

DLR nachhaltigkeit



Report 2018/19





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Report 2018/19



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DLRnachhaltigkeit

STATEMENT ON SUSTAINABILITY BY THE CHAIR OF THE EXECUTIVE BOARD



Anke Kaysser-Pyzalla, Chair of the Executive Board.

Dear reader,

As Chair of the Executive Board of the German Aerospace Center (DLR), it's my personal mission to increase our focus on sustainability and expand our work in this area. To continue on our charted course, keeping our end goal in mind: achieving balance. This tightrope act isn't always easy – as we've seen during the COVID-19 pandemic. Nevertheless, we have succeeded in carrying out excellent research projects in many areas where we can support sustainability research: whether it's emission-free flight, fuel-cell powered cargo bikes, wooden car components, tomatoes in space, the global monitoring of forests or educational projects on sustainability, to mention just a few. And if you also take into account our contributions to the Sustainable Development Goals (SDGs), it's a considerable achievement. The political frame of reference provided by the SDGs ensures sustainable development at economic, social and environmental levels worldwide.

At DLR, we seek to incorporate all aspects of sustainability into our work, whether in our interactions with fellow humans and co-workers; the impact of our activities on nature, the environment and society; or our fundamental processes. It is the responsibility of all of us to keep processes alive, to constantly develop sustainability in a transparent way, and where necessary to jointly resolve any conflicting research goals.

At the beginning of 2019, DLR met the criteria of the German Sustainability Code; we intend to continue to rise to this challenge in the future. We have also joined the United Nations Global Compact, taking another step towards sustainable research and practice. These

fundamental principles are embedded in our code of conduct and form the basis for sustainable development, giving us the visibility we need to continue with our balancing act.

Like its predecessors, this third sustainability report aims to spark interest in our research topics and in DLR in general. The topics of climate change, energy efficiency, the circular economy and sustainability are of utmost importance. Thanks to our broad portfolio and the synergic potential of scientific excellence – from pure research through to applied technologies – we are able to provide vital contributions and stimuli for transforming Germany and other countries into climate-neutral societies.

This report also seeks to encourage you to do everything you can to promote sustainability. Because even small changes have an impact.

We hope you enjoy reading this report. If you have any questions or comments, please write to Nachhaltigkeit@dlr.de.

We look forward to hearing from you!

Anke Kaysser-Pyzalla, on behalf of the DLR Executive Board

HIGHLIGHTS



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DIVERSITY AT DLR

In 2019 we added a 'Rainbow Portal' to the DLR Wiki page. The platform contains a lot of background information and tips related to sexual orientation and gender diversity. It also gives our staff the opportunity to network and share their views.



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ACTIVE FITNESS BREAKS

People working in offices usually spend hours at their desks with minimal movement. This can result in health problems, including back pain. To address the problem, colleagues at the DLR site in Bonn are being offered Bewegte Pause exercise classes, while those at DLR in Berlin can take advantage of Pausenfit. Trained DLR project management staff run the sessions to help their colleagues. Simple power exercises help strengthen muscles, while stretches help to relax them, particularly in the neck and shoulder area. The moderate intensity of the exercises means they are suitable for staff of all ages and physical ability, delivering benefits without the need for a full-blown sweat-inducing workout. Staff exercise in their everyday clothes.

WATER INSTEAD OF REFRIGERANTS

At the DLR Weilheim site, work is under way to test a novel, environmentally friendly method of cooling – the eChiller. The system uses water as a coolant, making it significantly more environmentally friendly than other refrigeration methods. The principle isn't a new one: it's based on direct evaporation, compression, condensation and release of water and steam in a closed cycle. Using water means fewer moving parts, less maintenance and no need for engineers. The first few months of testing have shown that the eChiller delivers significant energy savings compared with conventional cooling methods.



 **Deutscher NACHHALTIGKEITS Kodex**
Berichtsjahr 2018

GERMAN SUSTAINABILITY CODE


In November 2019, DLR published a DNK (German Sustainability Code) statement on its website, confirming its compliance with the 20 DNK criteria including those related to strategy, stakeholder consultations, political influence and equal opportunities measures. "It's exciting to look back over the past few years and see how awareness is gradually changing and how people have actually started to enjoy addressing these issues," says the DLR Chief Sustainability Officer. "I'm proud on behalf of all those who have made a contribution."

FUEL CELLS IN FLIGHT

The greatest ambition of civil aviation is emission-free flight. One way this could be achieved in the long term would be by converting hydrogen into electricity. That is why at DLR we are betting on electrification, which paves the way for a fuel-cell powertrain. The plan is to develop and validate this in collaboration with Aero Engines. Fuel cells generate no emissions other than water and they are highly efficient. Our flight demonstrator is a Dornier 228, which will be equipped with a hydrogen fuel cell and an electric propeller engine on one side and then flight tested. Its maiden flight is expected to take place after 2026.



NEW FORMS OF PARTICIPATION



WORKING OUT LOUD is an approach that encourages the creation and extension of networks and promotes optimal knowledge sharing through different channels. Familiar established and modern methods are used to communicate with and motivate people. Sharing knowledge encourages us to learn from one another, reducing overlap and enabling us to learn from the mistakes of others and support one another with good ideas. The result is more efficient and streamlined work, saving time and achieving results more quickly. Since 2018 we have been helping DLR staff to implement self-learning programmes and WOL in their everyday work in many different ways.

NETWORKING FOR SUSTAINABILITY



The Leibniz Conference in September 2018 was a good opportunity to exchange information and network with other research institutes. The audience was diverse and included research and administrative staff as well as decision makers, special interest groups such as NGOs and private citizens. In this interdisciplinary environment, 10 different sessions addressed various themes including how researchers can incorporate social challenges into their programmes, and how interdisciplinary cooperation can generate the knowledge needed to make progress towards sustainability.

THE SDG@DLR INITIATIVE



As a leading research organisation, we want to face the pressing social, economic and environmental challenges of our times with cutting-edge research – and share the results. Our brochure entitled 'SDGs@DLR Initiative' aims to help us achieve this. It describes our approach to using research and technological development to support national and international efforts to achieve Agenda 2030. As part of our sustainability management, the brochure acts as a bridge between DLR research and international cooperation and sustainable development partnerships.

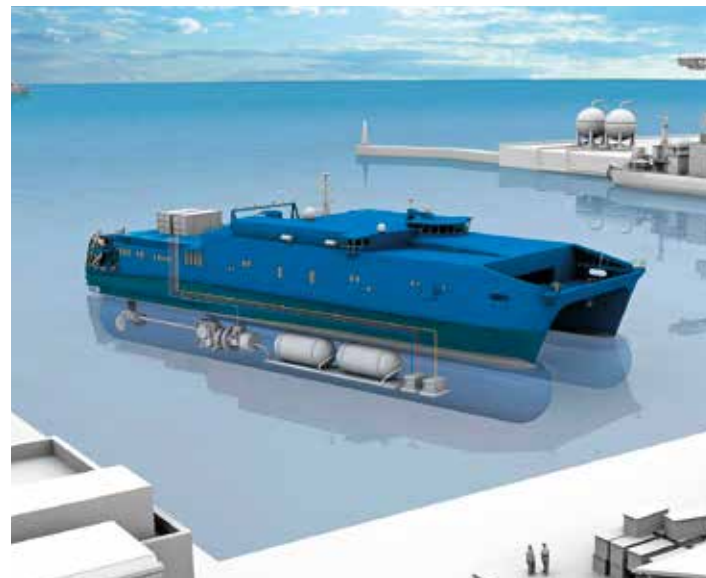
CHARGING STATIONS AT DLR

The promotion of alternative propulsion systems is a decisive factor in reducing carbon emissions and helping to achieve a sustainable future. At DLR we want to play our part, which is why we are planning to introduce extensive charging stations at our major sites in order to encourage our staff to switch to electric vehicles and to make the growing DLR fleet of electric vehicles more attractive. DLRDesign in Cologne has already set up charging points in preparation for the rollout.



SUSTAINABILITY – A BALANCING ACT

This is the title of the May 2020 issue of the DLR employee magazine **echtzeit**. From research topics on green hydrogen and space monitoring, through to work-life balance, equal opportunities in research and management, energy efficiency in new construction at DLR facilities and the DLR rideshare centre, the issue covers a variety of topics, giving staff a good overview of sustainability at DLR and beyond.



COMPETITION OF VISIONS

The aim of DLR's 'Competition of Visions' is to give greater visibility and scope to the creative potential of DLR researchers. The competition aims to encourage particularly younger DLR staff to submit exciting new proposals, with a focus on thinking outside the box. In 2018/19, the Competition of Visions received 54 entries. Two entries in the fields of energy and transport were selected by the DLR Executive Board to receive 180,000 euro each over their lifetime; three in the fields of aeronautics and energy were awarded 80,000 euro each over their lifetime.



DLR IS GROWING

Germany's technological capacity has been strengthened by new DLR sites: in 2019 seven new institutes were given green light, and in 2020 two institutes for transport and energy transition were added. Cutting-edge research related to other societal challenges will focus on quantum technology, space weather, storage technologies for sustainable energy provision, safety on land, water and air, and unmanned spaceflight. These new institutes have created new specialist workplaces.

I. Background

I.1 DLR AT A GLANCE

DLR is the Federal Republic of Germany's research centre for aeronautics and space. We conduct research and development activities in the fields of aeronautics, space, energy, transport, security and digitalisation. The Space Administration plans and implements the national space programme on behalf of the federal government. Two DLR project management agencies oversee funding programmes and support knowledge transfer.¹

LOCATIONS

DLR has grown considerably in recent years. The organisation has 10,000 employees at 30 locations in Germany: Cologne (headquarters), Aachen, Aachen-Merzbrück, Augsburg, Berlin, Bonn, Braunschweig, Bremen, Bremerhaven, Cochstedt, Cottbus, Dresden, Geesthacht, Göttingen, Hamburg, Hanover, Jena, Jülich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Oldenburg, Rheinbach, Stade, St. Augustin, Stuttgart, Trauen, Ulm, Weilheim and Zittau. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

MISSION STATEMENT AND RESEARCH OBJECTIVES

Climate, mobility and technology are changing globally. DLR uses the expertise of its 54 research institutes and facilities² to develop solutions to these challenges. All of our employees share a mission – to explore Earth and space and develop technologies for a sustainable future. In doing so, DLR contributes to strengthening Germany's position as a prime location for research and industry.

DLR's capability is based on its highly trained and highly motivated researchers, who are given the opportunity to continually improve their qualifications while working. We attach great importance to equal opportunities. Flexitime, part-time working and special support measures ensure that our employees can achieve a good work-life balance, and we have continued to provide these conditions even during the pandemic.

NETWORKS AND JOINT VENTURES

DLR holds shares in a number of organisations: for more details, please visit our website³. Networking is also important to DLR, which is why it is a member of a variety of organisations, projects and associations. Good relations and exchange promote knowledge transfer, business relations and excellence in science. DLR is a member of the Association for European Sustainability and Eco-Management (VNU). Its responsible action and reporting meet the criteria of the German Sustainability Code (DNK)⁴. In early 2021 DLR became a signatory of the UN GlobalCompact⁵, as the Chair of the DLR Executive Board mentioned in her introduction to this report.

DLR is funded by the Federal Ministry for Economic Affairs and Energy through a Bundestag resolution. Our staff are paid according to the collective agreement of the public service workers' union (TVöD). You can find more information about DLR's finances in the Organisational Measures section.

¹ The Project Management Agencies are responsible for funding projects, mainly on behalf of ministries or foundations.

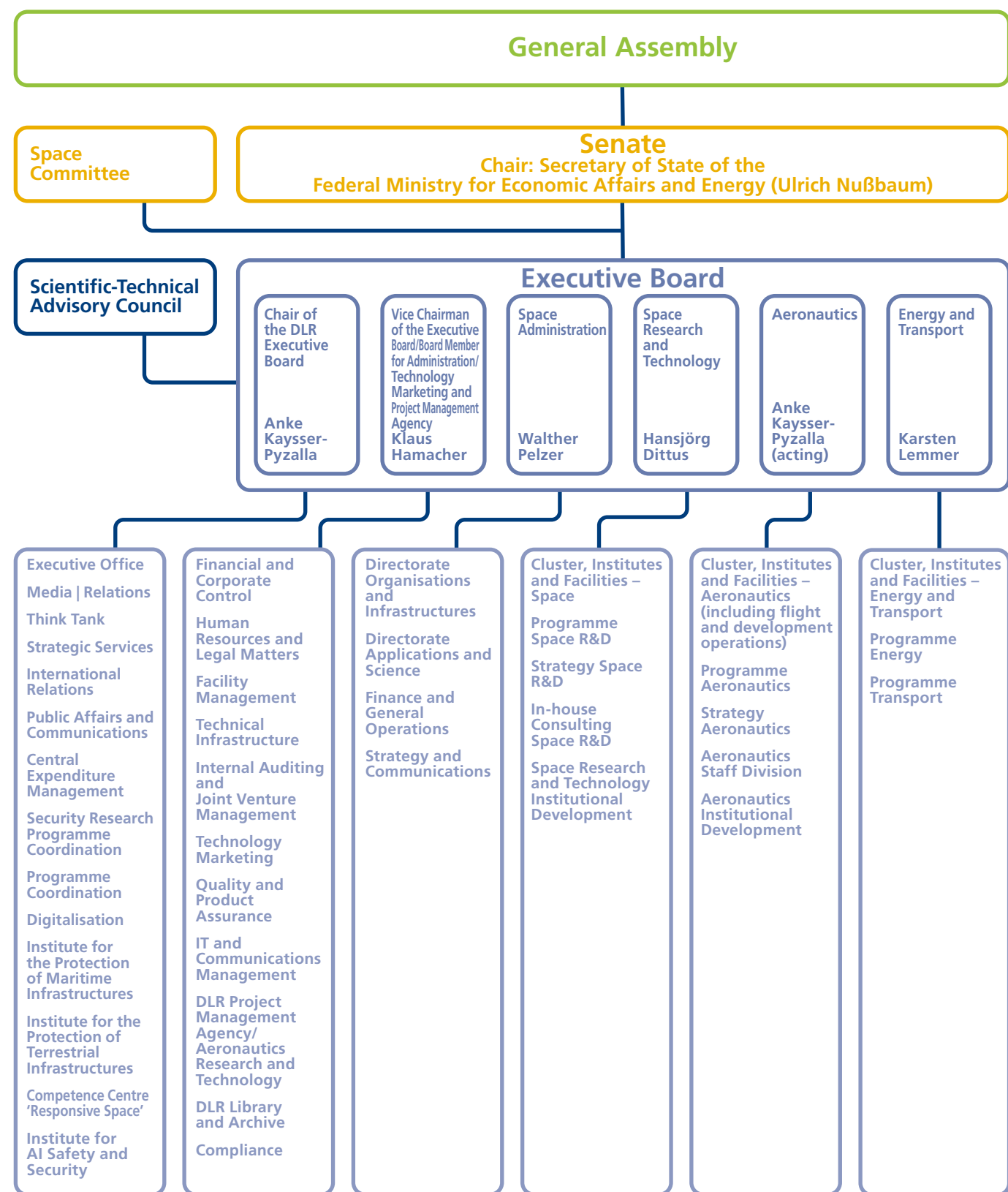
² For a full list of DLR institutes, go to: <https://www.dlr.de/EN/organisation-dlr/dlr/institutes-and-facilities.html>

³ For an overview of DLR's joint ventures, see:

<https://www.dlr.de/content/de/downloads/organisation/beteiligungen-des-dlr.pdf>

⁴ <https://datenbank2.deutscher-nachhaltigkeitskodex.de/Profile/CompanyProfile/13595/de/2017/dnk>

⁵ <http://unglobalcompact.org/participant/142403>



Officers:

- Sustainability officer
- Export control officer
- Equal opportunities officer
- Quality and environmental management officer
- Compliance and anti-corruption officer

- IT security officer
- Energy management officer
- Education and outreach officer
- Safety and environmental protection officer

Revised: 01/02/2021

I.2 OUR SUSTAINABLE APPROACH

To provide continuity with the DLR Sustainability Report for 2016/17, let's start with the same concepts: our organisational structure, stakeholders, benchmarking and central themes. As the following pages will show, we have been busy in all these areas to varying degrees. Before the Coronavirus pandemic, we introduced new formats to encourage interaction with a view to mainstreaming sustainability issues and incorporating new ideas and influences. These initiatives included a presentation given during the parallel dialogue of the Executive Board in June 2019, sessions led by the core sustainability team and workshops for DLR colleagues. Other examples of our approach to sustainability include presentations at works councils and 'establishing a presence' with a stand at the DLR Oberpfaffenhofen open day. The broad reach of this theme is also reflected by the fact that we devoted a whole issue of the employee magazine *echtzeit* to the topic of sustainability.

overarching process for developing and steering the DLR strategy. In the period covered by this report, some sub-processes were finalised, responsibilities were allocated according to the RASCI model and the length of the sub-processes were defined, with full involvement of the DLR sustainability officer. However, it is pertinent to note that changes in the DLR Executive Board usually lead to changes in strategic direction.

Digitalisation has driven us forward in many areas; however, the interconnection of environmental, work safety, quality and energy management data is a challenge that we will have to address in the near future.

The issue of sustainability has become increasingly important, both internally and externally. Networking with other research institu-



FROM BOTTOM-UP WORKING GROUP TO RULES OF PROCEDURE

When staff at the DLR Project Management Agency (DLR-PT) set up a sustainability working group in 2012, they had one aim: to incorporate aspects of sustainability into their everyday work. Since then, the working group has implemented numerous measures, including contributing towards environmental certification and making changes to foster a culture of sustainability in project management. The importance of sustainability has continued to grow in DLR-PT. As a result, the sustainability working group has been working closely with the Project Management Agency as an official committee within its structure. It proposes ideas and measures and acts as internal multiplier and a point of contact for staff on matters of sustainability. It also advises management on planning and implementing the sustainability strategy and operational objectives and provides inputs for planning and implementing appropriate measures in areas and departments. All DLR-PT areas, environmental management and quality management officers, departments, works councils and the disability spokespeople are represented in the working group. The group also holds regular exchanges with the DLR sustainability officers to ensure maximum success in the drive for sustainability.

Strategically and structurally, some sustainable approaches are quite prominent while others pass almost unnoticed. Phase two of the organisational development process is complete. Establishing sustainability in the DLR management guidelines remains on the agenda, and sustainability is gradually becoming embedded in everyday operations, thanks in part to the appointment of a sustainability officer. The DLR Strategy 2030, mentioned in our last report, is still our guiding principle. Work has also begun on creating an

tions, in particular via the sustainability task force within the community of the Helmholtz Association of German Research Centres, is particularly important for making progress towards sustainability at different levels. Other aspects include the exchange with our funding bodies and politicians and the German sustainability strategy. Of course, the Coronavirus pandemic has brought about some changes that will need to be evaluated and adjusted for in the future.

I.3 CHANGES FROM THE PREVIOUS REPORT

A peer review of our report for 2016/17 conducted by the Fraunhofer Society for the Advancement of Applied Research noted a number of areas for improvement. They recommended including information about the organisation-wide sustainability management of the Helmholtz Association of German Research Centres. We have taken this suggestion on board and have included it in the section 'Helmholtz Activities'.

They also noted that it would be useful to show which particular aspects of the sustainability guidance document (LeNa) recommendations were relevant to DLR. We succeeded in closely implementing the guidelines by re-analysing and updating our relevance diagram, which is shown later in the report. This gives an overview of the relevance of different aspects, while the scores give a more detailed picture. The structure of the sustainability guidance document is also reflected in our list of measures.

Sustainability management is continuing to move ahead at DLR, as can be seen in numerous developments since the previous report. Sustainability has been firmly embedded in the DLR business plan. In 2020, the Executive Board appointed a Chief Sustainability Officer. Progress can be seen in a wide range of DLR management systems. The volume of data may not have grown at the same rate as DLR itself, but its quality has improved. We have paid greater attention to the issue of stakeholders, while sustainability is now much more present in the DLR mindset. We are continuing to advance in small steps with regard to research for sustainability and the research process. In 2019, measures were introduced to establish a Research Ethics Department and an Ethics Committee.

Also worth mentioning are the growing number of campaigns and queries and increasing awareness among staff and the general public.

I.4 OUR STAKEHOLDERS

The DLR sustainability report is part of the management central activities sub-system (TSVO). In 2019, a process for systematic stakeholder analysis was successfully rolled out in the TSVO. In order to report on sustainability, stakeholders were first identified with the process managers. The interests, characteristics and intentions of the stakeholders were then collected and prioritised through interviews and role-plays. A report on the results from all TSVO process stakeholders was drafted and presented to the Executive Board for discussion, with a TSVO newsletter subsequently distributed to all staff.

Sustainability stakeholders are as follows:

Internal stakeholders:

- Executive Board
- Core sustainability team
- Employees
- Programme directorates

External stakeholders:

- The Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Education and Science
- Other research institutions
- The Helmholtz Association of German Research Centers
- Certain businesses and civil society organisations

Below is a more precise look at the roles, using the DLR Executive Board as an example.

