Hangar Nennig, we discovered old buried oil tanks, which have already been neutralised and will be removed. The polluted soil has been removed in accordance with current regulations.



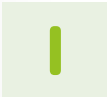
LO

BIODIVERSITY

PRESERVATION, PROMOTION
AND IMPROVEMENT



BIODIVERSITY		
FAUNA STUDY		
4	5	7
SPECIES INVESTIGATED	FOREST STANDS	INVESTIGATION MONTHS



In connection with the development of a green spaces management plan for the airport, we have conducted an airport fauna study. The study areas are located in the vicinity of Luxembourg Airport and are covered by forests that will have to be transformed in the near future because the increasing height of the woods will disturb the Obstacle Limitation Surface (OLS) of the airport. To ensure air traffic safety, the height of the groves must be reduced.

The overall investigation included the following species:



BREEDING BIRDS



BATS



DORMICE



WILDCATS

This study will help us to determine the impact of work required for airport safety reasons or new projects and to define the necessary measures to limit disturbance to wildlife. The study areas are located close to the NATURA 2000 sites "Grunewald" (FFH site LU0001022), "Vallée de la Syre de Moutfort à Roodt/ Syre" (bird sanctuary – LU0002006) and "Région de Schuttrange, Canach, Lenningen et Gostingen" (bird sanctuary – LU0002018).



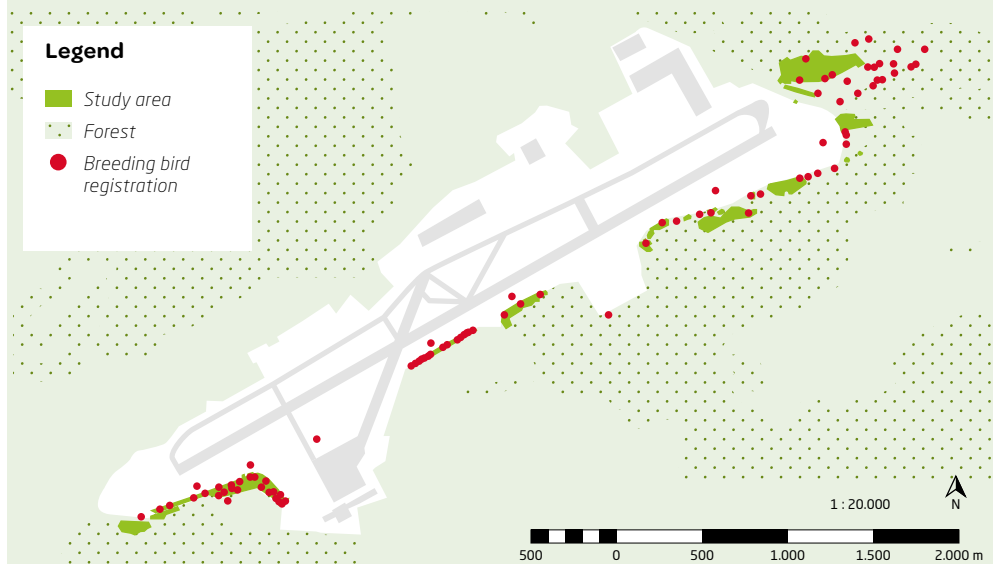
BREEDING BIRD REGISTRATION

The avifauna studies comprised five inspections including eyrie registration. A total of 52 breeding birds and 34 marginal settlers were found in all surveyed areas. The most common birds were the common whitethroat, yellowhammer, Eurasian skylark, tree pipit and common linnet but we also found red kite and northern goshawk.

	Breeding birds	Marginal settlers
Common whitethroat		
Yellowhammer		
Eurasian skylark		
Tree pipit		
Common linnet		
Others		

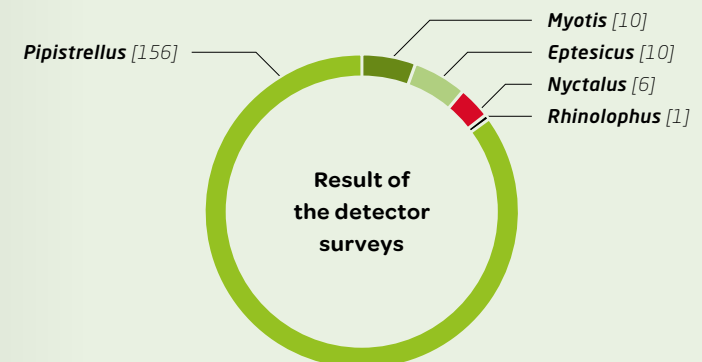
Legend

- Study area
- Forest
- Breeding bird registration



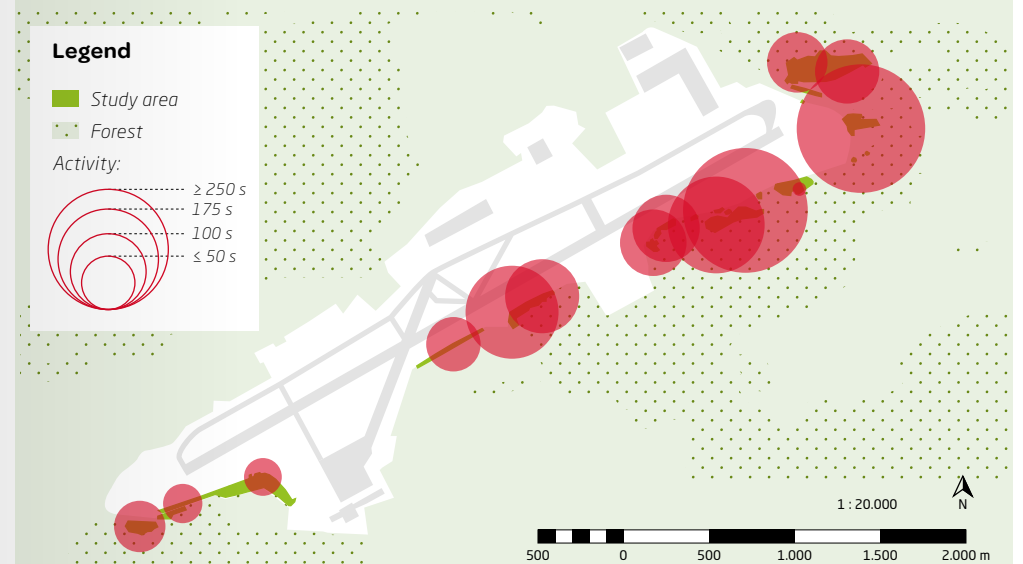
BAT DETECTION

A number of assessments were carried out in the study area to assess the potential of the neighbourhood. This included four detector walks to monitor the presence of bats. Nine night surveys were also conducted. Furthermore, four netting operations were carried out over seven nights to capture bats. The results showed that pipistrelles were the predominant bat species observed in the study area. However, no evidence of bats using roosts was found. Taking all detections into account, the overall level of bat activity can be classified as low to average.