Stakeholder	Stakeholder challenges	Classification	Authority	Legitimacy	Urgency	Role	Strategy analyses	Establishing its own strategy
Executive Board	To establish sustainability management with centralised reporting Fulfilment of self-imposed commitment in line with LeNa recommendations	internal	high	high	medium	supporting	The Executive Board wants to present the whole of DLR as success-oriented in terms of sustainability and as resolving the challenges facing society	Fulfil and implement the Executive Board's requirements optimally Regularly inform the Board and ask questions if necessary

Unfortunately, stakeholder consultations have not been systematised any further since then. However, the individual stakeholder dialogue formats have continued and have been partially expanded. For example, a sustainability roadshow for DLR employees was planned for 2020, with the aim of facilitating conversations and

identifying ideas and needs. We also intended to initiate and oversee a series of BarCamps with a highly interactive workshop and dialogue format. We plan to resume these activities once the COVID-19 pandemic is over.

I.5 HELMHOLTZ ACTIVITIES

The Helmholtz Association of German Research Centers has focused on the subject of sustainability for many years. In 2018 a multi-centre working group, the Sustainability Forum (Forum Nachhaltigkeit), was set up under the supervision of a member of the DLR Executive Board as a platform for wide-ranging collaboration and lively exchange. With its strategic orientation towards sustainability, DLR is keen to share its experience in this community and to drive forward change, as one of the working group's main objectives is to develop the Helmholtz Association into a research organisation that operates sustainably.



Held in November 2019 in Berlin, the first Helmholtz Sustainability Summit was an important milestone. It sought to encourage Helmholtz Association staff to exchange ideas on sustainable approaches for individual centres, institutes and central management, while giving them the opportunity to take part in a sustainable event. DLR staff contributed to many of the workshops, giving keynote speeches and running sessions⁶.

Another milestone was the adoption of the Helmholtz commitment to sustainable development. Developed by the sustainability forum working group, it was approved by the Assembly of Members of the Helmholtz Association in September 2020. The commitment sets out short-term sustainability targets that will be used to measure the Association's progress.

Staff of the Helmholtz Association, whose daily work consists of drawing together research and sustainability, have also shown a great interest in making the Association carbon-neutral.

As a result, staff circulated a petition then presented it to the President and the Managing Director of the Helmholtz Association in the summer of 2020, encouraging the Association to pursue a strategy to become carbon-neutral well before 2050. The working group has provided a platform for close exchange from the outset, also for this initiative.

I.6 OUR CORE SUSTAINABILITY TOPICS

METHOD

To compile this report, the Chief Sustainability Officer's team thoroughly reviewed the existing materiality assessment. The review confirmed the validity of the frame of reference used in the assessment, which continued to be relevant to DLR as a non-university research organisation.

(LeNa)⁷, following its priority functional divisions – organisational management, research, personnel, buildings and infrastructure and support processes – and adapting the different activity areas to DLR. Developed jointly by the Helmholtz Association, the Fraunhofer Society and the Leibniz Community, LeNa was adopted in 2016.

In the 2016/17 sustainability report, we noted that the core sustainability topics for DLR had been identified using the guidance note on sustainability management in non-university research institutions

Based on our experience of the suitability of this approach, we also reviewed the materiality assessment, amalgamating certain activity areas and adding new ones.

⁶ <http://www.helmholtz-nachhaltigkeit.de>

⁷ <https://www.nachhaltig-forschen.de/startseite/>

MAIN AREAS OF ACTIVITY

This process resulted in a new list of major activity areas for DLR; these have been grouped according to the LeNa functional areas:

- Organisational management**
 - Transfer and exchange
 - Integrated strategic planning
 - Participatory organisational development
 - Systemic embedding of sustainability
- Research**
 - Socially responsible research
- Personnel**
 - Service-oriented personnel management
 - Development and shaping
- Buildings and infrastructure**
 - Sustainable construction and life cycle assessment system
 - Operation and management
 - Corporate Carbon Footprint and DLR proKlima
- Support processes**
 - Transport
 - Procurement

ONLINE SURVEY

The restructured list was included in an online survey sent to internal stakeholders including employees, works council representatives and decision-makers in sustainability-related organisational units, as well as to a selection of representatives of the following external stakeholder groups:

- sponsors such as the Ministry for Economic Affairs and Energy, the Berlin local government and North Rhine-Westphalia state administration
- customers such as OHB and ESA
- civil society organisations such as WWF, Greenpeace, the German Sustainability Council and B.A.U.M
- other non-university research institutions involved in the LeNa project, such as the Forschungszentrum Jülich and the Fraunhofer Association

experts with specialised background knowledge of ethics, sustainability and social issues

asking them to gauge the importance of these new activity areas. The survey comprised 12 questions, with background information. Respondents were invited to reply using a scale of 1 (very important) to 5 (almost irrelevant). They also had the option of adding comments if they felt any key areas had been omitted.

Responses were received from 27 out of 53 recipients, giving a solid response rate of around 50 percent, which is also a good barometer of people’s attitudes. Due to the pandemic, we analysed the results of the first stakeholder survey in detail at an online evaluation session with the DLR core sustainability team and then re-evaluated them ourselves in order to extract a DLR internal vision to accompany the external vision. Finally, all the results were transferred to a new materiality diagram, which is reproduced in this report.

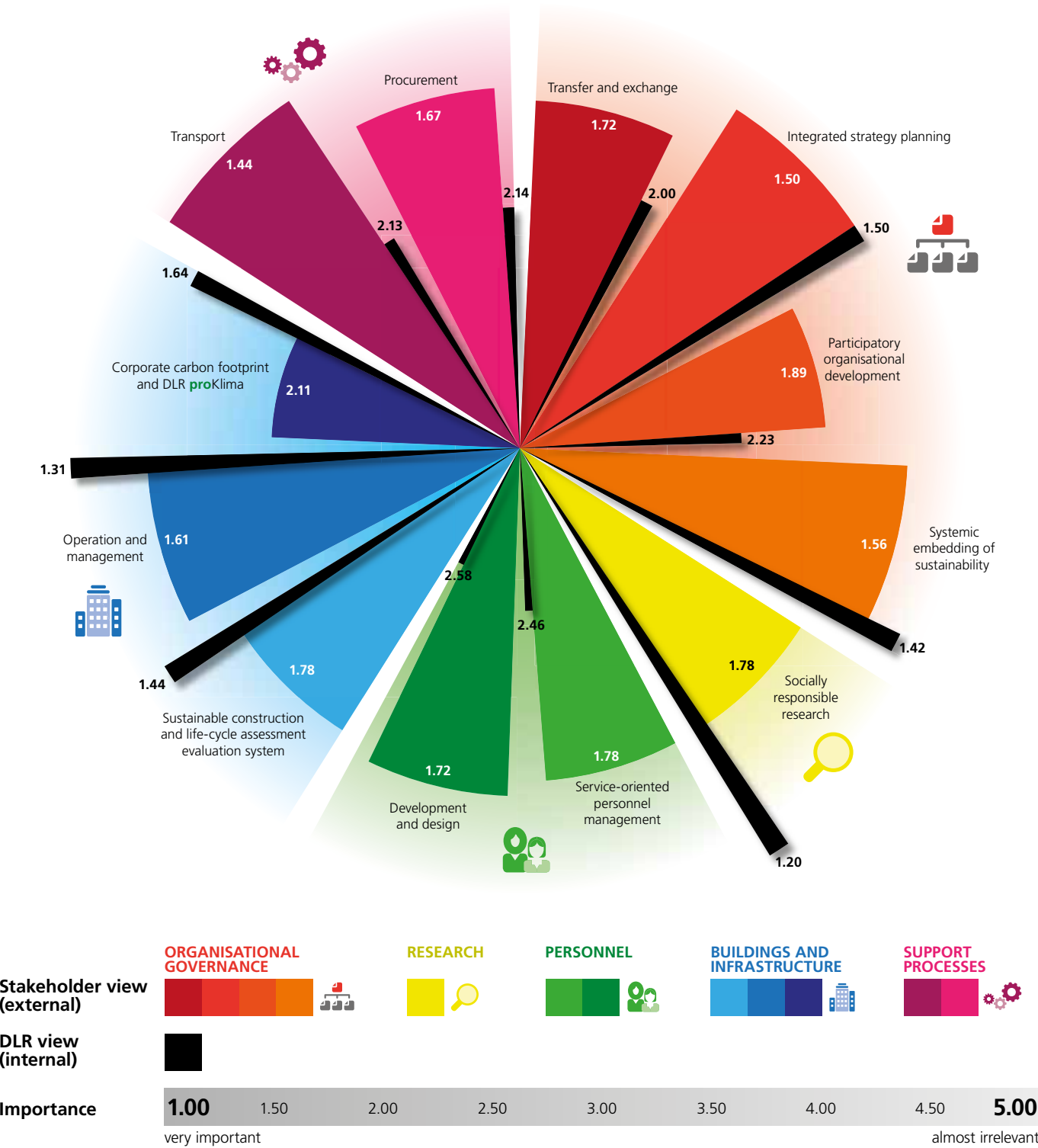
IMPLEMENTATION

The DLR Executive Board examined the core sustainability team’s results and approved the materiality assessment and the resulting materiality diagram as a binding framework for action towards the development of a sustainability strategy and sustainability management at DLR during the next reporting period (2020/21). Other important topics were also highlighted, such as good governance and the transparent and efficient management of DLR. These are not just reflected in the guidelines of the LeNa project, they are also part of DLR policy and the 2030⁸ strategy. Interaction with our code of conduct, our sustainability promise and any aims that may conflict with the UN Sustainable Development Goals (SDGs) provide a framework for a coherent approach to continually improving our sustainability performance and proposing solutions. Our support for the UN Global Compact, as set out in our code of conduct, provides a basis for sharing fundamental principles on human rights, working standards, environmental protection and anti-corruption measures. These factors will be important drivers of sustainable development at DLR.

⁸ https://www.dlr.de/content/de/bilder/management/dlr-kurzfassung-strategie_2017.html

DLR MATERIALITY DIAGRAM

The new DLR materiality diagram reflects the main areas of activity and their contribution to sustainability management at DLR, according to a survey of external and internal stakeholders. Both types of stakeholder generally endorsed the previous main activity areas; the new materiality assessment has added further detail and fine-tuned the areas, as shown in the diagram.



I.7 DLR SUSTAINABILITY PROGRAMME

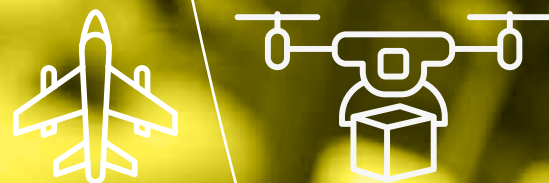
We have had numerous meetings with the core sustainability team, holding interviews and workshops to devise sustainability activities, measures and goals related to the five LeNa functional areas. The ideas and expectations of employees were taken into account, including those put forward at works council meetings, discussed in special consultations and added to our Wiki.DLR. This is the first time we have assigned a value to individual targets so that we can measure progress more effectively in future. The following list of measures includes a selection that was agreed with the Executive Board.

OBJECTIVE	MEASURES	STATUS
ORGANISATIONAL GOVERNANCE		
Systemic embedding of sustainability at DLR	Draw up a sustainability road map	<div></div>
	Implement new (including digital) formats and events for internal participation	<div></div>
	Comply with the German Sustainability Code (DNK)	<div></div>
	Expand our membership of sustainability-related organisations relevant to DLR	<div></div>
Measure stakeholder satisfaction	Conduct regular stakeholder analysis	<div></div>
	Involve stakeholders through consultations	<div></div>
Implement the result of the LeNa project	Adapt the LeNa discussion framework for socially responsible research	<div></div>
	Analyse the materiality of sustainability topics based on the LeNa functional areas	<div></div>
Develop a more sustainable organisational culture	Establish and implement 'reduce, avoid/substitute, offset'	<div></div>
DLR proKlima	Reduce DLR's carbon footprint	<div></div>
SUPPORT PROCESSES		
More sustainable businesses	Draw up guidelines for business	<div></div>
Measure the carbon footprint in greater detail and reduce it	Provide green electricity with at least EE01 certification	<div></div>
	Measure travel-related CO ₂ emissions through centralised travel management	<div></div>
Design a sustainable DLR store	Develop sustainability indicators in SAP	<div></div>
	Expand external marketing in order to increase sustainable procurement; strengthen communication of rules to internal customers for greater acceptance of the idea of sustainability	<div></div>
Maintain mental and physical health of employees	Management training in mental health	<div></div>
	Sports and health courses, medical check-ups	<div></div>
Ensure timely events management	Introduction of a quota for digital event formats	<div></div>
	Checklist and guidelines for carbon-neutral events	<div></div>
Provide alternative commuting options	Set up charging infrastructure for electric and hybrid vehicles at DLR	<div></div>
	Offer and expand subsidised seasonal tickets for public transport	<div></div>
	Conduct a bicycle-friendly employer self-evaluation	<div></div>

OBJECTIVE	MEASURES	STATUS
BUILDINGS AND INFRASTRUCTURE		
Identify potential energy savings	Establish an energy management system compliant with ISO 50 001	<div></div>
Measure the carbon footprint in greater detail	Improve the quality of environmental performance indicators and other environmental metrics/support DLR proKlima	<div></div>
Expand digitalisation	Support facility management through software	<div></div>
	Comprehensively implement an inventory planning system for businesses	<div></div>
Support sustainable construction	Review the list of requirements for designing and fitting new buildings	<div></div>
Reduce heat loss from buildings, incl. CO ₂ savings	Test green facades	<div></div>
Green IT	Develop and test heat concepts	<div></div>
	Implement the document management digitalisation initiative	<div></div>
	Establish green IT labels	<div></div>
	Extend maintenance contracts to reduce premature e-waste	<div></div>
RESEARCH		
Improve the usability of research outcomes	Further develop and systematically incorporate Open Science/Open Data in accordance with the framework conditions for export control, confidentiality and transfer requirements	<div></div>
Develop solutions to societal challenges	Increase user orientation in the research process	<div></div>
	Conduct a pilot project to test the climate impact of individual research initiatives	<div></div>
Increase acceptance and awareness of the SDGs	Continuously communicate about the SDGs in all available media	<div></div>
	Classify projects under the SDGs in the programme	<div></div>
Test innovative technologies in house and serve as a demonstrator	Promote more field laboratories/'hands-on' DLR	<div></div>
		<div></div>
Pursue good scientific practice	Update code of conduct and continuously improve the organisational manual	<div></div>
	Set up a Research Ethics department	<div></div>
PERSONNEL		
Create more balanced research teams and promote equal opportunities	Implement cascade model regarding quotas for women	<div></div>
	Present and maintain an internal exchange platform for LGBTIQ issues	<div></div>
Foster a more sustainable organisational culture	Increase the sustainability content in management seminars	<div></div>
	Establish more sustainability incentives when setting targets	<div></div>
Increase the efficient transfer of skills	Develop knowledge transfer and alumni networks	<div></div>
Measure work satisfaction	Conduct regular staff surveys	<div></div>
Status: planned <div></div> ongoing <div></div> completed <div></div>		



© DLR/Marek Kruszewski



Dagi Geister, IT specialist, Team Leader of Unmanned Aircraft Systems group at the DLR Institute of Flight Guidance. Up, up and away! There was a time when Dagi Geister wanted to take to the air herself. But today her greatest interest is making aviation as safe as possible in the future, with a special focus on drones and their multiple uses in crisis management, logistics and construction. For the research she conducts with her team of 17 at DLR, the sky's the limit.

II. Research for sustainability



FLIGHT DECK – LATEST NEWS IN AERONAUTICS RESEARCH



Here's the latest news from the DLR flight deck: there's a general trend towards the digitalisation of air transport. This is a decisive step towards future-proofing aviation and bolstering Germany's competitiveness as a centre for aviation.

DLR is helping to shape this process. Developing and implementing a digitalisation strategy in aviation requires close collaboration between science and industry. We want to offer businesses a platform for testing and realising ideas. Our vision is the comprehensive digitalisation of an aircraft – just one aspect of aviation – throughout

its life cycle. This covers everything from the prototype, certification and operation all the way to maintenance – in other words, the development of a virtual aircraft. One of the benefits will be even better reliability, as the virtual products will be able to keep closer track of wear and tear and ageing and facilitate preventive maintenance. Five DLR sites are involved in this mission.

But we are not ignoring other aspects of aviation research. We are also studying automation and unmanned flight, noise reduction solutions and global aviation management.

REAL AIRPLANE

Information



Design & development



Prototypes & certification



Commercial production



Operation and maintenance



Decommissioning

Data

VIRTUAL PRODUCT



Digital aircraft

Digital certification



Digital twin



Continuous updates of the digital twin

Digital thread

RETROFITTABLE NOISE REDUCTION TECHNOLOGY



Aircraft noise is an important focus of aviation research at DLR and has worldwide importance as a political objective. The ‘Visions 2020’ EU strategy paper sets a flight noise reduction target of 10 dB compared with the year 2000. This target is in keeping with UN requirements for the development of industrial infrastructure that is as robust as it is environmentally friendly: in this particular context it means less noise pollution from aircraft.

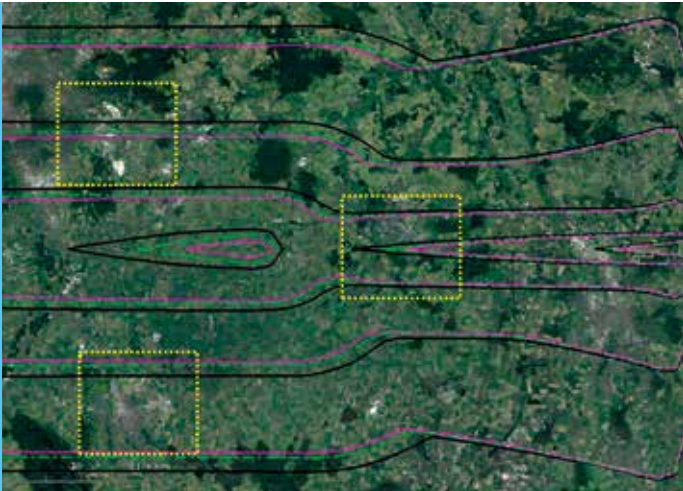
An effective reduction in noise pollution is only possible when all aircraft operate more quietly – particularly the most widely used models. This means that noise reduction solutions should allow existing aircraft fleets to be retrofitted. This is where the ATRA Low Noise Project comes in. Seeking to demonstrate the noise reduction potential of retrofitting, this initiative focused on reducing aerodynamic noise during approach. DLR uses the Airbus A320-ATRA (Advanced

Technology Research Aircraft) as a flight test prototype. The noise reduction measures for undercarriages, high-lift components and engines were derived from wind tunnel and test bed noise-reduction research projects previously carried out in the development of noise reduction technologies for these components.

Here is a summary of the results: the measures can reduce the high-lift system noise by 2 dB and the undercarriage noise by about 1.5 dB. The noise of the spoilers can be suppressed completely, bringing a further reduction of 2 dB. Jet noise at start-up was also reduced by up to 2 dB. All noise reduction information refers to the A-weighted overall sound pressure level.

Noise in the areas affected by a particular sound pressure level is reduced accordingly.

The ISO contours of the A-weighted overall sound pressure level for 40-80 dB (A) are shown from the outside towards the centre. The areas marked in yellow show exactly where the noise reduction measures can benefit the affected population.



Bottom: Measurement campaign with the DLR research aircraft



FUEL-CELL-POWERED CARGO BIKES



At DLR we are joining forces to develop new propulsion technologies and vehicle concepts that will help reduce local air pollution and CO² emissions. As in other areas, purpose-built fuel cells can help with this. The Fuel Cell Cargo Pedelec (FCCP) project funded by Interreg North West Europe (NWE) is looking at polymer electrolyte membrane fuel cells. They have the advantage of being very safe to use, despite their high current density. These fuel cell systems generate energy that can turn the wheels of cargo bikes and are being tested by various freight service providers for last-mile transportation.

Three DLR institutes are contributing expertise to the project: the Institute of Engineering Thermodynamics and the Institute of Vehicle Concepts in Stuttgart, and the Institute of Transport Research in Berlin. A total of 14 international partners in research and industry are involved, along with service providers and public administrative bodies.

The aim of the project is to demonstrate the possibility of low-emission and city-friendly alternatives for inner-city goods deliveries using conventional delivery vehicles. In addition to optimising fuel cell technology, the initiative is also testing innovative cargo bike solutions with parcel service providers and developing last-mile logistics that make the most of fuel cell technology.

The project is particularly geared towards parcel service providers who use diesel vehicles to deliver parcels in inner city areas and whose vehicles often block traffic during deliveries. The sector, which is

already testing the first concept cargo bikes, has particularly high demands regarding load capacity and powertrain reliability. Compared with conventional batteries, fuel cells offer the advantage that their output and capacity can be adjusted separately depending on requirements, while providing considerable weight savings. This could enable cargo bikes to be designed for new uses, such as carrying refrigerated cargo.

The Institute of Engineering Thermodynamics is developing special fuel cell components known as ‘stacks’, which are suitable for the power requirements of light vehicles. The institute has also produced a pre-heater that runs off the heat generated by the fuel cell, which dispenses with the need for an additional battery to heat the system. Longevity is an overarching sustainability goal in fuel cell development. In addition to the economic benefits, there are also environmental benefits because the use of precious metals is reduced.

The Institute of Vehicle Concepts is developing and coordinating technical research on novel vehicle concepts and vehicle technologies. Staff at the institute are contributing to the FCCP project by assembling cargo bikes and designing and coordinating their components.

In collaboration with two international research partners in France and Belgium, the Institute of Transport Research is working on a tailor-made logistics solution for the fuel-cell-powered cargo bikes that will maximise the benefits of the system in comparison with conventional battery-powered bikes.



GLOBAL TANDEM-X FOREST MAP



Forests are the lungs of our planet. They help reduce greenhouse gas concentrations in the atmosphere and thus counteract global warming, while also providing protection and resources for humans, plants and animals – yet they’re vanishing at an alarming rate. Satellite images show that forests cover just one third of Earth’s landmass today: more than half of the world’s forests have now disappeared, mainly because of deforestation. The DLR Microwaves and Radar Institute has created a special dataset to monitor, assess and protect the current state and development of these ‘green lungs’ – the global TanDEM-X forest map. The mapping is based on interferometric data originally acquired by the German TanDEM-X radar satellite mission for the creation of a global elevation model. This data is now being re-interpreted using artificial intelligence through a new classification algorithm, which has been optimised for different types of forest based on tree height, density and structure. The result is a map of the world showing the extent of forested areas at a resolution of 50 metres. The global map is freely available to researchers.

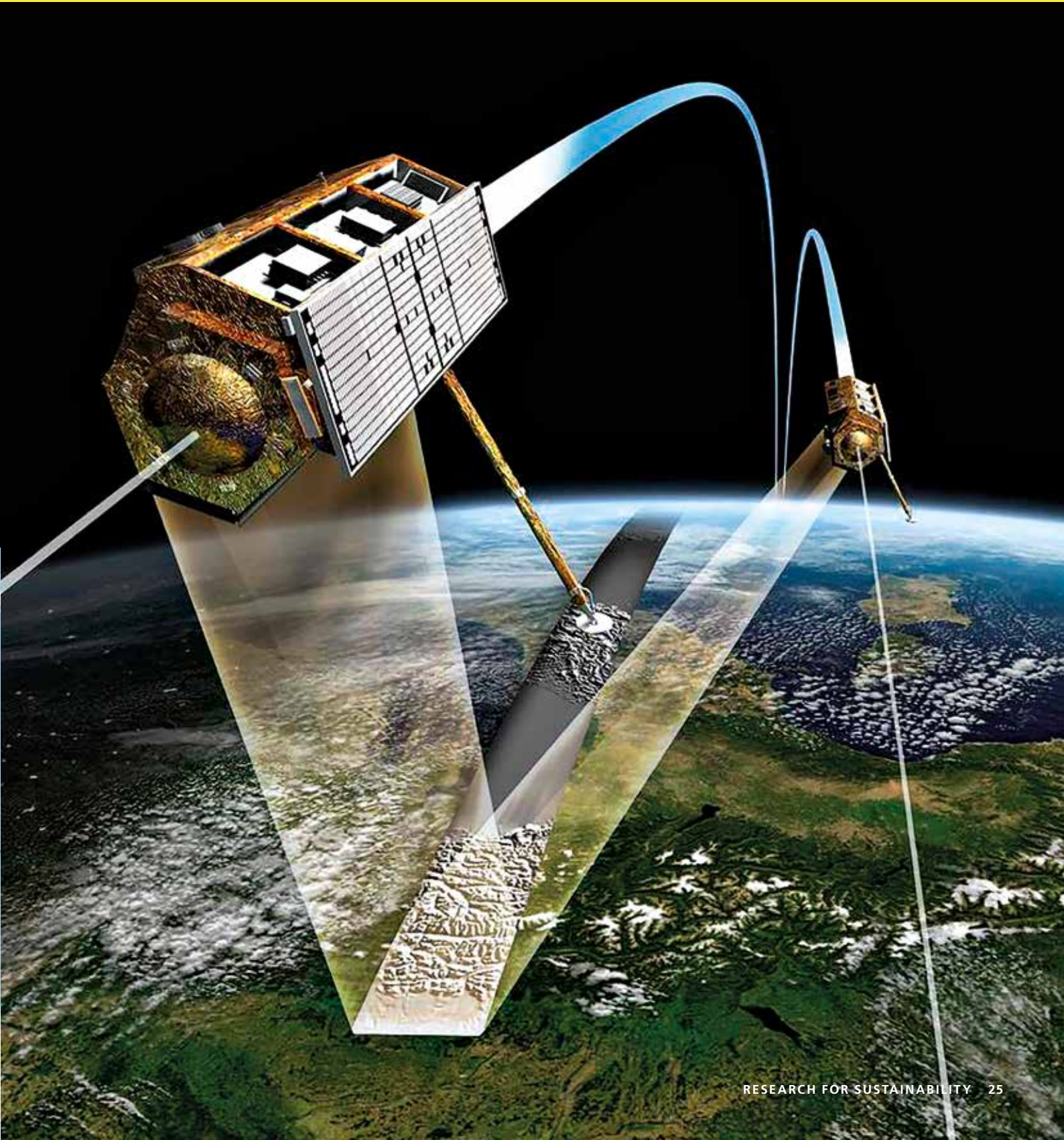
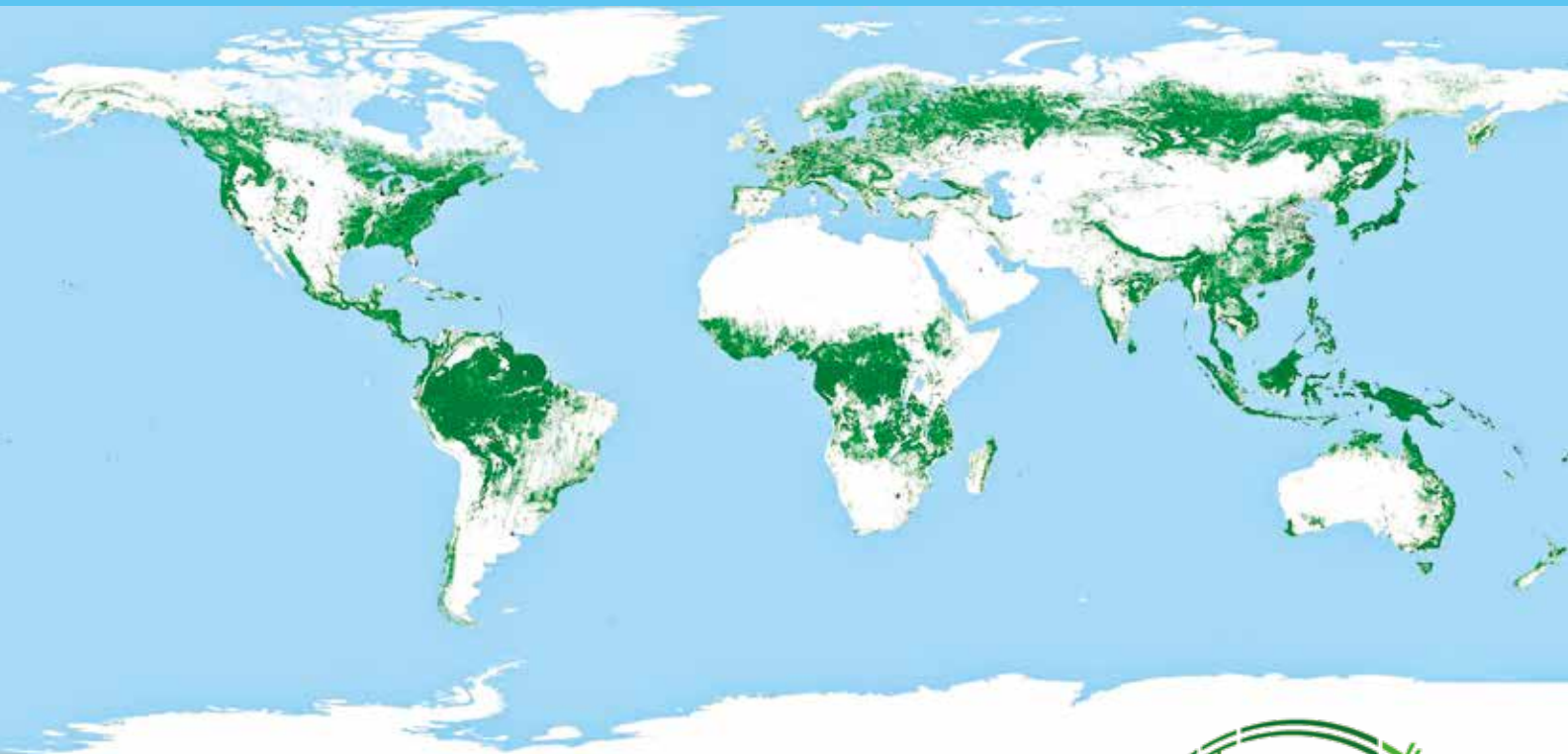
Radar satellites can acquire image data regardless of the weather or time of day – a particular advantage when it comes to mapping tropical forests, which are usually covered by clouds. The TanDEM-X Forest/Non-Forest Map closes the gaps that previously existed in the data and, for the first time, provides a uniform overview of the rainforests in South America, Southeast Asia and Africa. The findings are important for authorities and scientists alike, as these areas must be protected from illegal logging and preserved as important stores of carbon.

The new map also makes it possible to determine the forest biomass more precisely – a key factor when studying the global carbon cycle. The TanDEM-X Forest/Non-Forest Map thus provides an important dataset for research into global change and makes a variety of applications in agriculture, forestry, regional development and land-use planning possible. In addition, it also allows more precise predictions to be made and appropriate measures to be taken to address the societal challenges arising from global change.



The twin German satellites TerraSAR-X and TanDEM-X

TanDEM-X Forest Map – the future of forest mapping



BIG DATA PLATFORM

How can we process and analyse the ever-increasing quantities of scientific data? And how can we meaningfully combine Earth observation data with ground-based measurements to create new sources of information? As part of the cross-sectoral digitalisation initiative, the project described on the previous page aims to answer both

these questions as well as delivering a practical result that can make a big contribution towards achieving the SDGs: the global TanDEM-X forest map. Read the info box below to find out how the cross-sectoral initiative and Big Data Platform interact.



WHAT IS A DLR CROSS-SECTORAL INITIATIVE??

Numerous cross-sectoral initiatives connect DLR programmes in aeronautics, space, energy, transport and security through **digitalisation**, generating unique technological added value. The DLR **cross-sectoral initiative** systematically harnesses the **power of synergies** in order to make the best contribution towards tackling major societal challenges. For example, 21 DLR institutes are currently participating in the cross-sectoral **Big Data Platform** project, which aims to develop a methodical data science platform that will establish common standards in data acquisition, data management and data analysis across DLR.

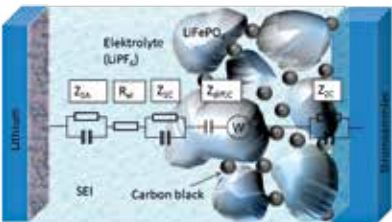
The **TanDEM-X Forest Map** is a sub-project of the Big Data Platform. The development of software, particularly **artificial intelligence**, plays an important role, as intelligent algorithms are a central tool for handling geodata, enabling large quantities of data to be analysed rapidly and in a targeted way, and automatically converting the data into useful information.



RAPID CHARGING: SMART HEAT AND BATTERY MANAGEMENT



Lithium-ion batteries have become a ubiquitous part of everyday life – they can be found in smartphones, laptops and other portable electronic devices. These compact power packs currently offer the best mix of high energy and output density combined with a low self-discharge rate and a high level of safety for many applications. That is why they are the most commonly used type of battery, and demand is expected to increase in the coming years with the growth in battery-powered cars, e-bikes, scooters and even the blossoming trend of Bluetooth earbuds. However, these power packs are subject to natural ageing processes. One of these is time-related ageing, which can be minimised with proper storage. The other is cyclical ageing, caused by charging and discharging patterns. Our Next Generation Car (NGC) project studies this cyclical behaviour, with the aim of increasing rapid charging capabilities while minimising ageing. The development of an impedance-based cell model will make it possible to determine battery status such as state of charge (SOC) and state of health (SOH) from the impedance spectrum. This provides a continuous information flow which is essential for the battery management system (BMS) developed by the DLR Institute of Engineering Thermodynamics. By measuring battery condition, the BMS ensures that the battery is operating within its optimum range, thereby slowing the ageing process.



The model also makes it possible to devise operating strategies. Heat management is another important factor for battery performance and life, as batteries only function really well at a temperature range of 25°C to 40°C, when ageing is slowest. At low temperatures, for example, it might be a good idea to warm the battery up before charging it. Another aspect of heat management is rapid charging, because the high current used for this generates a lot of heat and may damage the battery. By combining the cell model with a thermal model it has been possible to develop new rapid-charge strategies that can positively influence the long-term capacity and life of the battery. These new fast charge methods can be applied to all Li-ion batteries whatever their application.

This also has many benefits for the user. Fast charging time, for example, is not only more convenient, it also gives devices a longer life. This in turn helps reduce electronic waste and will help increase the acceptance of electric cars. This approach is another piece of the puzzle of how to ensure that the world is fit for future generations. Long-lasting and low-cost battery technologies have a part to play in remodelling our energy landscape, enabling us to reduce carbon dioxide emissions. Giving batteries a longer life will help us save resources and reduce waste.

EXACT



Forty-five researchers in 20 DLR institutes are taking part in the EXACT (Exploration of Electric Aircraft Concepts and Technologies) project to develop new technological components for environmentally friendly commercial aircraft. They are devising and examining suitable aircraft configurations and technologies that are both environmentally friendly and economically viable.

Although air transport accounts for just 2.8 percent of global carbon dioxide emissions, the future sustainability of aviation lies at the heart of the project. The decisive factor is that the air transport and energy sectors work closely together to develop joint holistic solutions. Because sustainability in aviation is more than just energy efficiency in flight: it encompasses the entire resource and energy chain used in the sector, and its environmental footprint. So the resources that go into construction, transportation, storage, energy consumption and operation right up to the decommissioning and recycling of aircraft are all taken into account.

Depending on the energy carrier used, there are various technological components for carbon-neutral commercial aircraft propulsion

solutions in the starting blocks. One promising idea for the short- and medium-range aircraft of tomorrow is the use of green hydrogen. This involves a fuel cell providing power to drive efficient electric motors during cruising flight. The only emission would be water. A hybrid propulsion solution would use additional gas turbines for energy-intensive phases such as take-off and landing. Both technologies would be optimised for the relevant flight phases. This concept has the potential to deliver carbon-neutral and economically viable flight while maintaining the usual safety and reliability.

The aim of EXACT is to investigate these and other ideas in order to increase the maturity of the technologies and reduce uncertainties with regard to climate impact, such as water in relation to altitude. Preliminary results indicate that environmentally and economically sustainable aviation is possible, even with increasing demand for travel.



Members of the EXACT project team discuss environmentally efficient flying and electric aircraft at DLR's Hamburg office

PERMASAR 2



Earth’s permafrost zones play an important role in climate change as they store huge quantities of carbon. The carbon is frozen in organic plant and animal remains that have been there for thousands of years. When the ground thaws, microbes break down the exposed organic matter and release greenhouse gases in the form of methane and carbon dioxide into the atmosphere. This increases the rate of warming in the atmosphere, which in turn accelerates permafrost thawing.

About 24 percent of Earth’s landmass and around 34 percent of the coasts of the Northern Hemisphere consist of permafrost, meaning that the average soil temperature in those areas is below zero for at least two consecutive years. Based on core samples and other methods, scientists have calculated that the upper areas of the permafrost store between 1300 and 1600 gigatonnes of carbon. By way of comparison, Earth’s entire atmosphere only contains 800 gigatonnes of carbon. So finding out how the world’s permafrost regions are changing is vital to informing the current climate debate and, of course, achieving the UN climate targets.

In addition to its long-term effects, thawing permafrost also has many immediate local consequences that could affect millions of people. For example, large settlements and thousands of kilometres of pipelines have been built on permafrost; the thawing ground threatens to cause major damage to buildings and pipelines, necessitating the relocation of villages and towns. There is also the phenomenon of increasing coastal erosion and changes to water resources and vegetation cover.

The international scientific community urgently needs data on the thawing depth and surface structure of permafrost ground, local ground uplift and subsidence and much more if it wants to gain a better understanding and predict the consequences of changes to the permafrost on global climate change. Unlike ground-level surveys, which have a limited reach and involve huge resources in remote places such as the Arctic, remote sensing allows extensive and continuous observation of the permafrost. Radar sensors, which can function regardless of daylight or weather conditions, are particularly suitable for this.

Researchers at the DLR Microwaves and Radar Institute are currently developing special radar technologies and analytical methods that will enable highly accurate monitoring of permafrost areas. As part of the PermaSAR (Permafrost Airborne SAR Experiment) project, they have carried out extensive survey flights aboard the DLR Dornier Do 228-212 research aircraft over the permafrost regions of Canada. The DLR F-SAR instrument was used to record a unique fully polarimetric and interferometric SAR (Synthetic Aperture Radar) dataset in the X, C, S and L frequency ranges.

The comprehensive measurements form a unique dataset that will help scientists develop new algorithms to characterise vegetation, determine thawing depth and surface structure, and measure local ground uplift and subsidence.

BIOFILTERS FOR SUSTAINABLE CYCLES IN SPACE AND ON EARTH



A sustainable organic economy needs closed material cycles to help prevent environmentally harmful emissions. The C.R.O.P.® (Combined Regenerative Organic food Production) project has developed a biological filter that turns urine and flushed toilet water into liquid fertiliser. As part of a bioregenerative system that helps sustain life, the C.R.O.P.® filter will allow humans to stay longer in space. The technology is equally suited for use on Earth, where it can increase food supplies in harsh environments. The fertiliser can be used in water-saving systems in which crops grow in an optimised substrate rather than in soil. The technology will allow astronauts on long missions, or farmers without access to fertile soil, to use their own wastewater to grow fresh food in a closed nutrient cycle. Based on experience in space travel, we have developed scenarios that will also allow the DLR C.R.O.P.® filter to close material cycles on Earth and contribute to the sustainable use of resources.

Used in combination with water-saving crop systems, small C.R.O.P.® filter systems that convert the wastewater from small numbers of people into fertiliser will remove dependence on economic assistance by enabling people to grow their own food. Saving money on mineral fertilisers could allow them to invest more in their children’s education. It will also prevent wastewater from entering the environment and contaminating drinking water.

On a larger scale, the C.R.O.P.® filter can be used for the sustainable development of cities and for sustainable food production. Urban farming is now becoming popular in many cities. The environmental footprint of these farms largely depends on the fertiliser used. Mineral fertiliser is manufactured using energy-intensive processes and some of the components are obtained in opencast mines. Using a C.R.O.P.® system that converts sewage into a liquid fertiliser will break this one-way system of food production and help to develop urban cycles. For towns without a central sewerage system, decentralised wastewater treatment of this kind will provide a good opportunity to save the high costs of installing a centralised sewage system with wastewater treatment plants.

In Europe food is produced mainly by medium and large-scale farms. Livestock farms come in for particular criticism because the manure they produce contaminates the air and water. In Germany there have been cases of nitrates from manure entering the drinking water. To address this issue, a C.R.O.P.® filter is now being developed to recycle manure. The first step will be to convert the manure into fertiliser that can be applied in a targeted way to minimise the risk of nitrates entering the environment. It is hoped that in the future, the C.R.O.P.® filter will be made so efficient that manure can be used as a greenhouse fertiliser. This will completely prevent emissions and allow new fodder crops – protein-rich algae – to be grown.



Permafrost areas of the Northern Hemisphere
Illustration: Tanja Hildebrandt/Helmholtz
(Source: Brown et al. (1997), International Permafrost Association)



Radar images of permafrost in Canada



The Micro Tina variety of tomato

The urine that the gigantic filter converts into nitrates is used to fertilise the tomato plants. The plants function mainly as biosensors indicating how successfully the urine has been converted into fertiliser solution. Micro Tina tomato seeds were used for the experiment. The variety was specially bred by Utah State University for use in space. The plants grow very quickly and very compactly (small and sturdy). The first ripe fruits were seen within 60 to 90 days. Micro Tinas are low maintenance, need little light, are relatively firm and have a slightly acidic taste.



A C.R.O.P.® filtering system

UNCREWED HIGH-ALTITUDE PLATFORMS



Technological advancements in the fields of electrical energy storage, highly efficient lightweight solar panels, lightweight construction and miniaturised aircraft systems will make it possible to operate high-altitude solar-powered aircraft for long flights in the stratosphere. High-altitude platforms like this open up numerous applications currently reserved for satellites in low Earth orbit. These systems offer great advantages due to their climate-neutral self-launch capability. In theory, flights of unlimited duration at heights of over 20 kilometres are possible. When required, the systems can be returned to Earth and even re-used.

Aircraft that can be placed in the stratosphere for a long time are ideally suited for Earth observation purposes, such as measuring air and water pollution in real time, monitoring shipping lanes and detecting forest fires. These platforms could contribute towards climate change mitigation, the provision of clean water and economic growth. The aircraft could also function as high-speed Internet providers in areas of the world with poor coverage, giving access to information and services such as e-learning. This would allow larger numbers of people to access high-quality educational services, which in turn would help combat poverty, reduce gender inequality and enable people to attain higher levels of education.