Legend

- Study area
- Forest
- Activity:
 - ≥ 250 s
 - 175 s
 - 100 s
 - ≤ 50 s





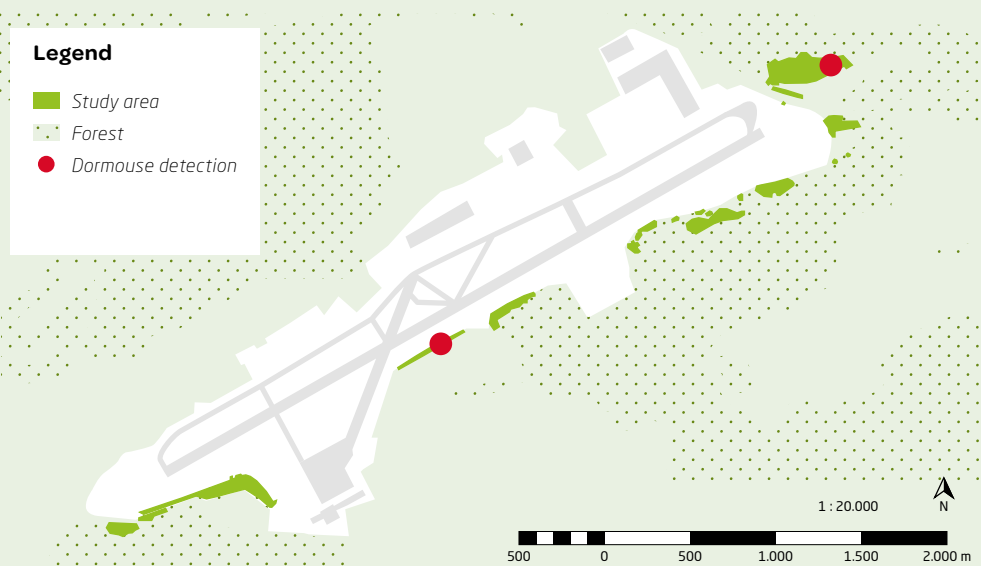
DORMOUSE REGISTRATION

The study used a variety of methods to assess the presence of dormice. A total of 70 nest tubes were deployed at strategic locations. In addition, efforts were made to search for tracks and free nests to identify potential dormouse activity.

Two dormouse sightings were recorded during the study, although no significant population was observed.

Dormice are small nocturnal rodents, typically reaching a maximum height of 8 cm. They are generally widespread and reasonably common in Luxembourg.

However, the main threat to dormice is the loss of their natural habitat due to the clearing of woods, hedges, copses or excessive pruning. This habitat destruction poses a significant risk to their population.

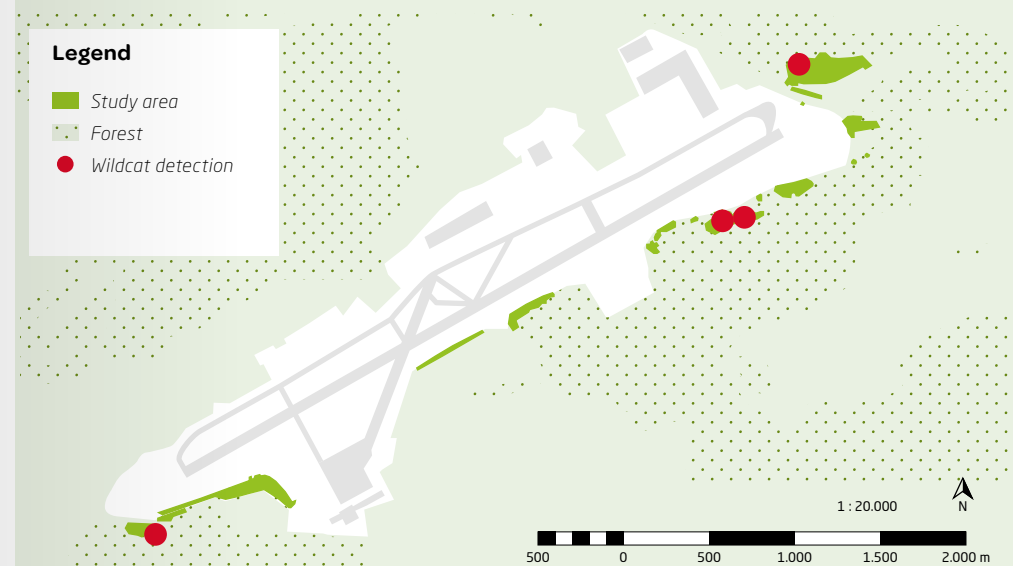
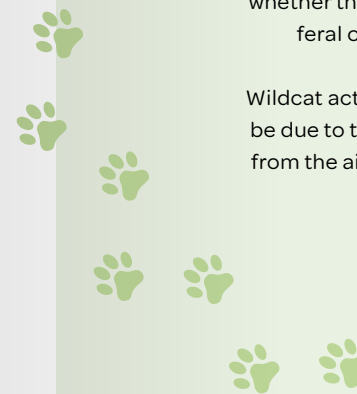


WILDCAT COVERAGE

To assess the presence of wildcats, a comprehensive survey was conducted. Fourteen wild cat cameras were deployed between April and September 2021. During this period, four instances of phenotypic wildcats were recorded in the captured images.

These images depicted what was believed to be a sub-adult animal. However, due to the low detection rate, it is uncertain whether there is a breeding site in the vicinity. In comparison, feral cat activity in the area was observed to be low.

Wildcat activity at the airport was also relatively low. This may be due to the constant high levels of noise and light pollution from the airport and surrounding roads, which may deter the presence of wildcats.



BIODIVERSITY

MORE BEES AT THE AIRPORT

24 HIVES AT THE AIRPORT	296 kg HARVEST 2022 IN TOTAL	700 ha BIO-MONITORING BY BEES
--------------------------------------	---	--

Since 2019, in cooperation with the ANA, lux-Airport has set up four beehives located at the foot of the antenna tower. This collaboration has led to a harvest of 88 kg of honey in 2019, and 120 kg in 2020. 2021 was a less fruitful year, with a single harvest of 30 kg in summer due to unfavourable weather conditions: a mild but very long winter and wet, not very hot spring, which resulted in low flower production.

NEW BEEHIVES

In 2022, lux-Airport's commitment to the preservation and development of bee populations took on a new dimension with the installation of 20 new hives. These hives are spread over two sites suitable for the tranquillity required by bee populations and their positive development. Ten new hives are located in a green space created in front of the new Cargolux Headquarters. This space is dedicated to biodiversity with Benjes hedges for birds, flowering meadows, cairns for reptiles, as well as insect hotels. Ten other hives were installed in a green space set back from the track and close to the forest. These two new sites are each managed by a professional beekeeper:

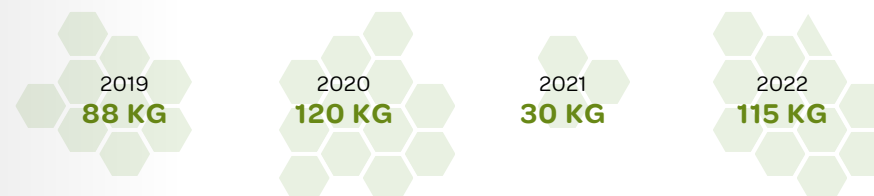
- Un chalet pour les abeilles – in the landside area
- Hunnegesch – in the airside area



One of the hives is "connected" - this means it is equipped with sensors which can detect various parameters of the hive such as temperature, hygrometry, weight and rainfall. Not only does this satisfy our curiosity, it mainly ensures the good health of the bees.