Despite their great potential, no functioning stratosphere platform has been realised thus far. Current technology has allowed a few prototypes to be launched, which have stayed airborne for up to 26

days. However, a large number of the prototypes have failed due to the technical challenges involved. An extremely light airframe is required to fly at maximum energy efficiency. But this poses significant challenges for take-off, ascent, descent and landing because the aircraft is exposed to major stresses as it passes through high-density atmospheric layers and through wind and rain. In addition, due to the extreme environmental conditions of the stratosphere, with high daytime temperatures and very low night-time temperatures, the reliability of aircraft systems must be considerably improved for flights lasting several months. Comprehensive and secure autonomous functions are required for long-term flights and to obtain permission to fly over controlled air space.

DLR has set itself the goal of developing and preparing comprehensive expertise for high-performance and reliable high-altitude solar-powered aircraft. To do this, a cross-sectoral initiative has been set up, incorporating a range of competences in aerospace and security, including miniaturised high-performance sensor technology. The aim is to test promising technologies and design concepts, as well as to demonstrate various potential applications. The aircraft will weigh 138 kilograms and have a wingspan of 27 metres, with each sensor system weighing no more than five kilograms. The system competences gained from this project will make it possible to develop, build and operate a reliable overall system (platform, payload, ground station and operational procedures) for long flight operations.

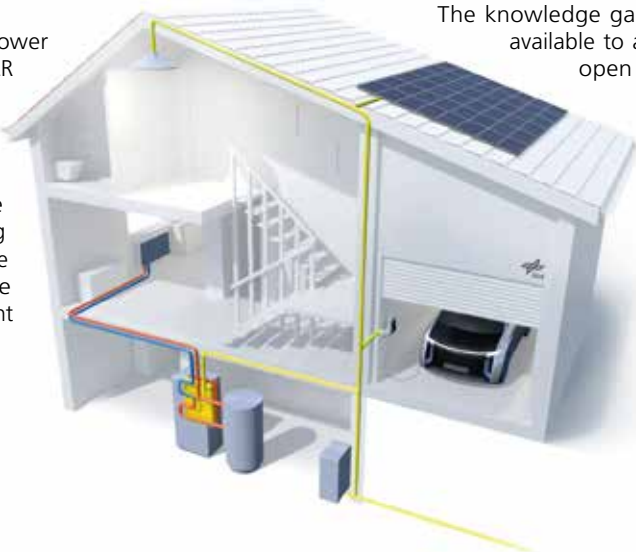
HYDROGEN, SECTOR COUPLING AND TRANSPORT



As climate change forces us to cut the use of fossil fuels and nuclear power plants are being decommissioned, the energy system has a greater need for flexible alternatives than ever before. Fluctuations in energy demand compound the uneven performance of renewable energy. Coupling the electricity, transport, heating and gas sectors can make a significant contribution to evening out fluctuations in power generation and demand.

When more energy is available than required by the electricity sector, it can be transferred to other sectors. For example, the charging of electric vehicles could be made dependent on network demand. Conversely, energy from the transport sector can be fed back into the energy sector by using the electricity stored in vehicles to stabilise the power network. In addition to technical aspects such as intelligent communications infrastructure, user behaviour, acceptance and economic viability also play a role.

It is also possible to couple the power and heating sectors. To this end, DLR is collaborating with RWE to develop a system whereby the combustion sections of redundant coal-fired power plants are replaced by a huge heat storage system. This can absorb fluctuating energy from the power grid and use it for reversion to power the steam turbine of the old power plant as and when required.



Another example of a flexible power source is the use of green hydrogen produced by electrolysis, which can be used as an industrial raw material, for heat processes or to generate electricity. In spring 2020 a project team at the Institute of Networked Energy Systems examined where and at what capacity power-to-gas plants in Germany could be connected to the gas network without exceeding the maximum mixing limit of 5 percent hydrogen. This was done by collating data on the topology and capacity of the gas network and overlaying it with a model of the electricity network. This made it possible to identify numerous regions that had connection capacities running into megawatts and gigawatts. Later in the project, this information will be used to determine which sites are most suitable for power-to-gas plants in order to prevent the power grid from being overloaded and to minimise the reduction of renewable energy.

The knowledge gained from this project will be made available to a wide audience via open source and open data, guaranteeing that all interest groups – from policymakers and scientists to network operators – can use it to help them proactively plan the transformation of the energy system.

High-altitude solar platform



Hydrogen storage facility at the DLR site in Cologne-Porz



LIGHTWEIGHT CONSTRUCTION USING WOOD



Recent years have seen a strong focus on lightweight construction for modern cars. Now there is a growing trend towards developing solutions that are not only lightweight but also sustainable and resource-efficient, making the use of natural materials increasingly attractive.



In spite of its good mechanical properties and the fact that it captures CO₂ while it grows, wood is hardly used in modern vehicle structures. That is why Projekt For(s)tschritt, an initiative involving partners in industry and research, has been looking at solutions that could integrate veneer-based materials in road and railway vehicles.

In terms of the specific qualities of its grain, wood is comparable to commonly used materials such as aluminium or magnesium. Beech, which is used as a layered veneer in the project, is widely available in Europe so it does not need to be transported great distances and is low-cost.

The pressures and temperatures needed to manufacture and process the veneer are significantly lower than for conventional materials such as steel. This reduces the costs of tools and presses, reduces tool wear and saves energy during the manufacturing process. The very simple mechanical processes needed to work wood, such as lathes, mean components can be produced inexpensively and easily.

At DLR we have developed a variety of solutions, from using wood to reinforce thin metal panels to building completely wooden structural components that only need local reinforcement. We have focused on steel and aluminium in the hybridisation of wood, as sustainability is central to our approach. The use of fibre composites such as CFRP was abandoned in the interests of easier and more efficient recycling. The use of aluminium containing a high proportion of recycled metal can save additional CO₂ and partially offset the energy-intensive manufacturing process. Once the wood has been mechanically separated from the metal, it can be chopped up and used to make fibreboard. The metal can be recycled normally.

The advantages of aluminium and steel are that they are established vehicle building components. This means that existing methods such as joining technology can be used.

The drawbacks of natural materials, such as reduced reproducibility, sensitivity to environmental factors and general failure patterns can be overcome by careful hybridisation and the use of layered veneers. It is very important to protect the wooden components from humidity to prevent them from deteriorating. The project uses intelligent sealing and the use of sandwich materials to physically protect the wood rather than chemical protection. Here again, sustainability was given preference.



QUICK CALCULATION

We optimised the design of a railway carriage door using an innovative composite wood solution, which reduced the weight of the door by 15 percent. In the original design, the aluminium components weighed 30 kilograms, but our approach reduced the weight to 19 kilograms. The new design has a wood component of around seven kilograms. The reduction in the amount of aluminium alone will provide CO₂ savings of around 110 kilograms. The positive carbon balance of the carbon stored by the wood during growth and the savings due to the lower weight of the component increase the overall balance even more.

The project considered beech-based hybrid materials as suitable for use in future vehicle construction. In other words, the first step has been successfully taken towards economically and environmentally attractive alternatives to existing materials. There are, however, numerous other topics we are working on in order to better meet the challenges of sustainability. For example, replacing conventional adhesives with biodegradable ones, or at least with organically based alternatives, and expanding the range of basic materials by considering other types of wood and processing methods.

HYSEAS III



The HySeas III project aims to develop a fuel-cell powered RoPax ferry for passengers and freight. The initiative will study the onshore infrastructure, test the propulsion system and, most importantly, compare the environmental, economic and social characteristics of

According to a DLR market potential analysis, there are 1400 RoPax ferries currently operating in Europe; those with a gross tonnage (GT) of over 5000 tonnes emitted 14.2 million tonnes of CO₂ in 2018. If other vessels with a GT of more than 5000 tonnes are added into the equation, the total CO₂ emissions according to the European Maritime Safety Agency amount to 142.5 million tonnes, equal to 0.4 percent of world CO₂ emissions in 2018. The European maritime sector therefore has huge potential for reducing CO₂ if green hydrogen is used instead of conventional fuels.

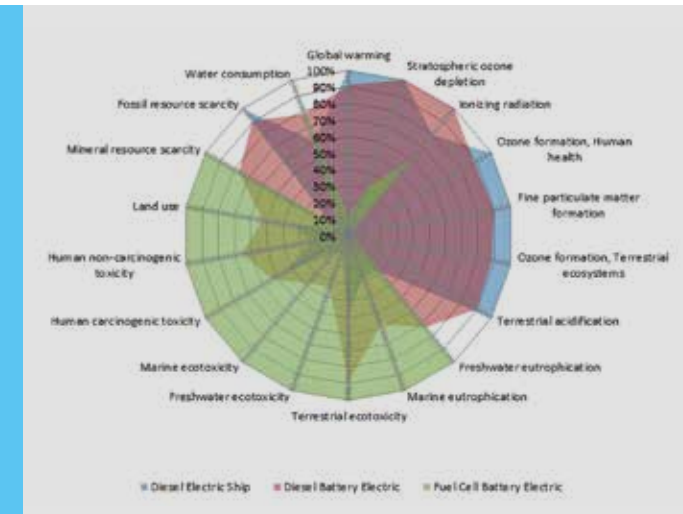
Although progress has been made in the use of batteries on ferries, particularly in Scandinavian countries, hydrogen-powered ferries have an important role to play as they can be used over longer distances. The final results of the environmental, economic and social impact assessments are expected at the end of 2021.

the ferry with those of diesel and battery-powered ferries. Making a hydrogen-powered fuel-cell ferry involves designing a suitable propulsion system with an on-board hydrogen tank, fuel cells and batteries and creating an onshore refuelling system, while meeting all operating and safety standards. Once the propulsion system has been successfully tested and funding is secured for the next phase, a prototype will be constructed and tested in real-life conditions between the Orkney Islands in Scotland, whose existing hydrogen infrastructure makes this a very suitable test site.

Initial environmental lifecycle assessments carried out by DLR show that hydrogen-powered fuel-cell ferries and their infrastructure generate almost 90 percent fewer greenhouse gas emissions than diesel ferries, provided that wind power is used to generate the electricity needed to make the hydrogen. Other environmental impacts such as eutrophication, toxicity and requirements for materials and space are greater over the entire lifecycle when compared with diesel ferries due to the need for substances such as lithium and platinum.

In July 2020, DLR set up the Institute of Maritime Energy Systems in Geesthacht. The institute will research and develop innovative solutions for decarbonising and cutting the emissions from shipping. These solutions will be tested in collaboration with industry partners. The DLR Institute of Networked Energy Systems and the Institute of Maritime Energy Systems intend to work closely together to promote cross-sectoral collaboration and deliver renewable energies for maritime systems.

Comparison of the results of an impact assessment with regard to the RoPax ferry alternatives for diesel-electric ships, diesel-battery-electric ships and fuel-cell battery-electric ships using the ReCiPe 2016 impact assessment method. The results were normalised to the highest overall impact alternative in each of the categories.



Artist's impression of a future hydrogen and fuel-cell powered RoPax ferry





SOLAR CEMENT – BUILDING A GREEN FUTURE



Cement is one of the most widely used raw materials in the world. Its manufacture requires high temperatures and therefore consumes vast amounts of energy. Cement production is estimated to account for about seven percent of anthropogenic emissions and plays a significant role in climate change. ‘Solar-powering’ this process would therefore make a big contribution towards achieving a sustainable future.

The most energy-consuming stage in cement manufacture is the calcination of raw meal. In the SOLPART project, our researchers at the Institute of Solar Research demonstrated that concentrated solar power can fully replace the fossil fuels usually used in this process. In four rounds of testing in the solar simulator at the DLR site in Cologne, they irradiated a rotating reactor filled with raw meal with concentrated artificial sunlight.

The research project was launched by the European Union as part of the Horizon 2020 programme. It seeks to replace at least some of the fossil fuels used in energy-intensive processes with concentrated solar power and deals with the high-temperature treatment of particles for different applications, particularly cement manufacturing.

A consortium of 11 European and non-European partners, including one of the world's largest cement manufacturers, carried out the project. DLR's role was to develop and test a solar calcination reactor.

The very first test run brought promising results. However, it took several modifications to the reactor before the fourth test run finally achieved the reliable production of successfully calcinated cement meal for several hours a day over several days in 17 chemical experiments. The raw meal was fed into the rotary kiln in quantities ranging from 4 to 12 kilograms per hour. The solar irradiation brought the temperature to approximately 1000°C, which is the minimum required for calcination. The process attained calcination rates of up to 99 percent and the quality of the finished product was comparable to that achieved with conventional processes.

The results and lessons learned from this project will enable scientists to scale up the method in the coming years. From our point of view, the successful operation of the calcination reactor confirms that solar power is suitable for applications requiring high temperatures, which previously could only make limited use of renewable energy.

MOVING FORWARD WITH CLIMATE CHANGE RESEARCH AND INNOVATION



The transition to a greenhouse gas-neutral national economy requires the radical conversion of all economic sectors and the development of new ideas and technologies. Changes in lifestyle and behaviour are just as important and require broad public involvement. To help this process, in its 2050 climate protection plan the German government decided to set up a scientific support process in the form of the climate protection science platform (WPKS), which has had an office at the DLR Project Management Agency in Berlin since 2019. Composed of eight prominent scientists, the platform steering committee interacts with other scientists and civil society and business representatives, gathering the latest knowledge in order to support and advise policymakers on the implementation and evolution of the 2050 climate protection plan.

With the WPKS office, the DLR Project Management Agency provides specialist and organisational support in advising policymakers and the public. To raise the public profile of WPKS and foster a dialogue with society at large, our department has set up a WPKS website, which was launched in autumn 2020.⁹

The first years of the WPKS – 2019 and 2020 – were important for climate policy. In 2019, the German government enshrined the emissions

reductions targets for 2030 in law for the first time with the climate protection act (Klimaschutzgesetz). It also proposed an action plan setting out how all sectors of the economy – such as transport, energy, industry, construction, agriculture and waste management – should achieve these targets. In its initial discussions with the government, the WPKS steering committee identified the need for guidance on the development of these measures and is working on corresponding statements.

For the WPKS, the beginning of 2020 was also marked by the COVID-19 crisis: the economic impact of the crisis, and particularly the economic package devised in response to it, have had a massive impact on climate protection. The way people live and the economy are changing, which can affect greenhouse gas emissions; planned high levels of government investment can help increase climate protection in these sectors if economic measures are implemented in a climate-smart way. The steering committee therefore quickly drew up a position on the stimulus package from a climate protection point of view, which it discussed with the government.

The WPKS also suggested that the entire stimulus package be subjected to a rapid assessment in order to gauge its climate impact. The package will need to make a significant contribution towards achieving the climate protection act target of reducing greenhouse gases by 55 percent compared with 1990 levels.

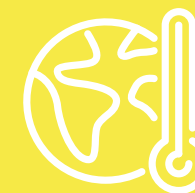


WHAT IS THE CLIMATE PROTECTION PLAN 2050?

In November 2016 the German government introduced the climate protection plan 2050, a national strategy for implementing the commitments made in the Paris Agreement to achieve a carbon-neutral economy by the middle of the 21st century. This aim is one of the United Nations Sustainable Development Goals (SDGs) and is indispensable in achieving many of the other SDGs, due to the huge impact of climate change on the economy and society.

⁹ <https://www.wissenschaftsplattform-klimaschutz.de/>

Commitment to climate protection: The office of the climate protection scientific platform (WPKS) has been part of the DLR Project Management Agency since 2019. The platform advises and supports the German government in implementing both the 2030 climate protection programme and the 2050 climate protection plan. (Source: Adobe Stock/Gajus)



PROTECTING THE EARTH – A NATIONAL SCHOOLS COMPETITION



"What can we do to protect the natural world and preserve biodiversity?" This is the question posed to schoolchildren by the 'Protecting the Earth' competition. The DLR Space Administration organises this competition to coincide with the missions of German ESA astronauts on the ISS, giving schoolchildren across Germany the chance to create a project linked to environmental protection. They can get help from space: Earth monitoring data can give them information about the state of the planet.

The competition seeks to inspire schoolchildren to become scientists themselves and provides an opportunity for them to discover how space technologies can protect the environment. Choosing one of four different habitats, the classes investigate it using remote monitoring data then independently devise a project for protecting it. Study materials and video messages from ESA astronauts support them in their work.

Competitions linked to Alexander Gerst's 2014 Blue Dot mission and his 2018 horizons mission encouraged pupils of different age groups

to create sustainability projects for Earth. Gerst lent support to the project as an ambassador in space. With projects such as 'Light Pollution in Bonn', 'Less Plastic Saves the Ocean' and 'Breakfast without Waste', pupils have managed to have an impact on their communities. For example, some classes wrote to their mayor to draw attention to light pollution in their towns, while others distributed hand-painted cloth shopping bags to shops in their local areas.

It is vital that pupils are allowed to develop their own ideas and then implement them through specific everyday actions. An independent panel chooses the best ideas for each area and selects the winners. Schools all over the country have taken part in the competition. The first round was aimed at schoolchildren in years 3 and 4; the second round was for students in the upper classes of lower secondary school. A third 'Protecting the Earth' competition for children in years 6 to 8 is currently being planned, with climate protection, sustainability and the SDGs as central themes.

READ ABOUT PREVIOUS WINNING PROJECTS
AT: **WWW.BESCHÜTZER-DER-ERDE.DE**
BE INSPIRED AND TRY TO PREPARE YOUR OWN
BREAKFAST WITHOUT WASTE.



In 2019, a group of students at Kardinal-Frings High School in Bonn won a distinction for their project 'Light Pollution in Bonn' from German ESA astronaut Reinhold Ewald. They were rewarded with a summer camp at the Max-Planck Institute of Animal Behaviour in Radolfzell.



In 2015 the four winning teams from Cologne, Wuppertal, Ludwigsburg and Forchheim were awarded the prizes of the national DLR 'Protecting the Earth' school competition by ESA astronaut Alexander Gerst at the German Museum of Technology in Berlin.

RARE EARTH ELEMENTS AND THE ENVIRONMENT



All 17 rare earth elements are highly valued for technological and economic reasons. As well as being used in the manufacture of catalytic converters, electric motors, batteries and high-performance magnets, they are needed for high-tech products such as micro-electronics, headphones, mobile phones and laptops. Although they are not as rare as their name implies, it is quite conceivable that some, such as dysprosium, will not be as readily available in the future due to their supply chain value and rapidly increasing demand. The ever-increasing quantities of electronic waste make efficient and sustainable manufacturing and recycling of paramount importance. The environmental pollution arising from the labour-intensive and costly production of rare-earth metals is high, as once mined, the ore requires repeated washing in acidic solutions to extract the rare earth elements. This process generates many dangerous waste products, some of them radioactive. Apart from the sustainability aspect, efficient processing is also of great importance from an economic and geopolitical point of view because even though raw material prices are currently low, there is very high market concentration: China owns around 90 percent of the global rare earth resources.

Until now, the process for treating rare earth elements has mainly been liquid-liquid extraction in a single processing step. As the chemical properties of rare earth elements are similar, the process is time-consuming and involves a lot of environmentally hazardous solvents.

The SESIMAG project was conceived to try a radically different approach: magnetic separation. Why is magnetic separation of such interest? Despite their chemical similarity, the magnetic properties of rare earth elements vary widely. If we want to establish a technical process, we must first understand and quantify the underlying physical processes. The first three-year phase of the project has already brought some major insights. Researchers discovered that the success with which rare-earth ions are separated from an initially homogeneous solution is based on the complex interaction of gravity and magnetic field gradient, which can only be unravelled through microgravity experiments. The results will be explored in more detail and verified through experiments on board microgravity flights in the follow-up project in autumn 2020. These are important steps towards a sustainable technical solution for extracting these important raw materials.

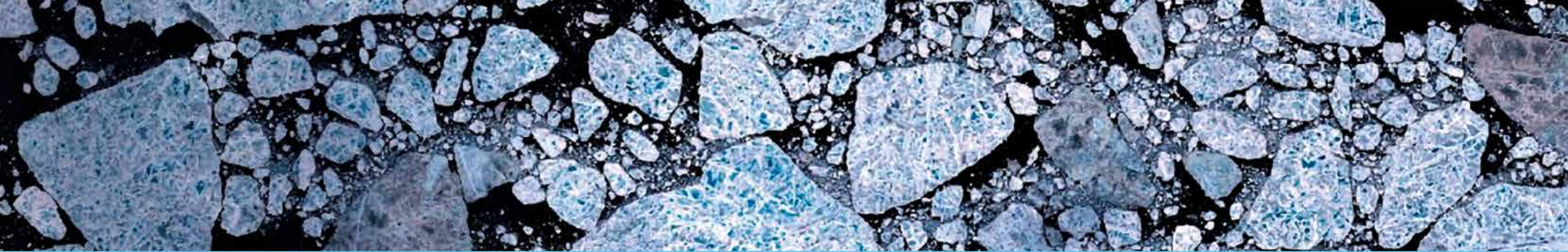


Periodic table with the 17 rare earth elements (marked red)

© Graphic: arte.tv

The SESIMAG I experiment on the DLR microgravity flight





Sentinel-2 image of Arctic sea ice in the Kane Basin between Greenland and Ellesmere Island acquired on 28 June 2019. The blue areas indicate melting sea ice (meltwater pools) (Modified Copernicus Sentinel data [2019]/Sentinel Hub).

INNOVATIVE APPROACHES FOR CREATING EARTH OBSERVATION-BASED INFORMATION PRODUCTS



This DLR-funded programme supports the development of a number of applications using satellite-based observations of Earth in the fields of environmental monitoring, resource management, sustainable agriculture and forestry, and the maritime economy. It incorporates 10 research initiatives.

The projects address a wide variety of issues that reflect the needs of domestic and international users. In order to protect the planet and to preserve it for human life and development and to use its resources in a more sustainable way, decision makers (mainly governments and institutions) need accurate information on which to base their decisions.

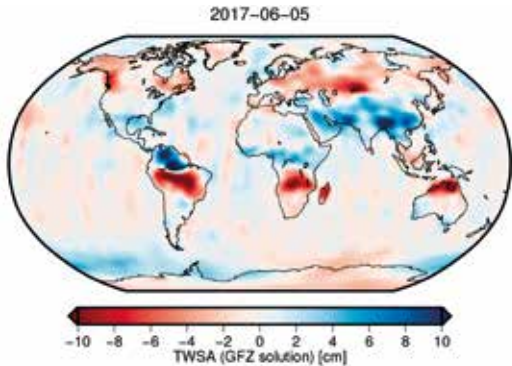
Some of the initiatives aim to map land and vegetation, providing data covering wide areas. These include AI4Sentinels (charting

global urbanisation processes), DLMonitor (monitoring agriculture and forestry areas), UAVforSAT (mapping vegetation), oBEF-Accross2 (tracking the composition and functional diversity of European forests), STRUKTUR-X (studying the structure, biomass and productivity of tropical rainforests) and TypSynSat (detecting algae in coastal and inland waters).

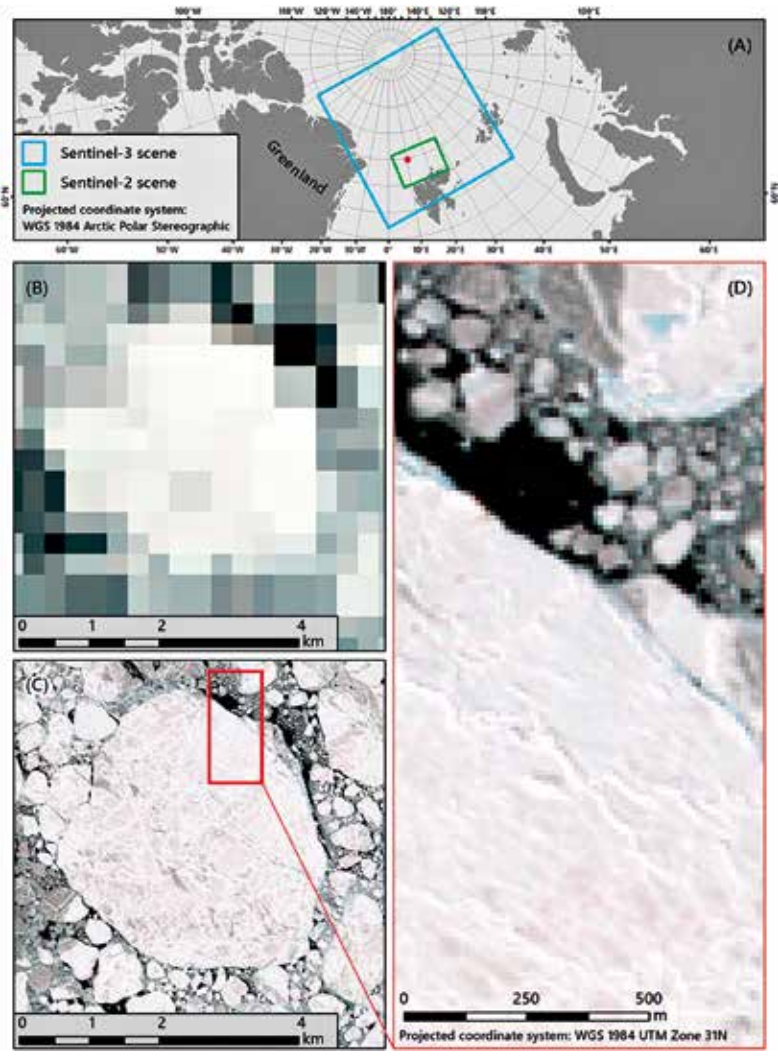
Other initiatives address parameters that are important for climate change. For example, the total water supply for agricultural vegetation stocks (AssimEO), thawing processes in Arctic sea ice (ArcticSense), anomalies in water reservoirs in order to predict flooding (AHOWAG) and tropospheric ozone content in the atmosphere above the middle latitudes (TROPO3-MIDLAT).

Global water storage anomalies measured by the GRACE Mission (the predecessor of GRACE-FO) on 5 June 2017. The blue areas show above-average water with possible risks of flooding while the red areas show dry areas.

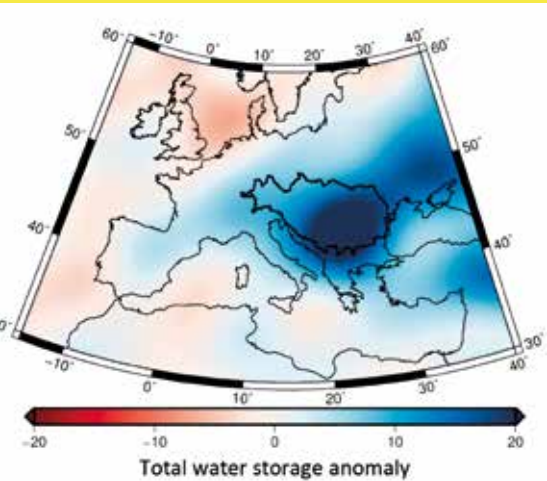
Water storage anomalies at the time of the Danube



Details of images from Sentinel-3 (B) and Sentinel-2 (C) taken in the Arctic Sea north of Spitzbergen (A). The pictures show ice floes and structures on the ice.



floods in 2006 measured by the GRACE mission (the predecessor of GRACE-FO). The dark blue indicates that flooding in the area around the Danube flood plain was unusually severe at that time.



ArcticSense, a joint project by the University of Kiel and EOMAP GmbH uses data from the European Sentinel-2 satellites to develop an Earth observation product that shows the summer thawing processes of Arctic sea ice in terms of time and space. The project will also examine the possibility of providing information on the contents of the meltwater pools on the surface of the ice. The future German EnMAP mission could be useful in this context by monitoring chlorophyll/algae growth. The information it obtains should give us a better understanding of the interaction between the atmosphere, ice and the ocean, which plays an important role in climate change and also has a big impact on marine habitats.

AHOWAG, a project by the GFZ German Research Centre for Geosciences in Potsdam: the GRACE-FO gravimetric satellite mission can measure gravitational anomalies on land, which indicate how much water is contained in the soil and in our groundwater reservoirs. GRACE-FO data are available in near-real-time and provide information about anomalies in water reservoirs, facilitating more accurate predictions of the dangers of major flooding events. The information product under development could later be incorporated into early warning systems.

SUPPORTING CLIMATE RESEARCH AND ENABLING SUSTAINABLE DEVELOPMENT IN AFRICA



Climate change issues transcend borders, so a global approach is needed. The German Federal Ministry of Education and Research has partnered with 11 West African and five southern African countries to create two regional competence centres for climate change and sustainable land management. For the past 10 years, the DLR Project Management Agency (DLR-PT) has been closely involved in the initiative. From the initial design phase in 2010 to the preparation and implementation phases and the current second research phase, DLR-PT has provided support for political negotiations all the way up to ministerial level in addition to guidance on technical implementation. In collaboration with the ministry, DLR-PT has established a multilateral partnership network of western and southern African research institutes, German universities and other research institutes that are implementing German government activities in and in consultation with Africa.

Their main aim is to strengthen the resilience of people and the natural environment to the impacts of climate change. In West Africa, the countries of Benin, Burkina Faso, Cabo Verde, Gambia, Ghana, Côte d'Ivoire, Mali, Niger, Nigeria, Senegal and Togo are working in WASCAL, the West African Science Service Centre on Climate Change and Adaptive Land Use; in southern Africa, SASSCAL – Southern African Science Service Centre for Climate Change and Adaptive Land Management – is active with Angola, Botswana, Namibia, South Africa and Zambia. The competence centres are co-financed as international African organisations by the partner countries.

The main focus of both centres is academic training, cooperation in research and the establishment of research infrastructure. African and German universities, research institutions, scientific organisations and

governments cooperate closely to deliver excellent training for newly qualified graduates and involve them in local research initiatives. One local competence centre in Ouagadougou (Burkina Faso), which is backed by an interdisciplinary research team, currently operates a modern observation and measurement network over the entire WASCAL region together with national institutions and German research partners. It includes 50 automatic weather stations and 60 water level monitoring stations, a satellite receiver system, laboratories for geoinformation systems and a supercomputer. SASSCAL boasts similar research infrastructure: WeatherNet and ObservationNet comprise 154 automatic weather stations and the IT infrastructure needed to exchange data and provide freely accessible high-quality weather and climate data from the region.

Both competence centres have built up high-performance geodata portals with WADI (WASCAL Data Infrastructure) and OADC (Open Access Data Centre). The Earth Observation Center at the DLR site in Oberpfaffenhofen has played an important role in establishing this central knowledge base for the competence centres and has been collaborating with them for a long time. The data and products are made available free of charge to interested institutions, international researchers and local political advisers. In addition, the centres are building the capacities of the countries involved, which will enable them to model their own climate forecasts and scenarios, develop policy-relevant climate services and devise policy measures. This also strengthens their capacity to represent their national interests in international policy processes. Together with regional stakeholders and users, the two competence centres design and test solutions for regional climate protection and scenarios for the climate change adaptation of major economic sectors such as water management.



For the past 10 years, DLR-PT has provided support for the establishment of regional competence centres in southern and western Africa together with the Federal Ministry of Education and Research in order to strengthen the resilience of people and the environment to the impacts of climate change. The picture shows a weather station being set up in Angola.
(Credit: DLR Project Management Agency)



BRINGING SUSTAINABILITY INTO EDUCATION AND EDUCATION INTO SUSTAINABILITY



Since 2016, an interdisciplinary team including employees from the DLR Project Management Agency has been supporting the creation and implementation of a national multi-actor process and the Education for Sustainable Development (ESD) national action plan on behalf of the German Federal Ministry of Education and Research. The team provides support and consultation through its coordination section, ESD, which consists of more than 300 actors in various national and local committees from civil society, industry and science. We supervise investment projects such as the monitoring project of the Freie Universität Berlin and organise events including annual meetings, thematic congresses and the major UNESCO conference planned to kick off the new ESD programme 'Education for Sustainable Development: Towards Achieving the SDGs', which has been postponed from June 2020 to May 2021 due to the COVID-19 pandemic. Special emphasis is placed on the inclusion of younger generations, who participate in the ESD 'youpaN' youth forum and demand better reconciliation of education and social responsibility, as well as greater attention to sustainable development in economic activity. Equal opportunities in education and digitalisation are among the themes addressed by the 25 members of youpaN.

Incorporating ESD in local and regional structures is vital because the local educational environment is frequently the starting point for societal change. The 'ESD Competence Centre for Process Support and Evaluation – Education – Sustainability – Community' (BiNaKom) will support this process: 50 pilot communities will be given practical and scientific support to identify positive approaches and prepare them so they can be shared with others. Support will be given to the joint project of the German Youth Institute, the Lower Saxony Local Education Management Transfer Agency as

sponsor and the Helmholtz Centre for Environmental Research. DLR-PT will offer guidance and support for the project.

In the meantime, the national ESD platform has filed its first interim report on the ESD national action plan, which underscores Germany's leading role in the ESD process. ESD is growing in importance in different fields of education at all levels. The challenges are further training for educators and the provision of critical support for digitalisation, whose relevance to the education system has been sharply highlighted during the COVID-19 crisis. The Global Action Programme on ESD ended in 2019. The next 10-year programme, the UNESCO 'ESD for 2030', will place even greater emphasis on the importance of ESD in achieving the United Nations 2030 Agenda for Sustainable Development.



WHAT IS ESD?

Every small decision we make has consequences for the world that we and future generations will live in. Raising awareness of the environmental, economic and social impact of even everyday activities such as buying a shirt or having a cup of coffee is one of the challenges of our time. That is why in 2014 at the world conference marking the end of the United Nations Decade of ESD in Aichi-Nagoya in Japan, UNESCO announced the Global Action Programme on Education for Sustainable Development (ESD) in order to help people all over the world to think and act in a future-friendly way.

Under the aegis of the Federal Ministry of Education and Research, a national multi-actor process was initiated to implement the UNESCO programme in Germany. In June 2017, the national ESD platform, the highest steering committee for this process, issued 130 targets and 349 specific recommendations for action in order to implement the ESD national action plan. From daycare centres to schools, from training organisations and universities to local associations, the aim is to make ESD as much a part of daily life as it is of education, to encourage creative ideas and spark the courage to put sustainable development into practice, and to reinforce a sense of responsibility in every single person. In this way ESD has made a substantial contribution towards achieving the 17 Sustainable Development Goals.



Since 2016, the DLR Project Management Agency has been guiding the ESD national action plan and advising more than 300 actors in various national and local committees at national and local levels from civil society, industry and science. The action plan seeks to involve younger generations through the ESD youth forum 'youpaN'. One of the largest youth conferences for sustainability in Germany – youcoN – was held in 2019.
(Credit: youcoN 2019/Stiftung Bildung)





© Adobe Stock/chungking

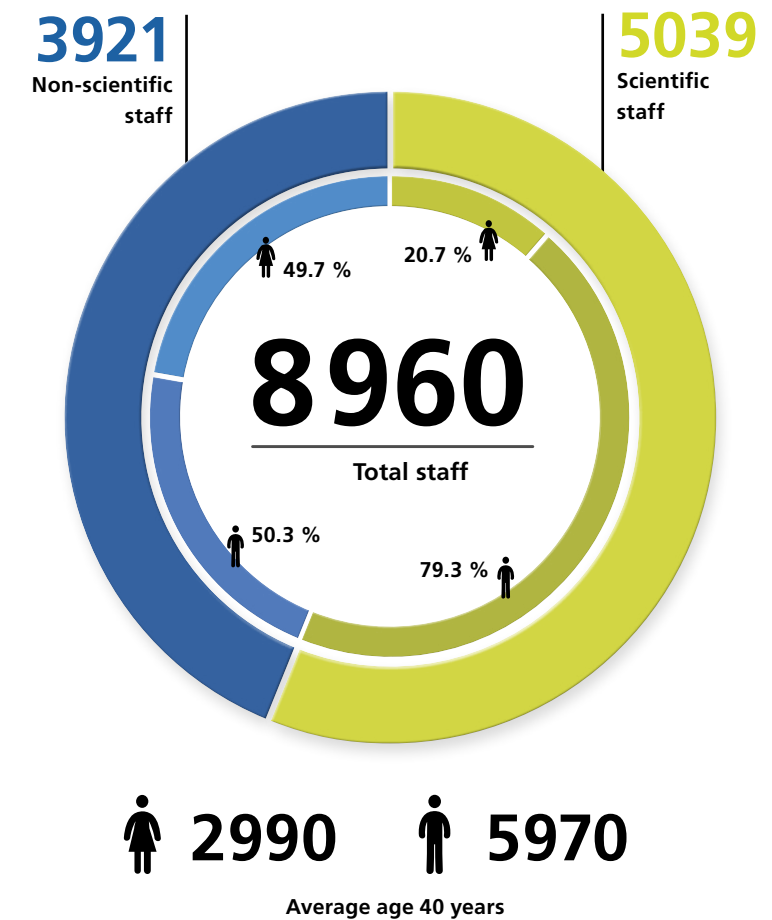
III. Researching and working sustainably

III.1 PEOPLE

The support provided to DLR staff is key to our sustainable human resources policy. Staff who feel cared for, supported and encouraged in their professional development are more motivated and perform

better in work processes, and therefore contribute to the success of the organisation.

STAFF DEVELOPMENT AND MANAGEMENT



Year: 2019

Stefania Tescari, physicist and engineer, project manager at the Institute of Solar Research.

As a child her motto was "always follow the Sun". That's why Stefania Tescari sees her work at DLR not merely as a job, but as her calling in life. With her international colleagues, she investigates ways of using solar energy for industrial applications, saving huge quantities of CO₂. And thanks to flexible working arrangements, she can also enjoy the Sun in her spare time.



LEARNING MANAGEMENT SYSTEM

A learning management system (LMS) is a software solution for managing digital further education programmes. The Human Resources and Organisational Development department is introducing one of these systems at DLR, optimised and informed by current trends in further education. It will give all DLR staff the opportunity to engage in systematic personal development.

which will allow us to optimise and promote continuous individual development.

YODA focuses on sustainability and preparing the Human Resources and Organisational Development department at DLR for the future. The LMS also supports the digital expansion capacity of further education and training.



With expert guidance, a list of DLR-specific requirements was drawn up in 2018/19, which led to the selection of the SAP Success Factors software solution.

Following a Europe-wide tender and a rigorous selection process, Data One GmbH was chosen to plan, configure and implement the LMS.

The first of three introductory phases started in 2019, following internal workshops and training given to individual project teams within the department. 2021 will see the launch of DLR's straightforward and intuitive learning platform YODA – Your Own Development Access,



- Users themselves gain additional benefits from the whole system:
- The **'My training plan'** allows them to view all registrations, forthcoming courses, outstanding course enquiries and pending feedback at a glance
 - **Improved course search** – a quicker overview of all or selected course offerings and courses with places available
 - Successful registration – invitation including **Outlook meetings**
 - **Personal training history** – all completed courses in one place
 - **Certificates** – ability to download digital attendance and any other certificates awarded

COMPETITIONS AND PRIZES

Each year, DLR staff take part in numerous competitions for prizes and external grants that recognise or further support their research. We estimate that they do this well in excess of 50 times a year, although not all prizes are for money. Internally, DLR awards a 10,000 euro Senior Scientist Prize and the DLR Science Prize of 10,000 euro.

Senior Scientists Dirk Holland-Moritz, Bilge Saruhan-Brings and Henri Siller were recognised in 2019. The DLR Science Prize was awarded to Pere Barriobero-Vila, Joachim Gussone, Jan Haubrich, Armin Weiss, Reinhard Geisler, Daisuke Yorita and Ulrich Henne.

A SELECTION OF DISTINCTIONS AND PRIZES AWARDED TO DLR STAFF

2018	EREA Association of European Research Establishments in Aeronautics Award awarded to Christiane Voigt, DLR Institute of Atmospheric Physics
2018	Gesellschaft Deutscher Chemiker prize awarded to Simon Geiger, DLR Institute of Engineering Thermodynamics
2018	ESA Living Planet Fellowship awarded to Francescopaolo Sica, DLR Microwaves and Radar Institute
2019	Hermann-Blenk research prize of Aeronautics Research Centre Niedersachsen (NFL) awarded to Srinivas Vasista, DLR Institute of Composite Structures and Adaptive Systems
2019	DGLRM Albrecht-Ludwig-Berblinger prize awarded to Eva-Maria Elmenhorst, DLR Institute of Aerospace Medicine
2019	ARD/ZDF TV sponsorship award for Women and Media Technology 19 awarded to Anna Kruspe, DLR Institute of Data Science

FOR POSTGRADUATE STUDENTS:
THE DLR_GRADUATE_PROGRAM

For more than 10 years, DLR has offered our graduate employees the chance to enrol in the DLR_Graduate_Program. This high-quality multidisciplinary graduate programme gives young employees a special skillset in addition to the professional supervision they receive from the DLR institutes. The programme covers a wide range of subject areas such as communication and social skills, presentation methods, work skills and methodology, project management and peer review publishing. There are also regular visiting graduate seminars and supplementary activities such as presentations at international conferences, publications in specialist journals and science teaching activities. More than 1200 graduates have taken part since the scheme began in June 2009.

The results of a self-evaluation indicated that the programme content closely matches the expectations of leading research institutes and industrial enterprises with regard to young scientists: the skills taught on the DLR_Graduate_Program largely reflect those that young scientists need today. It is also a 'self-learning programme' with regular feedback reviews and tests that analyse how students put the new knowledge and skills into practice. Workshop and seminar content is optimised using this feedback as necessary.



DLR TALENT MANAGEMENT PROGRAMME

DLR launched its pilot talent management programme in 2010. The goal was to identify outstanding young scientific minds, promote them and enable them to take on key roles in the organisation. In addition to joint workshops, networking activities and projects of relevance to the Executive Board, the programme focuses on personal development and multi-disciplinary skills.

In June 2018, the end of the third round of the programme was marked by a presentation of the project and an Executive Board discussion. Forty-six talented DLR employees completed the two-year programme and got together in November 2018 for the first time at an alumni event.

Following a lengthy selection procedure, 14 DLR employees embarked on the new 2019–2021 DLR talent management programme in June

2019, with one Development Center session followed by individualised development plans. Over the next two years, the participants will work on numerous joint training elements and their individual development goals. These include workshops on subjects such as team leadership, management, strategy development and change management. Other important elements are study partnerships and peer case study reviews. The programme offers participants a unique opportunity to reflect on and develop their individual competencies. Reviewing one's own strengths, potentials and areas for development, intensive group work, regular feedback and networking foster the personal career development of talented DLR staff all the way up to positions of more responsibility in the organisation.

	Total number	Men	in %	Women	in %
Participation in the DLR_Graduate_Program since the start of 2009	1237	927	75	310	25
Total participation DLR Talent Management Programme since 2010	60	36	60	24	40
Total participation DLR Mentoring Programme since 2000	175	117	64.8	58	35.2

DLR MENTORING PROGRAMME

We have introduced an innovative tool to support staff development and to promote young scientists. The aim is to encourage and develop staff with potential who are facing a change in tasks or embarking on specialist/disciplinary management tasks. The cornerstone of this strategy is access to the experience of senior management, which is provided through the direct and exclusive relationship between mentees and mentors.