HONEY HARVEST

4 BEEHIVES IN COLLABORATION WITH ANA:



10 BEEHIVES AIRSIDE,
CLOSE TO THE FOREST:



10 BEEHIVES IN COLLABORATION
WITH CARGOLUX:



BEE-O-MONITORING

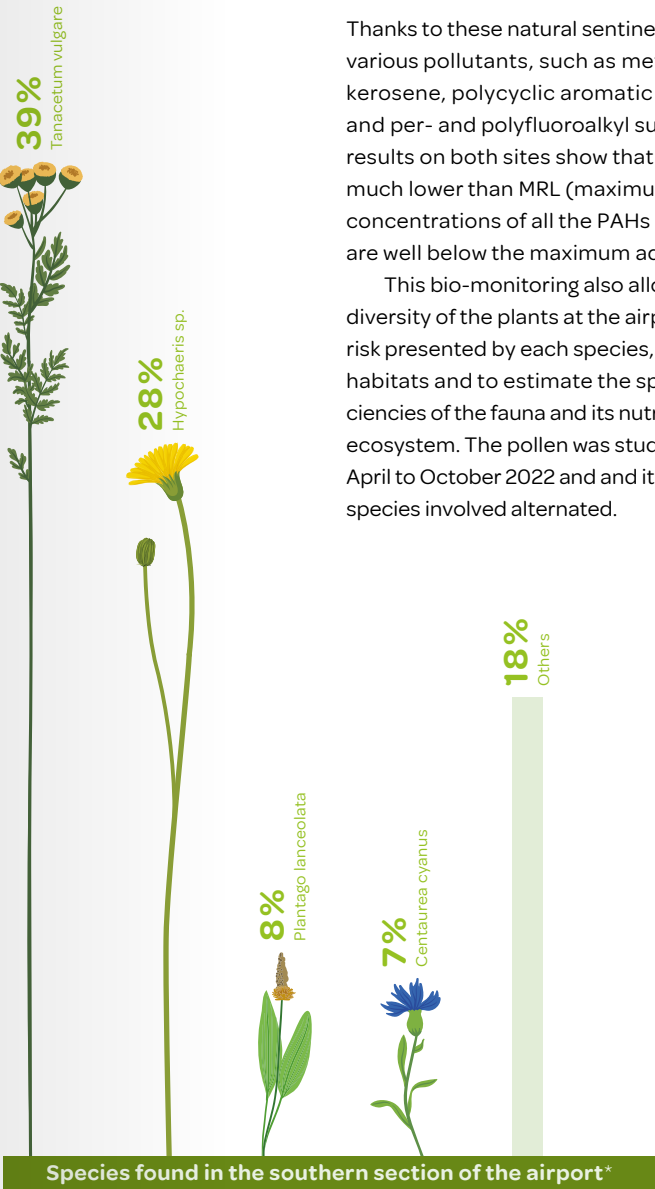
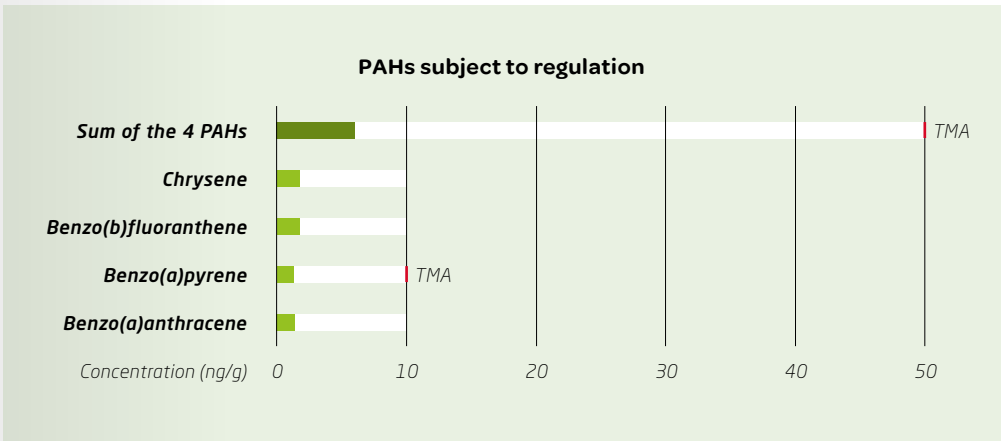
Not only will the bees help to develop biodiversity at the airport site, they will also help us to monitor the air and soil quality at a radius of 2 km. In fact, a bio-monitoring campaign using bee pollen has been set up with the company BeeOdiversity.

Bees, as “natural drones”, collect pollen and nectar. The latter, used as bio-indicators, allow daily and continuous sampling via pollen traps installed on some hives. No less than 8 billion samples per year over 700 ha: no technology can reach this range!

These campaigns are conducted from April to October. Pollen samples of 100 to 200g are collected 4 times during the season. The pollen removed in the process will not mean the bees go short, because it is only 0.3% of their entire harvest.

The results of this bio-monitoring will then make it possible to measure the impact of our improvement measures, in particular the management of green spaces or rehabilitation projects, on local wildlife and the airport environment.

FIRST PLACE
IN LUXEMBOURG
USING THIS FINE
MONITORING
WITH POLLEN



Thanks to these natural sentinels, we are able to analyse various pollutants, such as metallic trace elements, kerosene, polycyclic aromatic hydrocarbons (PAH), and per- and polyfluoroalkyl substances (PFAS). The results on both sites show that the heavy metals rate is much lower than MRL (maximum residue levels) and the concentrations of all the PAHs analysed for the period are well below the maximum admissible levels (TMA).

This bio-monitoring also allows us to establish the flora diversity of the plants at the airport site, to analyse the risk presented by each species, to categorise the different habitats and to estimate the specific and periodic deficiencies of the fauna and its nutritional quality for the entire ecosystem. The pollen was studied over four periods from April to October 2022 and it was revealed that the species involved alternated.

89%
OF THE PLANTS
IN THE SOUTHERN
SECTION OF THE
AIRPORT WERE
GROWING WILD.*

* In period 3: mid-July to end-August 2022

BIODIVERSITY CREATING A BIODIVERSITY ZONE		
12 INSECT HOTELS	11,600 m² DEDICATED TO BIODIVERSITY	6 BENJES HEDGES



PERFECT HOME FOR BEES

The great diversity of plants found on late-mowed meadows and the absence of pesticides make this the **perfect place for our beehives**. They also enable us to carry out biomonitoring of pollutants and plant diversity by analysing pollen samples.



PROVIDING SHELTER WITH STONE CAIRNS

Thanks to stone cairns, **a multitude of species** can find shelter in the area: hedgehogs, insects, shrews, slow worms and several species of lizards.

NEW SPACE FOR BIODIVERSITY

Within the airport, it is not always easy to find areas that can be dedicated to biodiversity without infringing airport safety, especially where attracting birds is concerned. On the other hand, this is possible in areas situated further away from the runway and aircraft parking areas. This is the case for the green zone in front of the new Cargolux Headquarters building on which we have been able to develop a project to create a space dedicated to biodiversity with the following measures:

- Sowing flowering meadows with late mowing which improves biodiversity year after year
- Benjes hedge installations with the wood recovered from pruning
- Cairns for reptiles with stones recovered from the site
- "Insect hotel" competition for Cargolux and lux-Airport staff
- Installation of 10 hives

STAFF-BUILT INSECT HOTELS

Built by the staff, the insect hotels will welcome several species including beneficial or auxiliary species: wild bees, ladybirds, spiders, hoverflies...

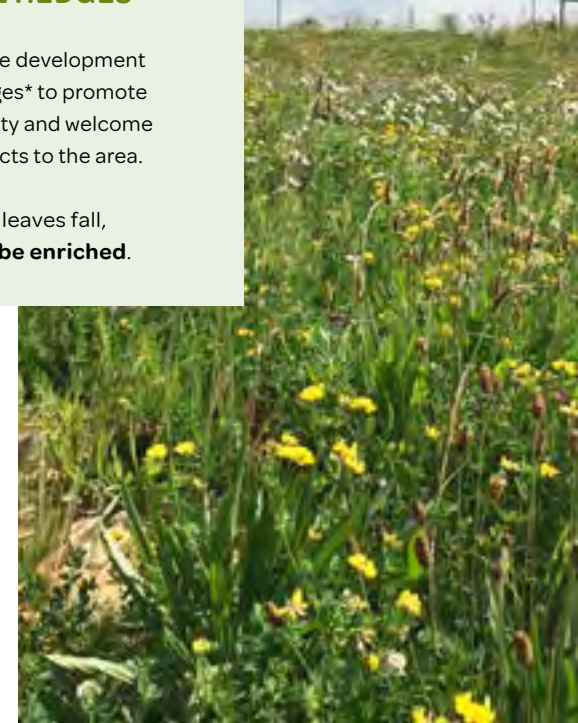
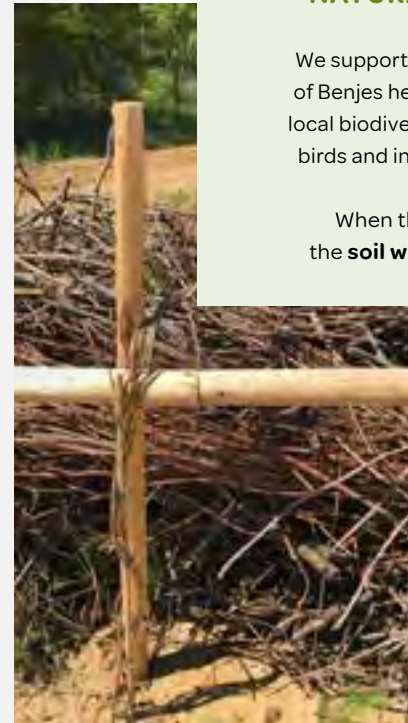
Did you know? Each ladybird eats at least 50 aphids per day.



A WARM WELCOME: NATURAL HEDGES

We support the development of Benjes hedges* to promote local biodiversity and welcome birds and insects to the area.

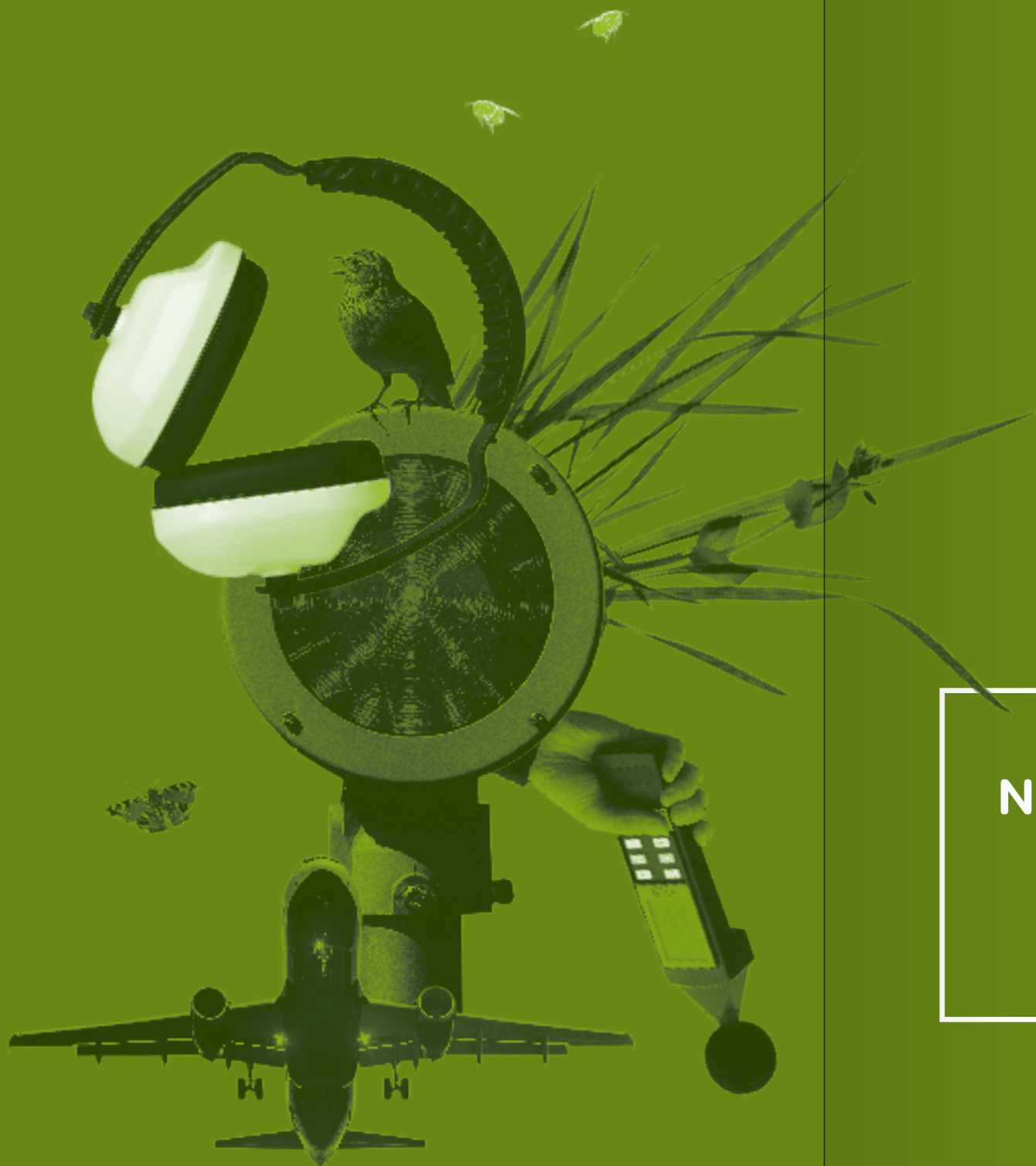
When the leaves fall, the **soil will be enriched.**



*A **Benjes hedges** is a pile of clumped branches held up by side posts. The mixture is partly composed of thorny branches which serve as more effective protective barriers for small fauna. Then climbing plants are installed around it in order to green the entire structure more quickly. These hedges have great ecological value:

- Protection zone for birds, small fauna, insects and pollinators. Hedgehogs, solitary bees, and many other species find precious shelter there.
- Humus restoration zone thanks in particular to fungi and bacterial populations, as well as the saproxylophagous invertebrates that settle there
- Fertile area for the spontaneous growth of species: the branches form a microclimate sheltered from the herbivorous predators of young shoots





NOISE MANAGEMENT

COMBATting NOISE
AND VIBRATION

NOISE MANAGEMENT		
NOISE IMPROVEMENT PROJECTS		
INTRODUCTION OF LANDING CHARGES	NEW ENGINE RUN-UP AREA MAX. DB(A)	TÜV STUDY IMMISSION POINTS
2021	17	16

LUX-AIRPORT'S COMMITMENTS

W

ith the airport's noise advisory board, lux-Airport is committed to improving the noise environment for its neighbours. We are working on the following topics:

- Development of theoretical scenarios for a potential evolution of the airport's operations
- Study for a new engine test area
- Financial incentive for landings

INTRODUCING LANDING CHARGES

In the summer season of 2021, lux-Airport introduced a landing charge to recover the costs for the safe and efficient operation of the airside infrastructure. The landing charges contain several variables based on the type and time of traffic, including an environmental factor index: a noise rating index.