In addition to the mentoring relationship and individual development measures, the 15-month programme provides joint framework activities for all participants. These include workshops on strategy, management and leadership-related themes, the contents of which are controlled entirely by the mentees, and regular case discussions with colleagues. In addition, mentees attend special Executive Board events, such as the Executive Parallel Dialogue and the annual General Assembly.

The programme seeks to develop work-related skills, generally for first-time managers. The content is built around case studies connected to the person's work and the development of communication and management competences, in combination with individual personal development, targeted network-building and increased visibility in DLR.

The success of the programme is visible not only in the positive annual evaluations and first management responsibilities, but also in the subsequent career progression of former participants: in addition to those achieving promotions with distinctions, senior management positions inside and outside DLR and junior professorships and appointments, one participant was recently appointed director of a DLR institute.



DLR talents of 2019 with Klaus Hamacher, Vice Chairman of the DLR Executive Board.

EQUAL OPPORTUNITIES, FAIR OPPORTUNITIES AND DIVERSITY

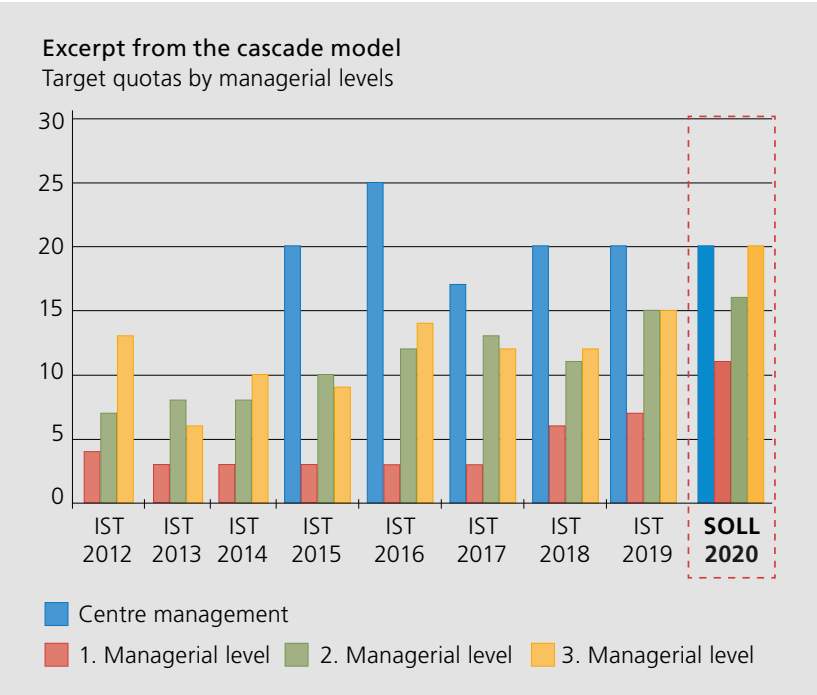
The issue of equal opportunities has long been part of DLR's human resources policy, including in its central aim of steadily increasing the share of women in the workforce, particularly in research and management roles. In order to achieve our self-imposed target quotas for female researchers, last year we implemented numerous measures and strategies. University of Cologne, RWTH Aachen University, Cologne University of Applied Sciences, the Forschungszentrum Jülich GmbH and DLR have established a close partnership in research, teaching and scientific management, which is underpinned by joint guidelines on equal opportunities. This regional network is developing further measures and planning and implementing joint campaigns.

The special attention DLR pays to equal opportunities is not just appreciated internally; it has regularly attracted external accolades in various corporate competitions and other distinctions. Examples include the HR marketing experts at TERRITORY EMBRACE and Germany's leading

women's magazine Brigitte, which listed the best employers for women in 2019. DLR is ranked among the top 120 employers for women, achieving a star rating of 5 out of 5 in aspects such as work-life balance, flexitime working, help starting careers, top management careers, encouragement for women in business and transparency.

DLR offers a wide variety of options for achieving a work-home and work-life balance. We were especially pleased with the ranking of DLR for work-life balance published on the Glassdoor recruiting platform in 2018. DLR received an average rating of 4.5 stars for work-life balance, putting it in top place in the ranking. The ranking was based on average employee evaluations of the work-life balance offered by their firms between July 2018 and July 2019 on Glassdoor.

In autumn 2019, for the sixth time in a row DLR was given the TOTAL E-QUALITY award with an add-on for diversity management. In its explanation, the jury said that the organisation of equality and diversity were exceptionally professional at DLR. All action areas had been backed up with comprehensive and highly appropriate measures, as the successful re-audits showed. In addition to established and proven activities, many areas were supplemented with additional measures. The TOTAL E-QUALITY distinction is awarded to firms and institutions with an exemplary HR policy in equal opportunities.



Adoption of joint guidelines at RWTH Aachen University, May 2018.



DLR employees are as varied in terms of gender, age, origin, education and personal development as the research topics and tasks of the organisation itself. We regard this diversity as hugely valuable, as diverse teams are usually more innovative and creative. This potential is essential for DLR as a future-oriented research centre. The annual diversity data report gives an overview of staff structure during the previous two years.

Diversity management helps sensitise us towards an attitude of tolerance and respect for the values of others. In the future, the dimensions of sexual orientation and gender identity will also be brought into sharper focus at DLR. One of the first activities in this context was to set up a 'rainbow portal' on an internal platform. This online portal provides employees with numerous tips, background information, events information and studies on sexual orientation and gender identity. All staff have the opportunity to contribute towards building up the collection of information. In practice, the rainbow portal has already been of great help in resolving conflicts that arose due to ignorance and insecurity.




Award ceremony in Munich, November 2019:
Patricia Femppel (DLR), Udo Noack (TOTAL
E-QUALITY Deutschland e.V.)

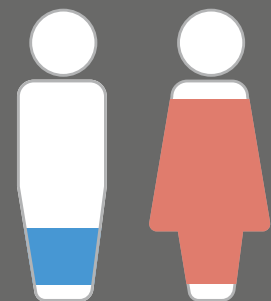
 charta der vielfalt

UNTERZEICHNET



 Parental leave in months

Men:
5.8



Women:
19.1



Year: 2019



	Total number	Men	as a %	Women	as a %
Employees	8960	5970	66.6	2990	33.4
Full-time	5028	3212	63.9	1816	36.1
Part-time	603	233	38.6	370	61.4
Managerial positions	774	601	77.6	173	22.4
Remote working	1019	545	53.5	474	46.5
Parental leave	134	27	20.1	107	79.9

Date: 31 December 2019

GENERAL ACT ON EQUAL TREATMENT

It is an employer's duty to protect staff against sexual harassment and gender-based discrimination, as enshrined in the German Act on Equal Treatment. When cases arise, they are frequently resolved on the spot with superiors and HR management. To make their work easier, DLR management training covers the contents of the general law and consultancy services are available. Since 2008, DLR has had officers responsible for the prevention of sexual harassment in the workplace. Equal opportunities officers often swap places with others in the Helmholtz Association of German Research Centers in order to further develop their own processes. To find out more, go to <https://www.dlr.de/EN/organisation-dlr/dlr/equal-opportunities-at-dlr.html>

SEXUAL HARRASSMENT

On the DLR intranet under the subsection 'Sexual harassment in the workplace, prevention and support', advice on how to properly handle the issue of sexual harassment is provided for managers, victims and witnesses. Incidents should be reported to the equality officer. During the reporting period, most complaints were related to job applications and disabilities. However, there were reports of the non-renewal of employment due to the gender of the jobholder. There were also reports of sexual and other forms of harassment in the workplace. Any such allegations are immediately investigated and result in a variety of measures, ranging from talking with the employee, mediation between the two parties, coaching sessions, cautions and written notices. Staff can also be dismissed on these grounds.





WORKER PARTICIPATION

WORKS COUNCIL

The general works council (Gesamtbetriebsrat) is responsible for matters relating to several divisions or the organisation as a whole that cannot be resolved by individual works councils (S. 50(1)(1.1) HS of the Industrial Relations Code BetrVG). Its remit applies to businesses that do not have a works council (BetrVG S. 50(1)(1.2)). Currently, the DLR general works council consists of members of its 15 constituent works councils; usually two members are elected from each site works council.

The general works council is not superior to individual, local works councils (BetrVG S. 50(1) (2)), which means it does not have the authority to give orders to individual works councils. The general principle is that of separation of powers, meaning that the general works council only has authority if the local organisations cannot or do not wish to deal with a particular matter and decide to refer it to the general works council for resolution.

The general works council meets regularly, currently two to three days every two months. The items on the agenda are discussed by a panel within the GWC. Topics are prepared and then discussion partners are invited. In 2019, these included the sustainability officer.

How is information exchanged? The elected members report back to their local works council after the general works council session. To ensure transparent communication with the workforce, the works councils invite them to meetings on site four times a year. At these meetings, staff are informed about individual measures and given an overview of the main points from the committee meetings. There were already some working groups on sustainability issues; others were newly formed after the meetings, while people at individual sites started to address the issue at their own initiative. The intention of the working groups is to provide inspiration, highlight different issues and search for solutions in support of the work of the sustainability officer.



III.2 NATURE AND THE ENVIRONMENT

ENERGY MANAGEMENT

In September 2019, we successfully achieved DLR-wide central energy management certification to the DIN EN ISO 50001 standard. The DLR management system is also almost fully integrated. Currently 18 of the 30 DLR sites have been certified and integrated into the energy consumption logging system. However, the current certification is bound up with the auditor's condition that newly added DLR sites also need to be included.



The audit of the energy management system has revealed weak spots at DLR, particularly in competencies related to energy law. These need to be expanded and improved by the energy team, who will receive regular training as part of the measures to address these issues.

With its metering structure, our current energy management system gives us a more accurate picture of energy flows and consumption.

This can be seen in many parts of this report in the form of energy consumption facts and figures. The improved metering infrastructure also revealed losses between heating plants and the point of use. The main culprit is probably ageing infrastructure, which has been identified and will be gradually upgraded.

Being able to accurately measure energy use has made it easier to identify potential energy savings and see where to focus our efforts to improve efficiency. In addition to the overall energy savings target of reducing energy consumption by 10 percent and specific energy consumption by 12 percent by 2025 compared to 2016 levels, energy management will facilitate the examination and implementation of energy upgrade measures and a shift to alternative sources of energy. By 2020, DLR had almost achieved its overall target, which has made us want to do even better. In the coming years we aim to increase energy efficiency further and retain our certification.

This reporting period was the first to include information on the consumption of diesel, petrol and kerosene for our research aircraft and the DLR vehicle fleet, including service and supply vehicles as well as research vehicles and executive vehicles.

Details can be found in the statistics at the end of the report. We do not yet have a detailed breakdown for this indicator; that is a task for the coming years.

However, data on the airborne research fleet can be disaggregated by

flying hours and the corresponding consumption of kerosene, back to the baseline year of 2016. This will help us to determine our carbon footprint more accurately.

To reduce our carbon footprint, in 2016 we began to use energy from renewable sources. Our main energy supplier, Stadtwerke Magdeburg, has provided us with the certificates for 2019. Almost all DLR sites now use EE01-certified hydro-power generated at Notodden,

Tyssedal and Vikersund in Norway. A small number still purchase their electricity from the Salzburg region in Austria. Our cogeneration plant in Cologne also produces its own electricity, but due to refurbishment works on the entire plant, its share during the reporting period was exceedingly small. In 2021, the plant is expected to generate 10,000 MWh of electricity. Our photovoltaic system in Cologne alone generated 28,215 MWh in 2018 and 2019. We are considering extending our photovoltaic capacity at other DLR sites in the future (see page 61).

ENVIRONMENTAL MANAGEMENT

Since 1999, DLR has been involved in environmental management (EM) in accordance with ISO 14001. We will continue to develop this initiative, although it may not be a smooth ride. At the Lampoldshausen site, the EM certified integrated system has been standard for a long time now. In 2018, the DLR Project Management Agency in Bonn achieved ISO 14001 energy management certification. The auditor praised the well-grounded and traceable methods used to measure and assess environmental aspects, along with the well-established sustainability team. At the end of 2018 the priority shifted to energy management, driven by the German energy services act (EDL-G). Having updated the relevant ISO 50001 standard in 2018, we are now working towards greater convergence of management systems. In doing so, we have optimised the continuous improvement process and made it more accessible to all staff with the aim of gathering more ideas and proposals on environmental matters.

We have developed our plans with regard to the standard for environmental performance evaluation pursuant to ISO 14031. To this end, we have developed various performance indicator profiles. Our environmental performance data on waste, land use, water and energy consumption can be accessed by all staff on the intranet and has allowed us to generate environmental characteristics such as CO₂ equivalents. The DLR Project Management Agency is already tracking the use of business travel and paper consumption in order to improve our environmental performance in these areas. Our aim is to obtain a detailed CO₂ footprint, which is also one of our targets in the list of measures and which in future will be important in focusing our efforts on carbon neutrality and the DLR proKlima policy.

In order to embed the environment and sustainability in the DLR culture and approach, various training approaches have been instituted or updated. They include EM content and its importance for the sustainable development of DLR, which is communicated to educators and trainees at DLR sites. The main environmental aspects of DLR, in other words all elements of activities that can have an environmental impact, can be accessed and discussed by all DLR staff members. New members of staff are also introduced to the aforementioned management systems.



The EM intranet pages have been restructured and updated, making them easier to find and the themes more appealing. As well as a list of EM systems, there is also an overview of relevant regulations. This includes federal states that have been newly added because new sites have been set up there. Some of the regulations required further action. A case in point is the forthcoming supply chain act, which will have a big impact on future sustainability activities. Other important regulations include the ordinance on installations for handling substances hazardous to water (AwSV) and the EU REACH regulation, which aims to change national products and disposal routes. The buildings energy act (GEG) should also be mentioned, as it will create a new framework for the energy and materials used in construction. During the reporting period there were no infringements of environmental law at DLR.

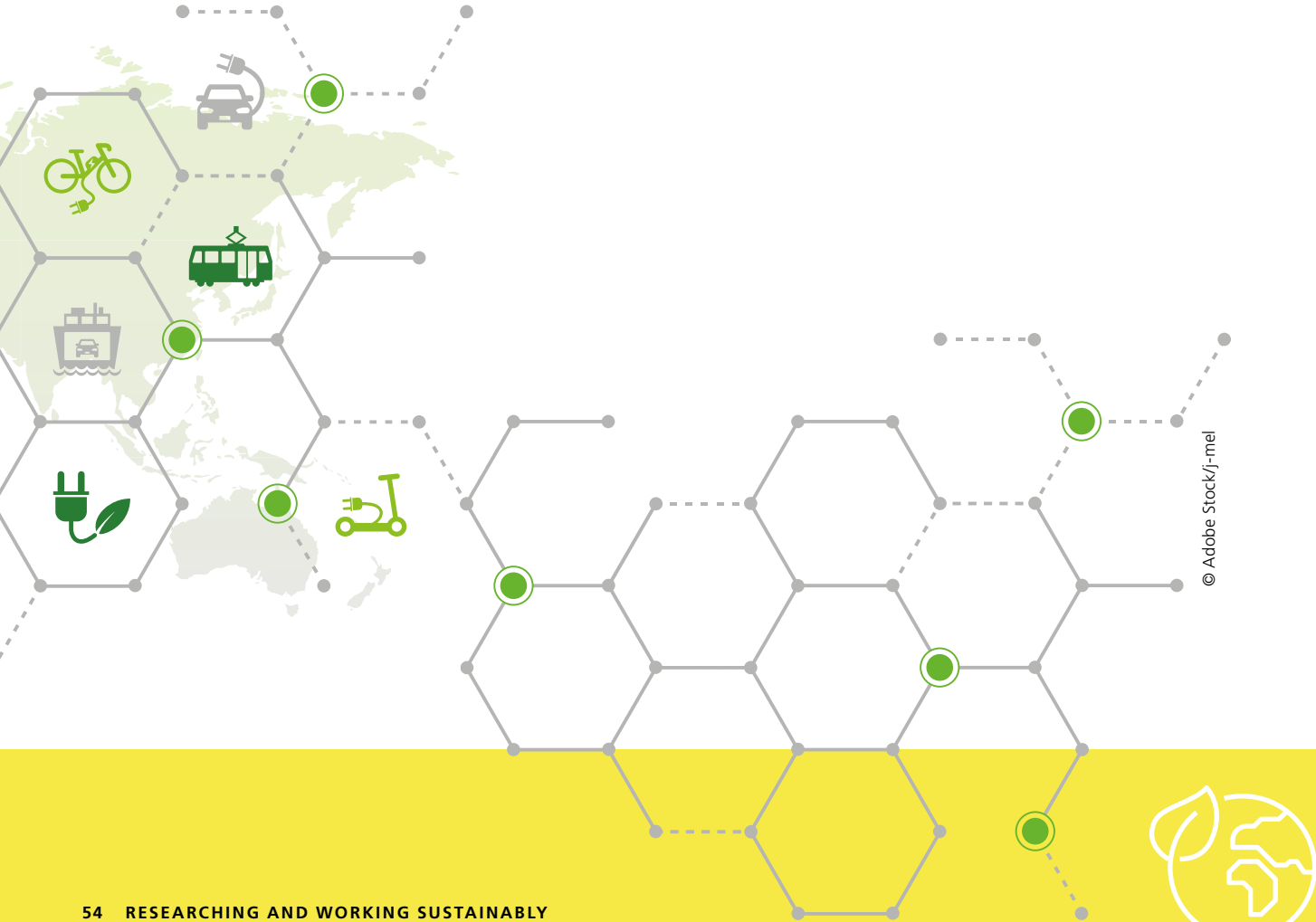
An important step for EM at DLR has been to renew and supplement old and current works council agreements on quality management systems, which now cover all management systems, including EM systems. This encourages staff representatives to focus more on working towards sustainability in operations. The representatives have also set up their own sustainability initiative.

After its initial focus on energy, the DLR EM team now has its sights set on a series of targets, which will be worked towards or met by the time the next report comes out. These include an organisational link to the quality management system to ensure that it addresses three goals:

- derive more benefit from the unified standards;
- offer EM services, including sustainability processes, more robustly in the sub-systems of DLR institutes and establishment; and
- jointly establish management standards.

In order to share best practices, our members of the internal DLR EM working group sit on committees of the Helmholtz Association of German Research Centers and are part of specialist groups, such as the association for sustainability and EM (VNU). In parallel with this, the DLR Project Management Agency has established itself as a service provider for policymakers, business and education with the environmental theme of "setting an example and inspiring sustainable approaches".

In the future we plan to offer EM training for special target groups such as managers, trainees and plant and laboratory operators. EM should be included in all audits in order to increase awareness. In addition, software support will be incorporated so that environmental condition indicators (ECIs), operation performance indicators (OPIs) and management performance indicators (MPIs) are simpler to measure and can be presented more transparently. To improve information on the subject, a regular newsletter on environmental protection, environmental management and related subjects such as climate, nature and energy will be launched.



ENVIRONMENTAL PROTECTION

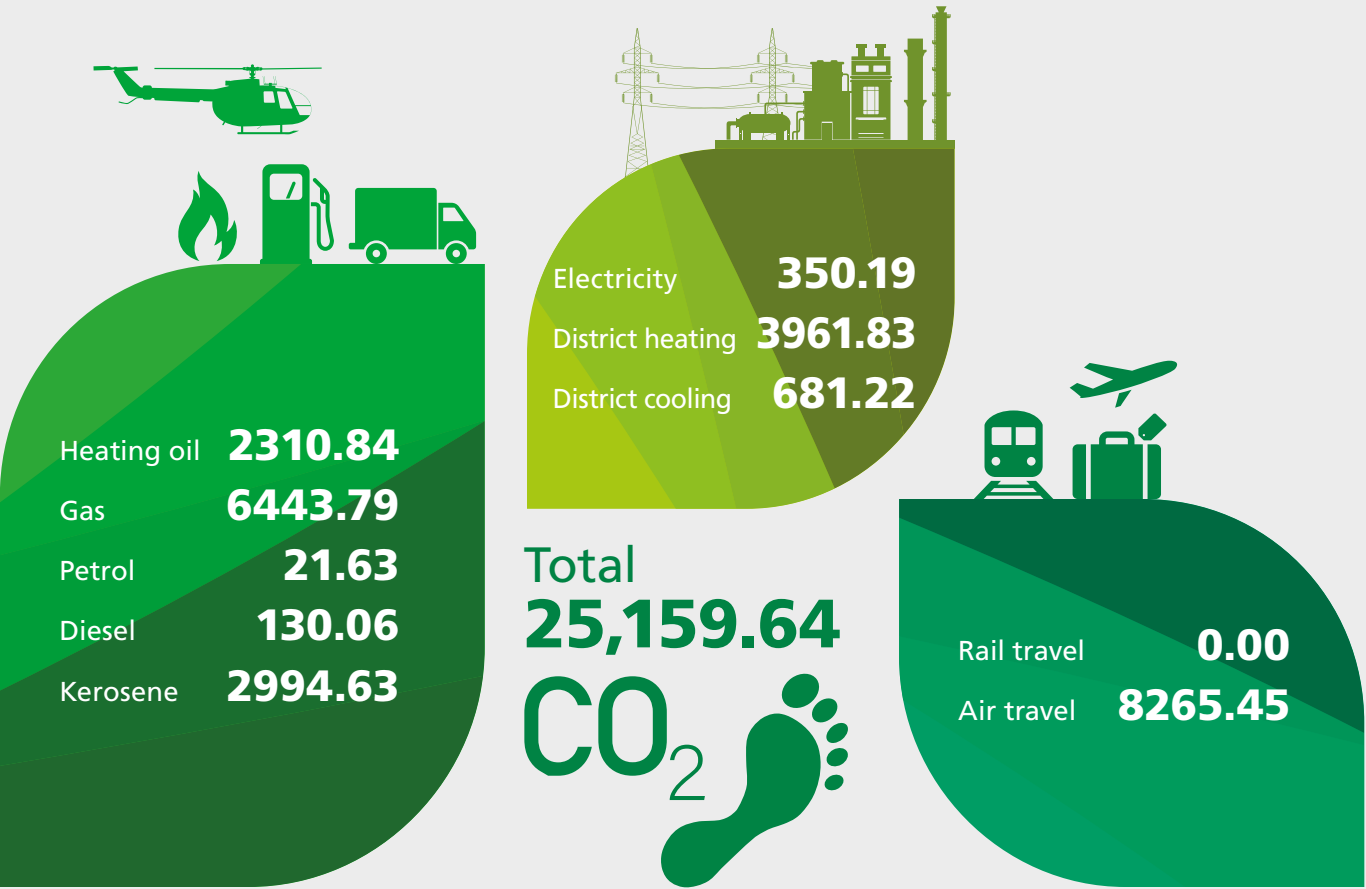
DLR has grown during the reporting period. The new DLR sites have brought in facilities that have an environmental impact, including test rigs, computer centres and even a whole airport in Cochstedt. We are working on optimising environmental performance and integrating it into the management system.

The idea of a lifecycle approach was introduced during DLR's very first environmental certification audit at the turn of the millennium. Since then, this holistic perspective has become part of everyday life at DLR's establishments and institutes, and as a result we have set even more ambitious targets and want to address the issue of sustainability more broadly. This approach is now extending into external supply and disposal processes, covering not just materials and media

but also products and services. We have scrutinised, updated and in some instances redefined disposal processes at many DLR sites. We have paid more detailed attention than ever to our requirements in order to avoid superfluous dry runs and half-filled containers. We are taking care to purchase less potential waste so that we can reduce our waste output by avoiding waste in the first place.

Economising on resources is another important aspect of environmental protection, as reflected in our list of measures. It is vital to avoid potential waste, save more and recycle more.

We have started to identify other sources of CO₂ and are also reducing travel-based CO₂ emissions in view of DLR proKlima. To give an



All figures are in tonnes of CO₂

Legend:
Heating oil, gas, electricity, district heating, district cooling: The data are based on certified energy management figures; adjusted figures and non-DLR users are increasingly excluded.
Petrol, diesel: Based on fuel consumption by DLR company vehicles in litres.
Kerosene: Based on fuel consumption by DLR research aircraft in litres.
Rail travel: Based on railway kilometres on long-distance business trips, which are stated as 0 emissions due to the eco-power used by Deutsche Bahn AG.
Air travel: Based on CO₂ emissions from business travel.

example, in 2019 the DLR Project Management Agency succeeded in using 28 percent less CO₂ for business air travel per employee compared with 2018.

Plants that generate electricity as well as heat for their own use, such as cogeneration plants, which have a high level of efficiency, will be given more consideration in future plans and site developments.

However, with its test beds at sites such as Lampoldshausen, its large heating plants and its fleet of research aircraft, DLR is still subject to carbon offsetting. Since 2019, we have had DIN ISO 50001 energy management certification (see page 52), which means that our energy performance is being constantly optimised through corresponding targets. Examples from our energy management master plan are shown in the list of measures included in this report.

RESULTS OF THE TOP 8 RESEARCH SITES:

ENVIROMENTAL PERFORMANCE DATA FOR 2019¹⁰

	Electricity (consumed) MWh	Electricity (generated) MWh	Heating oil MWh	Gas MWh	District heating MWh	District cooling MWh	Drinking water m³	Wastewater m³
Berlin-Adlershof (BA)	1645.63	—*	—*	—*	1414.00	915.00	3300	3300
Bonner Bogen (BN)	830.44	—*	—*	866.00	—*	—*	10,357	10,357
Braunschweig (BS)	8003.83	—*	—*	—*	6094.87	—*	10,999	10,999
Göttingen (GÖ)	6378.89	—*	—*	—*	3724.69	—*	16,055	16,163
Cologne (KP)	19,428.00	2104.33	—*	20,442.76	—*	—*	27,606	24,904
Lampoldshausen (LA)	1695.73	—*	1617.81	—*	—*	—*	8426	8704
Oberpfaffenhofen (OP)	15,365.75	—*	6359.18	4314.60	—*	—*	23,506	23,506
Stuttgart (ST)	5905.64	—*	6.29	—*	5891.45	3173.22	11,237	12,300

*) not used

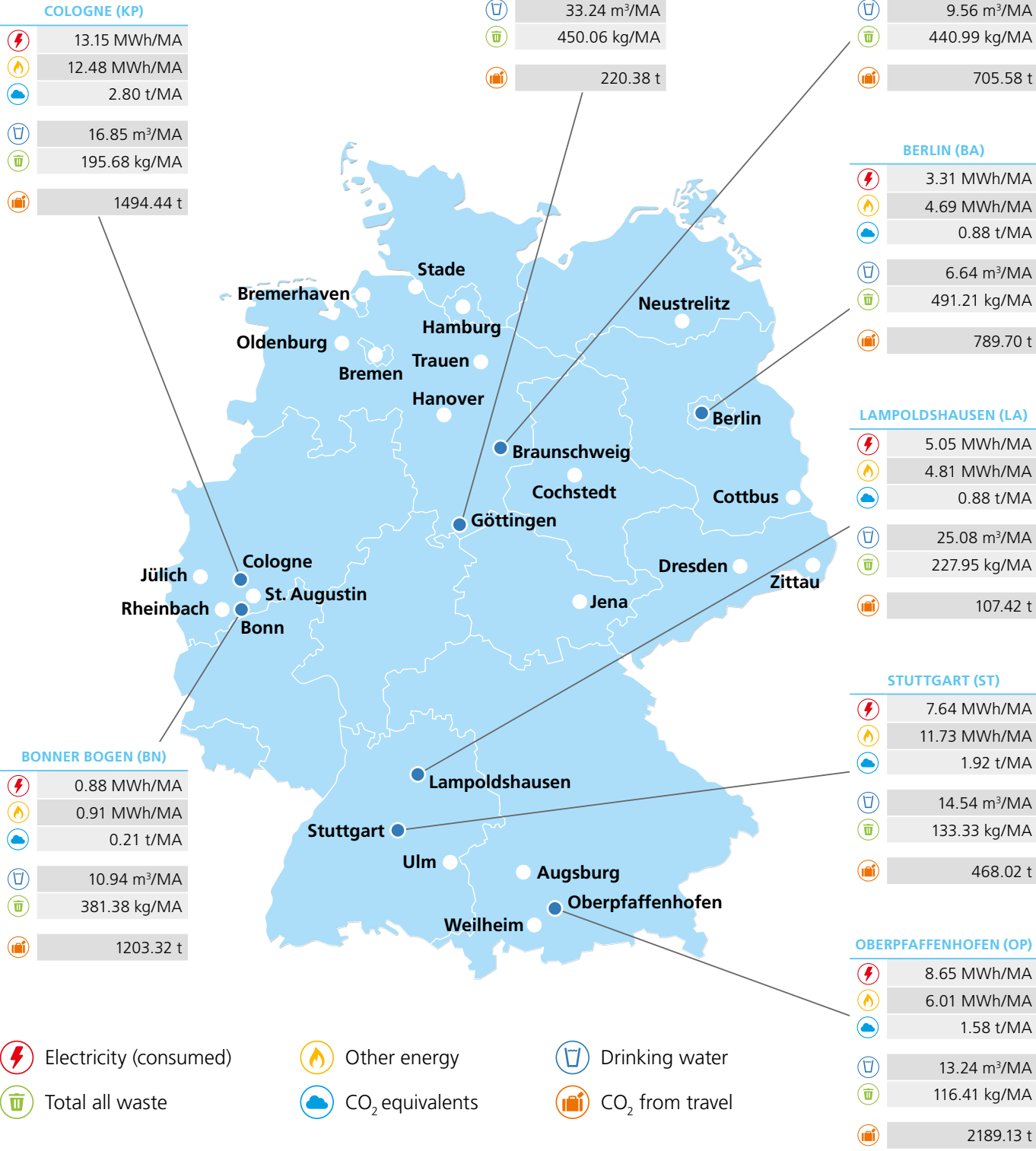
WASTE DATA FOR 2019¹⁰

	Total of all waste in kg	Non-hazardous waste in kg	Hazardous waste in kg
Berlin-Adlershof (BA)	244,131.60	244,131.60	—
Bonner Bogen (BN)	361,163.22	361,163.22	—
Braunschweig (BS)	514,741.00	514,213.00	528.00
Göttingen (GÖ)	217,381.30	208,491.30	8890.00
Cologne (KP)	320,527.66	258,838.64	61,689.02
Lampoldshausen (LA)	76,590.05	67,080.55	9509.50
Oberpfaffenhofen (OP)	206,752.20	204,299.30	2452.90
Stuttgart (ST)	103,065.40	100,027.40	3038.00

The top eight sites – according to the first environmental performance indicators and the calculated CO₂ equivalents – are shown in the table. The comparability of the environmental indicators is limited because of the large variation in the size, number of staff and research fields of the different sites – and therefore in their activities that impact the environment. However, we are continuing to try to go one step further. These figures cover 84 percent of the DLR workforce, with a focus on DLR staff.

¹⁰ Not every criterion applies equally to each site. For example, one site may use its own generated electricity while another is fully dependent on district heating or does not use any of these energy types at all. That is why some cells in the tables are blank.

TOP 8 RESEARCH SITES



Graphic: Top 8 DLR research sites in environmental figures and CO₂ equivalents



DLR has continued to strive for more sustainability in procurement in the past few years, greatly aided by the sustainable procurement guidelines, which we amended in 2019 to reflect changes in the legal framework.

When we enter into framework agreements or use online catalogues, it is important that our colleagues in charge of purchasing can see whether a product or supplier is sustainable and to what degree. For example, electric goods have an energy efficiency rating. Where possible, including in the DLR store, an indication is given of whether a framework agreement partner meets the requirements of the EU RoHS Directive. Directive 2005/95 EC, also known as the RoHS Directive, was introduced to restrict the use of certain hazardous substances that pose a threat to health and the environment in electrical and electronic equipment and components. The Directive severely limits (to a maximum of 0.1%) the presence of particularly problematic toxic and environmentally dangerous components such as lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers. Ensuring that procured items conform with the RoHS Directive helps to give sustainable protection to people and the environment. In addition, our electrical goods supply partners under framework agreements have positive, mainly silver, Ecovadis certification. DLR Procurement has made efforts to ensure that all these quality parameters are taken into account in the organisation.

We plan to develop a testing scheme to identify energy-relevant procurement processes. This test scheme will be incorporated into the process and help our procurement department to determine whether the product in question is one whose energy consumption is equal to or greater than one percent of the annual site consumption. Where this is the case, energy efficiency criteria have to be assessed and the matter discussed with the energy management team.



- Framework agreement for multifunction devices and copiers: when the tender was issued, sustainable evaluation criteria were taken into account, particularly relating to power consumption. The contract was therefore awarded to the company offering devices that automatically switch to stand-by mode when not in use. The devices also have a light barrier.

Conclusion of a new DLR-wide framework contract for office furniture and office chairs. Our purchasing department included a great number of sustainability criteria in the evaluation for this tender, the fulfilment of which could be demonstrated by the new framework contract partners:

- Proof of an environmental data sheet for each product with details of sustainable certificates
- Proportion of recycled materials used
- Proportion of recyclable materials used
- Percentage of material used, etc
- Proof of sustainable supply chains through Ecovadis rating in bronze, better silver
- Compliance with the energy management standard ISO 50001
- Proof of industry-specific sustainability certification for the four categories materials, health, energy and social responsibility – here: BIFMA level
- Proof of certification with regard to emissions/pollutants – here: Greenguard certificate
- Proof that the company is also voluntarily committed to corporate environmental protection

- Framework agreement for DLR business enterprises with a company supplying sustainable packaging material from renewable raw materials. Previously, large amounts of single-use plastic were used; this new framework agreement brings us one step closer to fulfilling our environmental sustainability commitment.

● DLR-wide framework agreement for premium print products as well as general information materials. In this tender, potential suppliers had to explain how they incorporate social and environmental aspects of sustainable action in the manufacturing process or when fulfilling orders. These could include environmental certification of primary products, existence of an energy management system, or employment of trainees or people with disabilities.

Framework agreement for winter services at the Oberpfaffenhofen and Cologne-Porz sites: the supplier with the smallest environmental footprint in terms of vehicle CO₂ emissions and using environmentally friendly grit was awarded the contract. The grit in question is lava-based grit from the nearby Eifel mountain range. This is a salt-free solution that does not contaminate plants or water and has the 'blue angel' environmental mark. The lava grains have a strong basification effect and bind the meltwater, which makes them particularly effective in icy conditions. Once the winter season is over, the granules can be spread on grass areas where they help loosen and aerate the soil.



CONSTRUCTION AND SITE MANAGEMENT

There are currently plenty of building works under way at DLR. Refurbishments, extensions and new construction all show how quickly DLR is expanding. Our efforts to integrate this with sustainability are progressing. As a result, we have made modifications to our administrative processes and invested in designs and building alterations.

Since 2018 we have continuously improved on our previous approaches. Our ‘Guidelines on the Design and Fitting of Buildings’ from 2013 were developed into ‘DLR Facility Management Standards on the Design and Fitting of Structural Works’ in 2018 and 2019. Their purpose has always been to incorporate sustainability aspects in structural works. This makes the specifications mandatory for all DLR staff. For example, based on the German federal evaluation system for sustainable construction (BNB), various minimum standards have been defined for DLR: visual impact requirements; construction requirements, i.e. low-waste, low-noise and low-dust building sites; requirements regarding the building materials used; and minimum site footprints for newbuild sites.

Planning and construction are resource-intensive processes, particularly construction. Nevertheless, in building management we have

the site and contribute to saving resources and protecting the environment.

We have taken a similar approach at the Cologne-Porz site. Currently, a cogeneration plant provides heating and electricity. The boiler system was commissioned in 1996 and has reached the average lifespan of such systems.

The refurbishment project will replace the old boiler system with a modern one. During the works, the system has been out of use, which is reflected in the consumption figures for the site. Now an integrated exhaust heat exchanger with a potential efficiency of 97 percent is being installed, together with more efficient network pumps. Exchanging the old boiler is also connected with the new DLR energy management system described earlier and the intention of increasing energy efficiency, and thereby sustainability. In compliance with Article 8c of Directive 2014/24/EU and Directive 2014/14/EU, only products that guarantee the highest level of energy efficiency are being used.

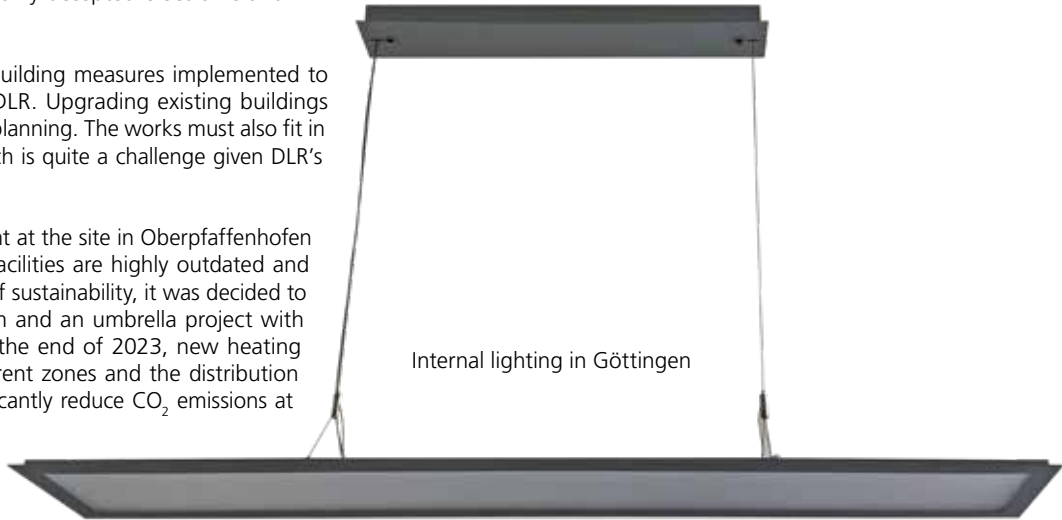
Small changes can also have an impact. The internal lighting at the Göttingen site was installed at different times, with some elements dating back to the 1970s, leading to frequent outages, technical faults and above all significantly high energy consumption and operating costs. Following a feasibility study, the decision was made to retrofit the entire internal lighting system in two stages. As a result, there is now sustainable LED lighting in almost all areas. Other positive effects of this upgrade are improved fire safety and better workplace protection as it is now possible to adjust the lighting according to the requirements of each individual work area. The first part of the retrofit is almost complete, and the second stage is in the early planning stage.

What can be done inside can also be done outside. At the Braunschweig site, the street lighting along the main road and other external lighting had become outdated. The light intensity was fading and some of the lighting fixtures were missing. For safety reasons, new lights were installed, ensuring greater safety for vehicles and pedestrians. The old lamp posts were replaced with new ones.

aimed to achieve a paper-free office as a move towards sustainability by implementing two main measures: the introduction of electronic contracting (e-contracting) and conversion to xml invoicing (xRechnung). By the end of 2019 we had largely achieved these goals. At all DLR sites, building management is able to complete all contracting and awards electronically. By November 2020 we had put all arrangements in place and since then we have only accepted electronic and xml invoices.

We should also mention several building measures implemented to improve energy consumption at DLR. Upgrading existing buildings requires careful consideration and planning. The works must also fit in with the corporate-level plan, which is quite a challenge given DLR’s many sites all over Germany.