NOISE-BASED LANDING / TAKE-OFF CHARGES

The noise factor is determined by the ACI Noise Rating Index, which specifies the noise performance of any individual aircraft compared to its certified noise limit values. A gradual adjustment of the noise factor is planned in the charges system.

STRUCTURE OF THE LANDING CHARGE

TYPE OF TRAFFIC



CARGO

Scheduled and non-scheduled cargo flights

Factor **70%**



PASSENGER

Scheduled and non-scheduled passenger flights

Factor **100%**



SMALLER AIRCRAFT

Aircraft ≤ 2 tonnes

Fixed fee

TIME AND OPERATION



DAY 6:00–22:59

No surcharges



TAKE-OFF

Factor **100%**



LANDING

Factor **100%**



NIGHT 23:00–5:59

Differentiated surcharges



TAKE-OFF

Factor **200%**



LANDING

Factor **150%**

NEW LOCATION FOR ENGINE TEST RUN-UP AREA

A NEW ENGINE TEST RUN-UP AREA HAS BEEN STUDIED IN ORDER TO REDUCE THE NOISE IMPACT ON THE AIRPORT'S NEIGHBOURS WHILE ENSURING CONTINUITY OF AIRPORT ACTIVITIES.

APPROACH

The calculation of the maximum noise levels $L_{A,max}$ for an engine test in the run-up area (take-off thrust) is carried out using the Aviation Environmental Design Tool (AEDT). The determination and evaluation for different locations was carried out in residential areas, in particular at the boundary of the built-up area "Sandweiler locality" (immission points 2-3-4). The results are then compared between the existing and planned locations for the engine test run-up area.

NOISE IMPACT

Comparison between existing and planned locations for engine test run-up area at lux-Airport:

IMMISSION POINTS		DIRECTIONS 06/24 $L_{A,max}$ [dB(A)]				
No.	Description	existing 06	existing 24	planning LAP	difference 06	difference 24
01	Birelerhaff	73	65	66	-7	1
02	Sandweiler, Rue des Champs	86	89	72	-14	-17
03	Sandweiler, Rue de la Chapelle	79	80	71	-8	-9
04	Rue de Luxembourg	79	78	75	-4	-3
05	Rue de Sandweiler /Val du Scheid (Scheidhof)	68	67	75	7	8
06	Val du Scheid	< 65	67	68		1
07	American Cemetery and Memorial	< 65	65	< 65		
08	Route de Trèves	79	78	73	-6	-5
09	Cité de l'Aéroport	78	78	72	-6	-6
10	Airfield Hotel & Restaurant	76	78	68	-8	-10
TOTAL SUM					-46	-40



Location of the immission points and the current and future test run-up area

INTENSITY DIFFERENCES:

- 1 dB – barely perceptible
- 3 dB – clearly perceptible (means double/half sound energy)
- 6 dB – aircraft noise reduction of Airbus A320neo against A320ceo
- 10 dB – perceived about twice as loud

THE CONCLUSIONS ARE:

- Clearly perceptible reduction of maximum noise levels for 7 immission points (Birelerhaff only 06)
- Increase of maximum noise levels for Scheidhof
- $L_{A,max}$ of 75 dB(A) for built-up areas in Sandweiler not exceeded

The future location meets the requirements of the operational regulation to guarantee an $L_{A,max}$ of 75 dB(A) for built-up areas in Sandweiler. The new site will also include fences (noise barriers) behind aircraft on the engine run-up area, which are not included in this noise calculation.

TÜV STUDY

LUX-AIRPORT IS WORKING ON A GROUND NOISE STUDY BROUGHT ABOUT BY TÜV RHEINLAND.



The strategic airport noise maps developed by the Administration de l'Environnement were carried out according to the calculation methods of the "Règlement Grand-ducal du 2 août 2006" implementing Directive 2009/49/EC of the European Union. In addition to these maps, and in close consultation with the Administration de l'Environnement, lux-Airport is working on a ground noise study brought about by TÜV Rheinland.

In order to complete the data already available, we carried out on-site measures on the aprons and taxiways.

STATUS

The work plan has been submitted to the AEV, including a detailed review of the areas to be considered in the final study. Once the methodology and noise receiver points have been validated, the digital model containing the noisy activities on these areas/plots will be launched.

The results of this study will help us define measures that could have an optimum impact on reducing nuisance noise to our neighbours.





07

AIR QUALITY

MONITORING AND
ANALYSIS

AIR MANAGEMENT		
GROUND AIR QUALITY ANALYSIS		
2019 REFERENCE YEAR	33 PM10 MAX. µg/m³	341 NO _x MAX. µg/m³

STUDY ON THE IMPACT OF GROUND ACTIVITIES

A CALCULATED ANALYSIS AT LUX AIRPORT OF PM10 AND NO_x FOR 2019 HAS BEEN COMPARED WITH MEASUREMENTS TAKEN IN THE SURROUNDING ENVIRONMENT.

We conducted a ground-based air emissions study, which complements the campaign around the airport carried out by the Environmental Administration with LIST in 2018-2019 to determine the impact of airport activities on the region. In the study, we analysed the parameters that are most commonly associated with an airport: NO_x and particulate matter, especially PM10.

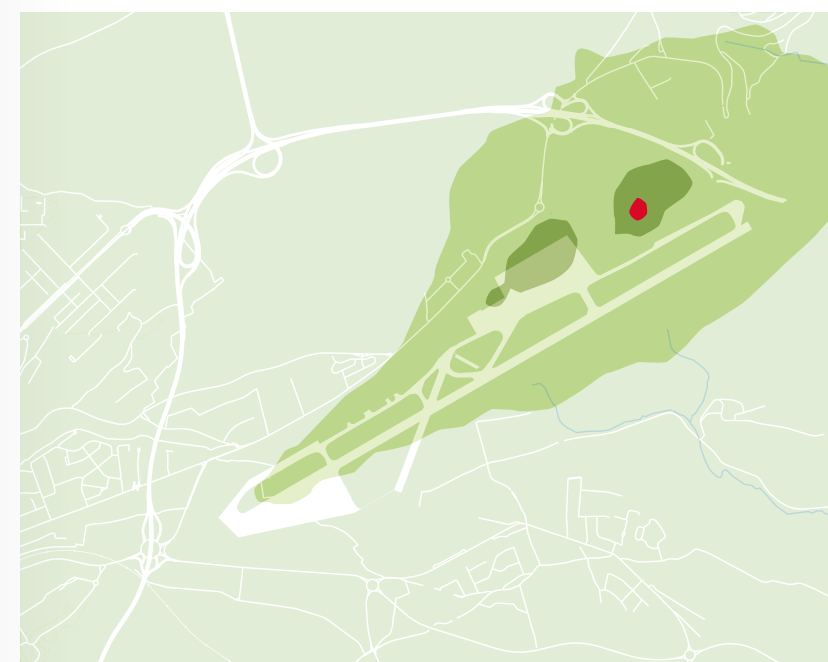
PARTICULATE MATTER

Particulate matter (PM 10) refers to all particles in the air that are smaller than 10 micrometres. Particulate matter comes from traffic, livestock, combustion processes (e.g. in industry) and natural sources (e.g. sea salt). Primary particulate matter is released directly into the atmosphere by human activities. The part of the particulate matter concentration that is formed in the air is called secondary particulate matter. PM10 is one of the substances that contribute to smog.

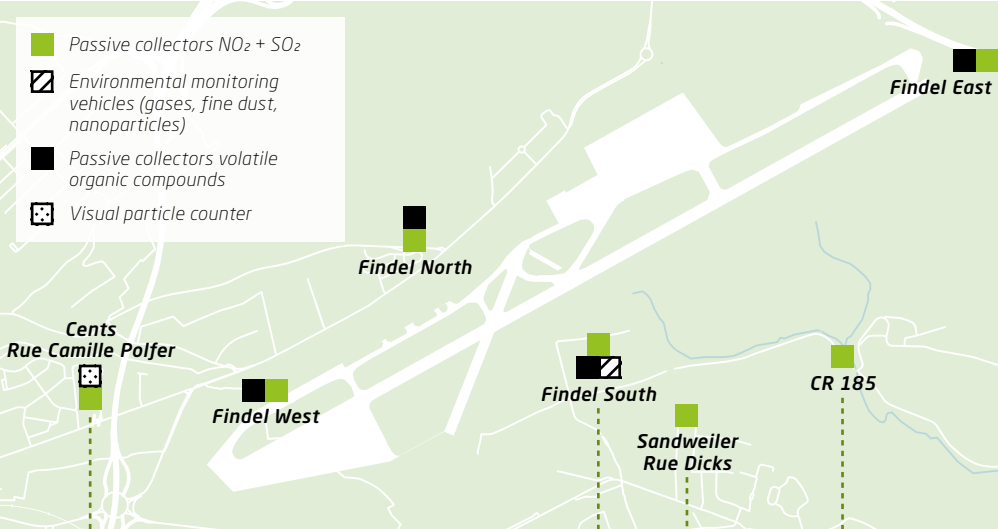
For PM10 there is a threshold of 40 µg/m³ as an annual average, which must not be exceeded, and a threshold of 50 µg/m³ as a 24-hour average, which must not be exceeded more than 35 times per year.

PM10 (ANNUAL AVERAGE)

The calculation was performed for a full year. The highest concentration was found at the centre of the apron cargo with a value of 32.79 µg/m³, which is below the average annual threshold of 40 µg/m³. In general, the highest concentrations were found around the apron (less than 10 µg/m³), followed by the taxiway and runway areas (less than 1 µg/m³) and then rapidly decreasing to less than 0.1 µg/m³ outside the airport perimeter.



PM10 – COMPARISON WITH STUDY
“MONITORING AIR QUALITY AT FINDEL AIRPORT”



**Cents
Rue Camille Polfer**

- Measured annual average: **13.6 µg/m³**
- Calculated annual average from airport emissions: **< 0.1 µg/m³**

The corresponding daily average values are based on half-hour measurements, which do not allow the influence of emissions to be detected at Findel Airport.

**Findel South,
Sandweiler Rue Dicks,
CR 185**

- Measured daily average: **3.2 – 43.1 µg/m³**
- Calculated annual average from airport emissions: **< 0.1 µg/m³**

However, it can be stated that the air pollutants introduced from the area of the airport into the immediately adjacent environmental measuring car only have low concentrations of NO₂ or PM10. The influence of the airport on the area outside the airport perimeter is therefore very low in terms of nitrogen dioxide and PM10.

→ **Airport emissions have a very low impact on PM10 emissions in the environment surrounding the airport as concluded in this report.**

NITROGEN DIOXIDE

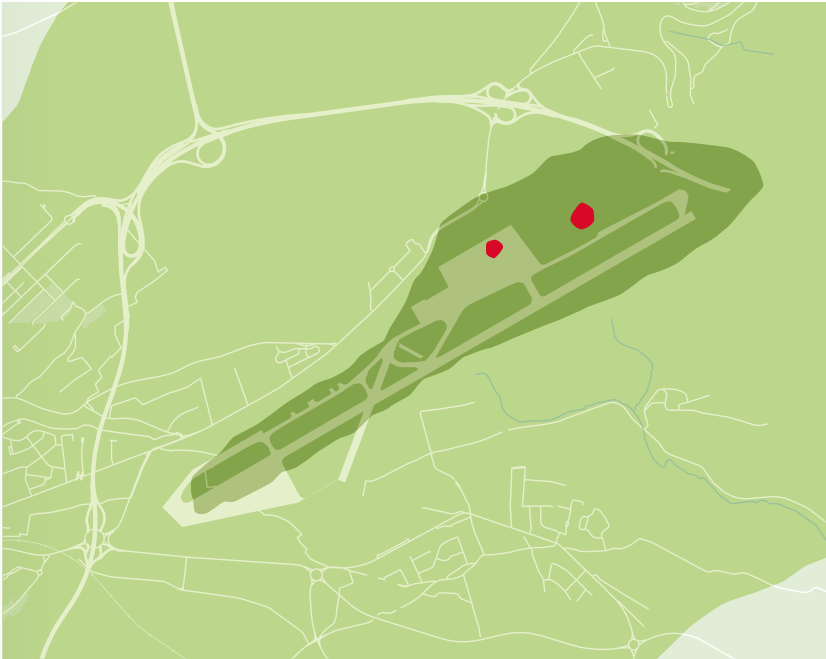
Nitrogen dioxide (NO₂) belongs to a group of highly reactive gases known as nitrogen oxides (NO_x). ICAO certification measures the total NO_x emissions (NO_x = NO + NO₂). However, the proportion of each component varies depending on the engine and thrust setting (Timko et al., 2010a).

Based on the prevailing conditions in aviation, an average f-NO₂ value of 0.15 is recommended for the fraction of NO_x emitted as primary NO₂ from these sources, except for the taxiing phases, for which a ratio of 1 is used.

NO_x (ANNUAL AVERAGE)

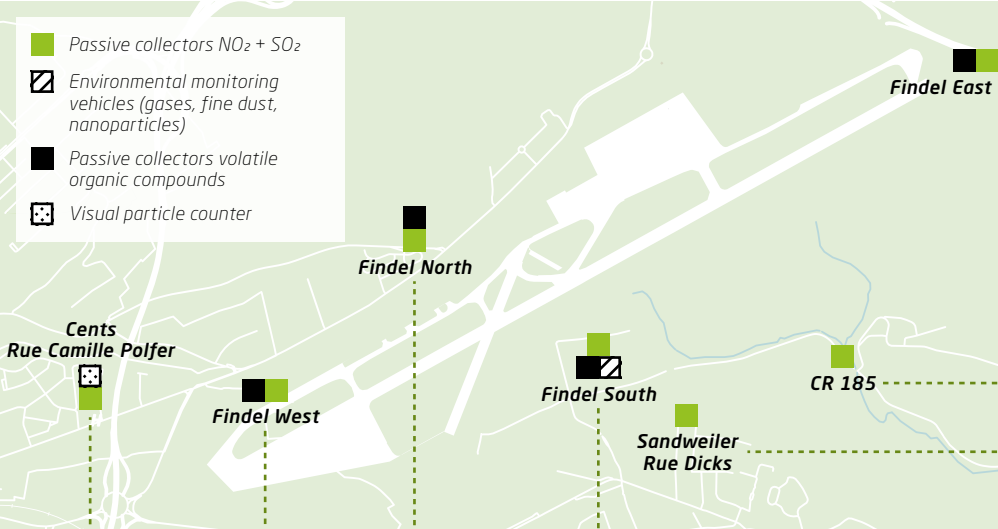
The calculation was performed for a whole year. The highest concentrations were found at two locations in the middle of the apron, both cargo and commercial, with a value of 341.06 µg/m³. This high concentration quickly drops to lower levels.

In general, the highest NO_x concentrations were found throughout the airport area with values in the tenths of µg/m³. The area surrounding the airport showed a concentration of less than 10 µg/m³. The level drops to less than 1 µg/m³ at a distance of at least 4 km from the airport (more in the direction of the runway).



NO_x [µg/m³]
● 100–341.06
● 10–100
● 10–10
● 0–1

NO₂ – COMPARISON WITH STUDY
“MONITORING AIR QUALITY AT FINDEL AIRPORT”



Findel West

- Measured annual average: **13.1 µg/m³**
- Calculated annual average from airport emissions: **~ 1.5 µg/m³**

Ratio NO₂/NO_x = 0.15

Cents / Rue Camille Polfer

- Measured annual average: **13.0 µg/m³**
- Calculated annual average from airport emissions: **0.15–1.5 µg/m³**

Ratio NO₂/NO_x = 0.15

Findel South

- Measured annual average: **9.9 µg/m³**
- Calculated annual average from airport emissions: **0.15 – 1.5 µg/m³**

Ratio NO₂/NO_x = 0.15

Findel North

- Measured annual average: **11.3 µg/m³**
- Calculated annual average from airport emissions: **1–10 µg/m³**

Ratio NO₂/NO_x = 1 (*conservative)

Findel East

- Measured annual average: **15.9 µg/m³**
- Calculated annual average from airport emissions: **1.5–15 µg/m³**

Ratio NO₂/NO_x = 0.15

CR 185

- Measured annual average: **13.5 µg/m³**
- Calculated annual average from airport emissions: **0.15–1.5 µg/m³**

Ratio NO₂/NO_x = 0.15

Sandweiler / Rue Dicks

- Measured annual average: **8.8 µg/m³**
- Calculated annual average from airport emissions: **0.15 – 1.5 µg/m³**

Ratio NO₂/NO_x = 0.15

→ **Airport emissions at Findel East and Findel North are in the same range as the measured annual average. For the other sites, the calculated aviation emissions are a fraction of the total emissions measured (ratio of 1/10).**

CONCLUSIONS

1. The airport's emissions of particulate matter (PM10) and NO_x are centralised inside the airport and dispersion outside is very low.
2. The annual average of the highest concentrations of PM10 remains below the average threshold.
3. The calculation of dispersion of emissions due to ground airport activities shows it to be weak, which confirms the hypotheses and conclusions made in the final report “Monitoring air quality at Findel Airport”.



AIR MANAGEMENT ANTI-SMOG		
HYDROGEN-BASED TECHNOLOGY	AIR EMISSIONS -80%	SOLAR IMPULSE CERTIFIED

The Anti-smog technology for vehicles is integrated with existing technology in internal combustion engines and acts pre-combustion. In other words, the technology acts before the combustion process takes place.

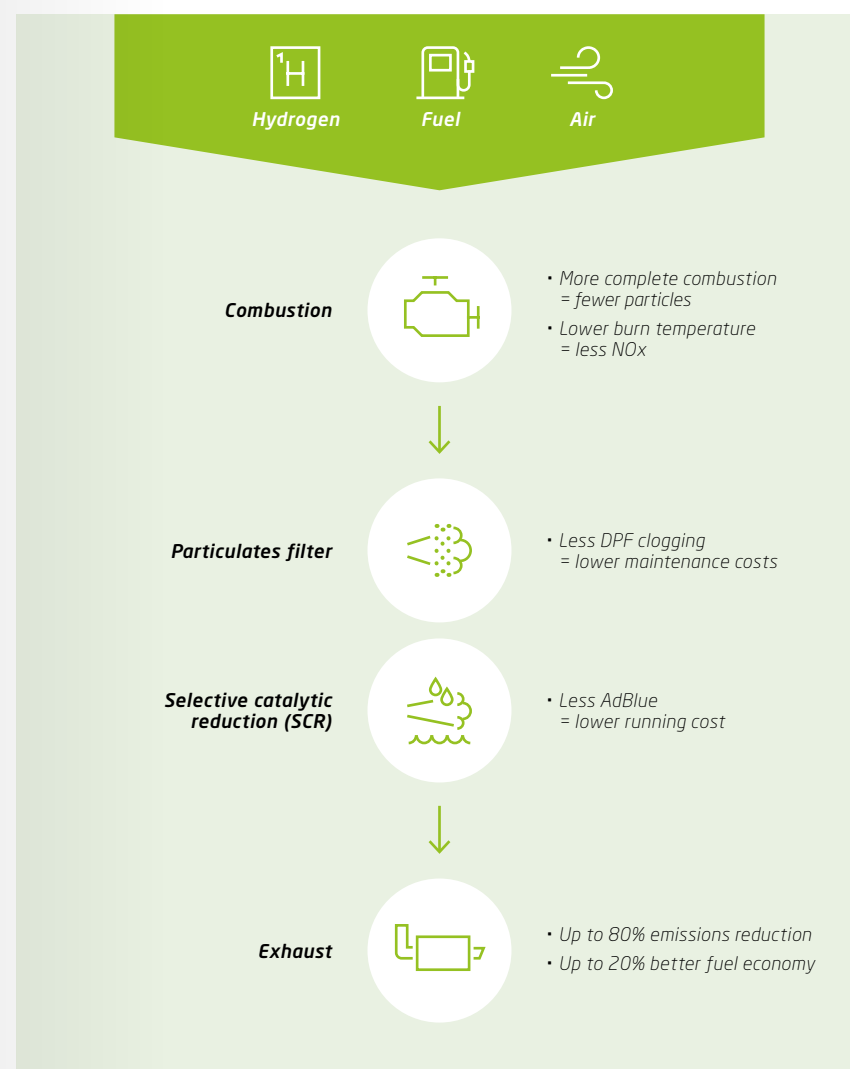
The solution is based on an innovative principle for improving hydrogen fuel. Adding small amounts of hydrogen to the air-fuel mixture helps to reduce exhaust emissions, including particulate matter and NOx. This process has been adapted to allow its implementation on a smaller scale in vehicles.

The process is based on the generation of small amounts of hydrogen onboard the vehicle, using the principle of electrolysis of a water-based potassium electrolyte solution. This small amount of hydrogen is then added to the vehicle's air-fuel mixture prior to combustion. The hydrogen then allows the fuel to burn more completely, reducing the amount of unburned gases and particles.

Unlike filters or selective catalytic reduction, which are post-combustion technologies used today, hydrogen enrichment is a pre-combustion solution, which is at the heart of the proposed innovation.

PRE-COMBUSTION TECHNOLOGIES

This technology is suitable for diesel engines in vehicles over 5 years old. At lux-Airport, with our commitment to a policy of renewing our fleet according to our roadmap towards neutrality, we do not have this type of vehicle. However, we have decided to install it in one of our mobile diesel masts, which illuminate certain areas of the aircraft parking aprons. This will allow us to compare its impact with that of an un-equipped mobile mast during the test phase. Depending on the results, we will extend this to all of our mobile masts and encourage the use of this technology in the ground support equipment of our stakeholders. Through this initiative, we hope to reduce emissions by up to 80% and fuel consumption by up to 20%.



IN BRIEF

AWARENESS CAMPAIGN

To ensure the effectiveness of its environmental policy, lux-Airport believes in raising environmental awareness by educating employees about the airport's specific environmental priorities, for examples sorting waste, environmental emergency procedures and so on.

lux-Airport also conducted environmental awareness campaigns aimed at passengers. In summer 2022, we organised the 'La Fresque du Climat' (climate fresco) sessions, a serious game about climate change aimed at passengers and based on collective intelligence and creativity. In just a few minutes, passengers could retrace the causes of climate change and discuss the consequences, challenges and changes they saw coming or wanted to see: an interactive approach that was well-received by the passengers.

Getting as many people onboard as possible to understand climate issues means giving ourselves the means to participate in the essential transformation of our societies.



VISIT OUR WEBPAGE

Of course, we also raise awareness about environmental issues externally. To this end, we have created a dedicated "Environment and Sustainability" section with updated information on our regular website.



ENVIRONMENTAL EMERGENCY PROCEDURES

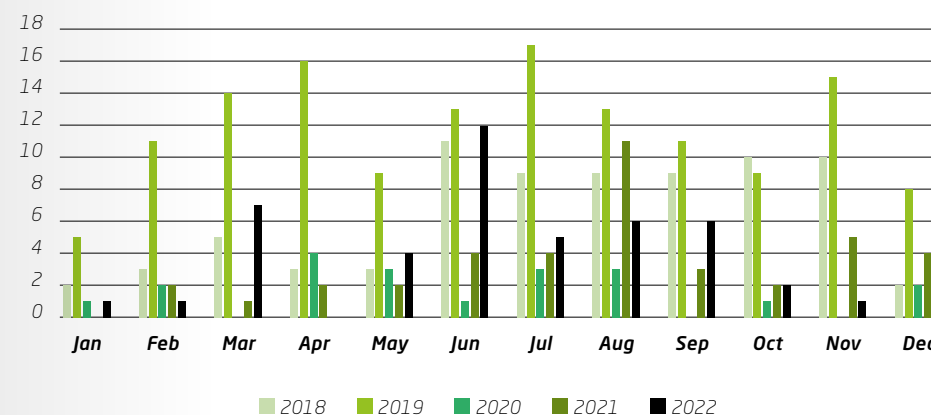
As part of our measures to preserve the quality of drinking water in Luxembourg City, lux-Airport has implemented a new procedure for managing environmental emergencies in collaboration with CGDIS and Ponts&Chaussées. This procedure, in addition to the existing one, aims to activate the environmental emergency team of the airport fire brigade as quickly as possible.

As soon as they arrive on the scene, they have the necessary equipment and skills to stop the problem, prevent it from spreading into the water network

or the natural environment, clean up the area and remove the contaminated waste according to its type. If there is a risk of the pollutant spreading into the networks, the airport infrastructure manager is informed in order to contain the product as closely as possible to the source and to ensure appropriate treatment.

The procedure also provides for an automated alert to be sent to the relevant actors, such as the Administration de la Gestion de l'Eau and Luxembourg City.

Number of occurrences per month



OUR GOALS

1. NET ZERO 2030 COMMITMENT



lux-Airport actively promotes the production and use of renewable energy and since 2014, buying only renewable energy specifically, 100% hydroelectricity.

The commitment to the Airport Carbon Accreditation programme means that we aim to achieve the neutrality specified by the level 3+ requirement in 2022. lux-Airport plans to reach the level 4+ requirement by 2025, as defined in the road-map to reach real neutrality by 2030.

The first star in the Lean & Green certification was awarded in 2019 and the second star is planned for 2025. In parallel, lux-Airport is strongly committed to reducing its energy consumption with a dedicated task force. Each new project includes renewable energy.

2. WATER MANAGEMENT



Located in three different ground water protection areas, lux-Airport is working closely with the dedicated entities to ensure the ground water's quality, as well as taking steps towards developing environmental emergency management procedures to avoid any risk.

The management of wastewater, currently being improved by new facilities, is reinforced by the removal of the de-icing water directly on stand to optimise the treatment.

3. WASTE MANAGEMENT



lux-Airport is continuously working to reduce the waste production at source: it strives to stop single-use plastic by promoting re-usable items, increases the recycling rate and searches for new solutions for recycling and recovering. The management is certified by the SuperDrecksKescht label.

4. SOIL MANGEMENT



lux-Airport is developing a land-use plan for the various different zones, enabling the necessary anti-pollution measures to guarantee a healthy environment and prevent contamination. For each project, the soil quality is analysed and restoration realised.

5. BIODIVERSITY



The preservation of fauna and flora is taken into account in each new project and the necessary measures planned to avoid any kind of disturbance.

The promotion of biodiversity involves a range of different projects, such as, developing beehives, creating new habitats and improving the quality of environmental life by stopping the use of glyphosate anywhere in the airport.

6. NOISE MANGEMENT



lux-Airport is conducting ground noise studies to define noise pollution and define an action plan. lux-Airport is also engaged in the airports noise advisory board in order to improve the noise environment for its neighbours.

7. AIR QUALITY



Air quality on the ground is strongly linked to aircraft routes and vehicle use. Based on a ground air quality study, lux-Airport has identified areas for improvement and has already tested new technologies for reducing air emissions.

KEY FIGURES

We measure our sustainability-related performance by using meaningful key figures. They document progress, but also indicate necessary improvements, and thus form the basis for managing our sustainability activities on our journey to achieving 100% sustainable business operations.

	2018		2019		2020		2021		2022	
Traffic Unit <i>(PAX + T Cargo/100)</i>	12,987,669	→	12,949,575	→	10,899,270	→	13,032,662	→	13,805,366	
ENERGY										
Electrical vehicles for staff <i>(%)</i>	29%	→	32%	→	36%	→	29%	→	29%	
Fuel for vehicles <i>(litres)</i>	35,041	→	33,376	→	29,870	→	51,614	→	43,015	
Fuel for heating <i>(litres)</i>	424,343	→	451,468	→	325,953	→	362,120	→	293,780	
Energy consumption for heating <i>(kWh)</i>	4,095,910	→	4,131,760	→	4,439,832	→	5,438,804	→	4,184,478	
Energy consumption for cooling <i>(kWh)</i>	5,048,650	→	4,905,040	→	1,987,230	→	3,451,270	→	3,878,700	
Overall energy consumption <i>(kWh / hydroelectricity)</i>	15,992,734	→	16,463,927	→	15,001,330	→	15,197,124	→	15,558,050	
WASTE										
Sorted waste <i>(tonnes)</i>	168.9	→	116.9	→	54.2	→	73.5	→	124.6	
Residual waste <i>(tonnes)</i>	272.8	→	284.5	→	123.2	→	145.2	→	284.8	
Total amount of waste <i>(tonnes)</i>	441.7	→	401.5	→	177.4	→	218.7	→	409.4	
Recycling rate <i>(%)</i>	38%	→	29%	→	31%	→	34%	→	30%	
GREENHOUSE GAS EMISSIONS										
CO₂ emissions * <i>(t CO₂)</i>	2453.7	→	2655.3	→	929.44	→	1080.02	→	875.09	
CO₂ relative emissions <i>(kg CO₂ / TU)</i>	0.189	→	0.205	→	0.085	→	0.083	→	0.063	

NATURALLY SUSTAINABLY PRODUCED

A fully sustainable report shows that we take our environmental responsibilities seriously. This is why this Sustainability Report includes not only 'resource-saving' content, but is itself produced sustainably. By choosing to print in accordance with the 'Blauer Engel' scheme, we are also helping to minimise our carbon footprint – which includes using PURE inks and 100% recycled paper to reduce the need for virgin raw materials and minimise waste.



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RECYCLED PAPERS**



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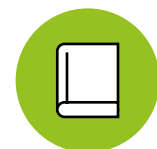
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EMISSIONS**



**FLAWLESS
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**LEGAL
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- emissionsarm gedruckt
- überwiegend aus Altpapier

JMO

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MOVING FORWARD