The centralised district heating plant at the site in Oberpfaffenhofen and the additional local heating facilities are highly outdated and need upgrading. On the grounds of sustainability, it was decided to decentralise the centralised system and an umbrella project with three packages was initiated. By the end of 2023, new heating plants should be installed in different zones and the distribution facilities renovated. This will significantly reduce CO₂ emissions at

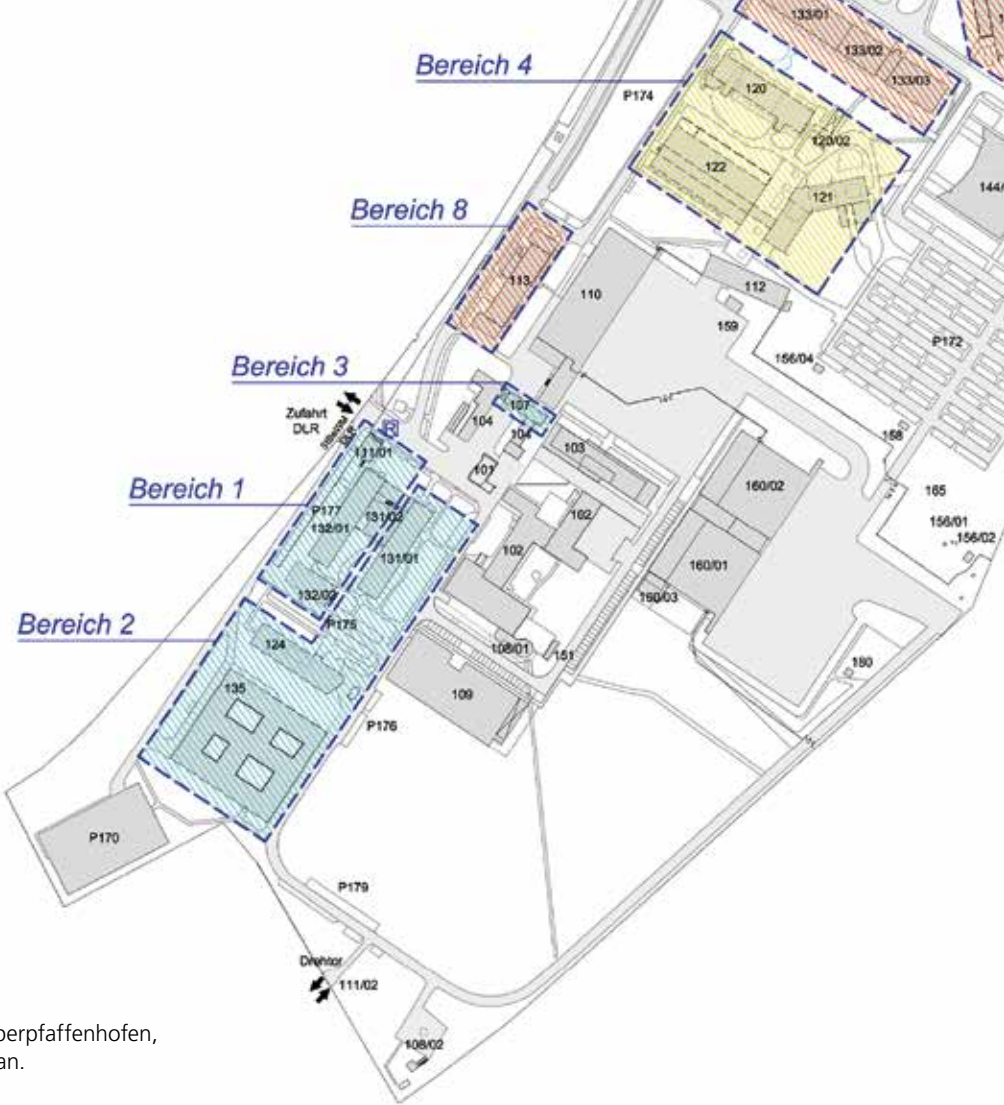


Wärmeversorgung OP - Paket 1		
Bereich 4:		
4.1	Gebäude 122	Erdberechnungszentrum (EOC/DFD/IMF) / Cafeteria
4.2	Gebäude 120	Institut für Physik der Atmosphäre
4.3	Gebäude 121	Erdberechnungszentrum (EOC/DFD)
Bereich 6:		
6.1	Gebäude 126	Systemhaus Technik / Fotomedien
6.2	Gebäude 123/01	Baummanagement / Institut für Physik der Atmosphäre
6.3	Gebäude 119	Institut für Elektrotechnik GmbH

Wärmeversorgung OP - Paket 2		
Bereich 1:		
1.1	Gebäude 132/01	Gerätewirtschaft / Kreativwerkstatt / Geheimschutz
1.4	Gebäude 111/01	Besucherempfang und Betriebschutzzentrale
Bereich 2:		
2.1	Gebäude 135	Institut für Robotik / Mechatronik / Systemdynamik & Regel.
2.2	Gebäude 124	Vorstandsgebäude / Leitung des Standortes
2.3	Gebäude 131/01	Fahrtbereitschaft / Gleitzeitstelle / Catering
Bereich 3:		
3.4	Gebäude 107	Personalentwicklung (Sprachen- und IT-Schulungsraum)

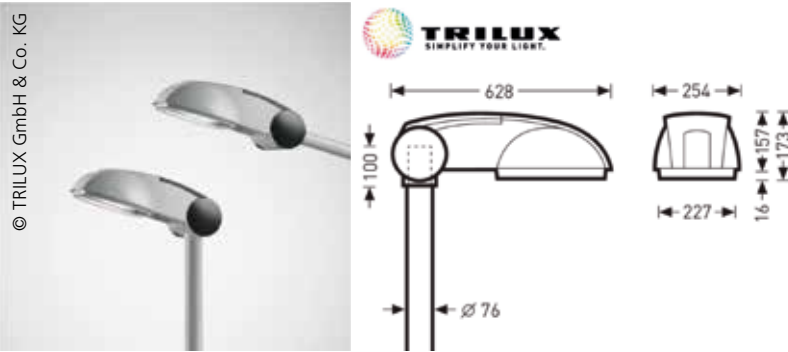
Wärmeversorgung OP - Paket 3		
Bereich 5:		
5.1	Gebäude 133/01	School_Lab / Moraba
5.4	Gebäude 133/03	Erdberechnungszentrum (EOC/DFD/IMF)
Bereich 7:		
7.1	Container-Industriebau für die neue Heizungsanlage	
7.2	Gebäude 140/01	Raumflugbetrieb (GSOC)
7.3	Gebäude 140/04	Raumflugbetrieb (GSOC) / ESA / COL-CC
Bereich 8:		
8.1	Gebäude 113	Objektbewirtschaftung

© Thomas Landgraf consulting engineers



The heating supply system at the DLR site in Oberpfaffenhofen, project presentation for the implementation plan.

The old lights, which used high-pressure mercury vapour (HME) or high-pressure sodium vapour (HSE/T) lamps, were replaced by modern LED lamps. The long service life and durability of these lamps, combined with the energy savings and ease of subsequent disposal (they are recyclable and have no special disposal requirements) make them more sustainable. While the Braunschweig site featured here is an example of an upgrade, such measures are being implemented from the outset at other DLR sites and new developments, such as those at the DLR site in Lampoldshausen.



We still have quite a long way to go with solar panels at DLR. While there may have been good reasons for this in the past, today the main obstacle is fire safety, which requires careful consideration. A decentralised photovoltaic (PV) system will, however, be built on the roof of the DLR Weilheim site and feed power into the site’s own network. The generating capacity will be selected to ensure that all power is used on site, without the need for energy recovery into the network of mains supplier EVU (Bayernwerk). The planned peak output is 200 kVA. As such, we’re making progress towards transforming this into a green site and will be assessing the suitability of other DLR sites for PV systems, in addition to those in Cologne and Weilheim.



Areas of the Weilheim site with sufficient light exposure to enable the installation of a ground-based PV system

CLIMATE-FRIENDLY EVENTS

Sustainable development is an increasingly important criterion and feature of DLR events: all those organising events at DLR can do their bit.

To implement sustainability requirements credibly and successfully, it is vital to incorporate sustainability into every event through a precise, tailored approach that covers everything from the initial concept to organisational planning.

DLR events planners can get advice on and assistance with organising sustainable events from a number of different sources. In addition to the DLR Events Management Service team, most of whom are trained sustainability consultants, the DLR sustainability officer can play an important role, including by giving information and advice on the potential portfolio of measures, as positive sustainability outcomes can only be achieved through a balanced mix of economic, social and environmental considerations. The sustainability officer can also be consulted on issues such as compensatory measures, suggesting the best compensatory solution in each particular case. Complementary to the service, information, guidelines and rules related to events planning is provided on the main DLR intranet.

Events also have financial outcomes and must therefore be subjected to an economic feasibility study. The full implementation of recommendations related to individual sustainability-oriented activities ultimately depends on the financial objectives for each DLR event, notwithstanding the aims of the organisers.



Peter Burauel at the first Sustainability Summit. During his time at the Forschungszentrum Jülich, he set out a crucial roadmap towards making the campus sustainable and was instrumental in embedding sustainable thinking and action at the Helmholtz Association of German Research Centers. Sadly he passed away in May 2020.

However, every event has an environmental footprint, which is why we will continue to work towards minimising the carbon footprint in the future, because even small individual savings contribute towards big reductions across DLR as a whole.

Research plays a key role in achieving sustainability. Acting sustainably for future generations is a global challenge that the Helmholtz Association of German Research Centers has been addressing since 2011. We are endeavouring to reinforce and promote the theme of sustainability at all our centres. Aside from the work carried out by researchers, events managers at the various Helmholtz centres coordinate with one another and exchange information on planning and organising sustainable events. Everybody learns from each other in this network, which helps to distil best practice.

A case in point was the first jointly organised Helmholtz Sustainability Summit held in 2019 in Berlin. In addition to hosting a broad-based discussion of sustainability in the Helmholtz Association, the event sought to identify areas of activity that could impact sustainability during the planning and design phases, assessing their relevance and determining the best possible measures for each area.

The result was a climate-friendly summit. Unavoidable CO₂ emissions were offset by compensatory payments, handled by atmosfair.



- The first Helmholtz Sustainability Summit was certified a climate-friendly event
- The total carbon emissions generated by the event were 22,346 kg
- An average of 200 participants attended both days of the first Helmholtz Sustainability Summit
- 56 percent of participants came by train, 38 percent travelled by other public transport and only 6 percent flew
- Only a tiny handful of attendees drove

Atmosfair uses its carbon offsetting receipts to support thousands of impoverished small farmers in India in selling their previously worthless harvest waste for power generation. This will help replace fossil fuels with renewable sources of energy, while providing the smallholders with additional income.



DIGITALISATION – WHAT WILL DLR EVENTS BE LIKE IN THE FUTURE?

Even before the COVID-19 pandemic, the events world was undergoing a digital transformation. For example, DLR events were increasingly being supplemented by digital formats or organised as hybrid events.

As COVID-19 will continue to challenge us for months to come, events for 2020 and 2021 have been planned as hybrid or entirely online events. This has meant completely overhauling preparations, some of which had been under way since 2018, in order to significantly reduce the number of cancellations. Digitising events is a huge challenge. All the stakeholders and major partners inside and outside DLR need to be involved in the process to ensure that the virtual event is appealing to all those involved.

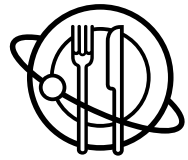
Virtual events have a lot to offer in terms of sustainability, especially with regard to certain resources. However, it is important to strike a good balance between online and offline events and to choose the right format for each type of event, or simply to alternate between face-to-face and virtual events.



Left: Virtual trade fair stand at the IAC Congress

Right: Multi-disciplinary INNOspace conference





BETRIEBSRESTAURANT

DLR CATERING AND FOOD SERVICES

Catering and food services at the major DLR sites are provided by individual businesses, which regularly exchange sustainability-related expertise.

The introduction of a goods management system in 2020 has enabled more targeted food purchasing and the closer tracking of usage rates. This will help us to improve the efficiency, flexibility and sustainability of our catering operations, for example by reducing over-production.

Sustainability is constantly being rethought in other aspects of our work in this area. We have showcased two of the most exciting ones here.

General steps taken by the catering and food service providers operating in DLR canteens:

- whole foods
- displaying nutritional content and calorie counts
- all binding agents are gluten-free (rice flour-based)
- only organic Fairtrade coffee in coffee vending machines and catering
- biodegradable coffee mugs and disposable cutlery
- weekly Weight Watchers meals

COVID-19: ALSO A CHALLENGE FOR OUR CATERING AND FOOD SERVICES

With the gradual reopening of DLR sites, we have had to devise new ways of incorporating more stringent hygiene measures. These have included limits on entry and tracking, along with socially distanced seating areas and the sale of pre-packaged salads and sauces rather than open salad bars. One complicating factor is that it is hard to predict how many staff will turn up at the canteen. This makes long-term planning difficult and requires a high level of flexibility.



© Adobe Stock/Haltpoint



FISH CERTIFICATES

Generally speaking, only MSC- or ASC-certified fish products are sourced for DLR canteens. The Oberpfaffenhofen site has gone beyond this measure with a novel idea: a 'Fischaktie', or 'fish share certificate'. This testifies to our undertaking to purchase a certain quantity of fish from sustainable sources over the year. The fish is

sourced from local suppliers who use natural feed and give the fish plenty of time to grow. The great benefit of this is that having direct contact with fish farmers means that DLR staff can enjoy fresh and home-smoked fish at the canteens.

ECOLAB DETERGENTS

ECOLAB is a sustainable business that aims to reduce water consumption, carbon emissions and waste. It also endeavours to make its methods transparent for customers, as a way of nudging them towards more sustainable and environmentally friendly behaviour. As a result, DLR has chosen ECOLAB to help shape its hygiene

and cleanliness arrangements, which are subject to regular review. For example, water consumption has been reduced by carefully calibrating the amount of detergent used in dishwashing. Staff health and safety have also been improved by using solid detergents and more accurate apportioning methods.

The ECOLAB dispensing unit in the dishwashing area of the Cologne-Porz canteen



FOOD WASTE INTO ENERGY

The canteen at the DLR site in Cologne uses a local partner to recycle food waste. Food waste mixed with water is collected in a large organic waste container during operations. A modern bio-waste chute with an integrated disposal unit takes the leftovers and turns

them into a homogeneous mass. Our partner comes at regular intervals with a tanker to transport the kitchen waste to a dairy farm in the Eifel hills, where it is used in a biogas generator to produce heat and electricity.



The biowaste chute (left and centre), which has been placed next to the dishwashing area for ease of use. The biowaste container is shown in the pictures on the right.



MOBILITY MANAGEMENT

The last few years have highlighted how much scope there is to improve work-related travel, whether DLR business trips or commuting. The mobility sector is of special importance as carbon savings can be achieved through measures that also improve the health of staff. However, far more attention is devoted to it than its potential would indicate. Indeed, transport management is featured in various parts of this report. The chapter on energy and environmental management provides information on our expanding recharging infrastructure and analyses business travel as part of our carbon footprint. Statistics for 2018 and 2019 are provided at the end of this report.

As an employer, DLR is looking at various facets of mobility and trying to make the best possible use of all options for reducing our

carbon footprint, which is partially generated by travel to and from our sites.

For example, ‘job-tickets’ (subsidised seasonal tickets for public transport) are already being offered at some of our sites. By negotiating with our partners in the transport sector, we have come up with financial incentives for our staff to use public transport. We are also in discussions with the national railways operator Deutsche Bahn to secure bulk discounts. There are two kinds of discounts available to DLR staff: the Jobticket¹¹ offered by Deutsche Bahn and bulk discounts offered at 11 DLR sites by local public transport operators. We are working with all our partners to expand our offers and make them more attractive in future, as well as combining them with other initiatives such as digitalisation and new working methods.

¹¹ www.badv.bund.de/DE/ZentraleAufgaben/JobTicket/DeutscheBahnAG/start

CASE STUDY: E-BIKES FOR GETTING AROUND JENA QUICKLY

The relatively new DLR Institute of Data Science, which conducts research into data management, IT security, intelligent systems and citizen science, needed to open new branches in different parts of town to accommodate its growth. It now has three sites in the city centre between which staff need to travel. The best solution for this was to purchase electric bicycles. Pragmatic and effective problem-solving like this has beneficial side-effects: DLR presents itself as an attractive, cycle-friendly employer; carbon emissions from business travel are reduced; and staff are encouraged to adopt a healthier lifestyle. This is backed up the positive feedback from the site, which in turn has led us to consider further investments. „The bikes are fun to ride and very practical for commuting to the town centre and the university data centre,” says one of our IT employees.



OTHER EVENTS

- The DLR Bonn site is taking part in **JOBWÄRTS** – *einfach.besser.pendeln*, a campaign to reduce commuter traffic. It organises information sessions and enables those interested to test-ride alternative modes of transport, such as pedelecs and speed bikes.
- A change to the German federal travelling expenses act has ushered in greater flexibility in the modes of transport available for business travel and the adoption of mobile working.
- The internal carpooling tool has been reworked to make the process of posting car shares quicker and the search function has been made more user-friendly
- Our tenders for hire vehicles and hotel accommodation are also placing a greater emphasis on sustainability.
- A self-assessment of DLR’s credentials as a bicycle-friendly employer will be carried out as part of efforts to make DLR sites more appealing to staff who cycle to work. Plans are also under way to identify other areas for improvement.



FIGURES FOR 2019:

13,880,996
business travel by rail (km)

61,608
reimbursed business trips

For **99.9 %**
of business trips, staff are reimbursed electronically.

The DLR fleet includes
4 hybrid and **15**
electric vehicles

6875 rental cars used



OCCUPATIONAL SAFETY

DLR employees are required to record accidents using an internal accident report form, even if they are near misses. A total of 796 accident report forms were filled out in 2018 and 2019 following an incident. Some of these are shown in the accident statistics while others were minor accidents that entailed up to three days of absence and are not included in the statistics. DLR Safety has collated, analysed and transposed the accident data into DLR’s accident statistics.

Based on the information in these reports, 61 accidents in 2019 warranted inclusion in the statistics, compared with 63 in 2018. The accidents led to 1289 days of absence from work.

Of the accidents that occurred in 2019, 22 (eight fewer than the previous year) were directly related to work activities; 37 accidents (four more than the previous year) occurred while travelling to or from work, representing an increase in the proportion of accidents related to the latter. Even one accident is one too many, and we are pleased to report that there were no fatal workplace accidents at DLR during the reporting period.

DLR’s accident figures for 2019 are significantly below the national average and the figures for various professional associations.

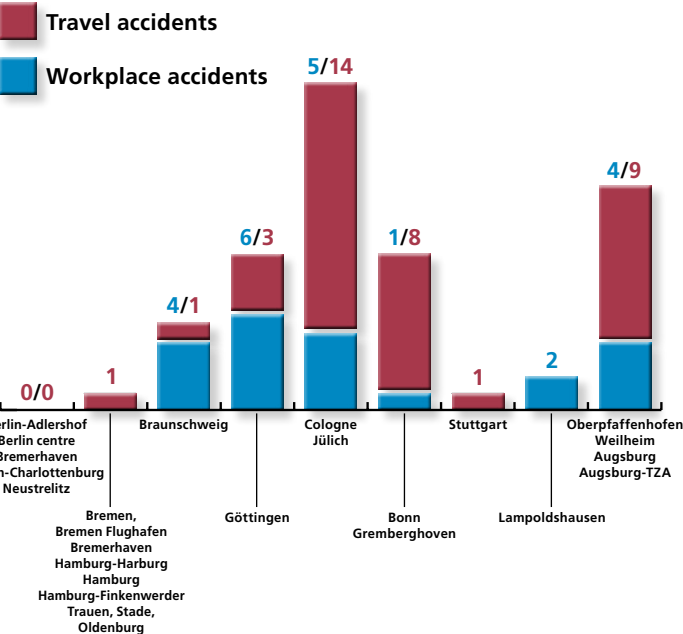
Accidents among DLR staff are extremely rare. Inside DLR, where the employer can influence the conditions, the likelihood of an accident is even less than during journeys, where, according to the analysis, employee attentiveness is paramount. And as for the previous two years, the number of accidents makes us a clear leader within our professional association, BG ETEM.

As part of our continuous education and prevention work, we have successfully expanded our internal training programme to include safety-related topics. The programme allows site-specific subjects to be addressed. From 2020 there will be compulsory content, with YODA facilitating individual adjustments, which will result in more targeted and cost-effective training.

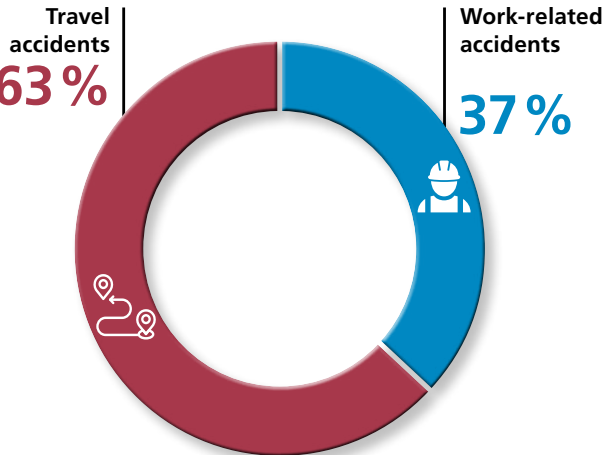
A new tender for occupational health and safety services was put out in 2019 in order to meet the increased requirements in this area.

Various electronic lists, such as the DLR-wide dangerous substances list, have been drawn up with the participation of 18 institutes and facilities. The list pools important information from a variety of sources, collated locally. Another important step has been the updating of fire safety maps in order to assess building conditions and identify the need for further action.

DISTRIBUTION OF ACCIDENTS BY SITE IN 2019



PROPORTION OF WORKPLACE ACCIDENTS TO TRAVEL ACCIDENTS



III.3 SOCIETY

KNOWLEDGE TRANSFER

In its 2016 paper on knowledge and technology transfer, the Wissenschaftsrat (German Council of Science and Humanities) recommended that research be carried out more transparently, with the aim of helping members

of the political sphere and society in general to develop and exercise better critical thinking skills. Greater transparency can also contribute towards personal development and the sharing of values. Greater openness to social issues on the part of the scientific community would serve to identify trends and help develop solutions systematically.

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"59 percent of Germans are interested in science and research subjects. Around half of those surveyed believe that the public is not sufficiently involved in decisions about science and research."

[Quote from Wissenschaftsbarometer 2019]

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EDUCATION AND OUTREACH

Taking a holistic approach, DLR supports young scientists along the entire education chain, covering all target groups. Individual measures build on and mutually reinforce one another. The DLR_School_Labs project has seen as many as 40,000 pupils visiting our 13 special laboratories, with a wide-ranging impact on all types of schools. Such visits can be followed up, for example, by projects carried out in collaboration with selected groups of pupils, or even work placements to deepen their interest. Activities to promote

excellence go one step further and are aimed at particularly interested and talented young people. Overall, the spectrum runs from pre-school and school offerings all the way through to academia, with students invited to attend summer schools and get involved in ideas-based competitions, as well as a high-calibre graduate programme that equips young scientists with multidisciplinary skillsets.

DLR_SCHOOL_LABS AND DLR_RAUMFAHRT_SHOW

"Out of school and into the lab!" This is the motto under which we have been inviting children and adolescents to the DLR_School_Labs programme ever since it was launched in 2000. The scheme aims to give pupils insight into the fascinating world of science by enabling them to take part in hands-on experiments. Studies have shown that the enthusiasm that this sparks in our young visitors stays with them

(DLR Space Show) to more than 80,000 children across the whole country, in venues that included a football stadium with 25,000 spectators. The stage performance was an entertaining science show, consisting of mystifying experiments organised by the team of moderators with pupils getting their hands dirty, plus captivating videos and opportunities for audience participation. "Simply amazing and "I have

The DLR_Raumfahrt_Show took place for the very first time in Erfurt Stadium in 2019. In the morning, 16,000 pupils watched the entertaining stage show, while the evening session was attended by a further 9000 people, mainly parents with children.



for far longer than the day itself; even weeks and months later, interest in MINT (maths, IT, natural science and technology) subjects remains high among the majority of girls and boys. Even a single one-day visit to DLR_School_Labs can be a lasting experience.

never seen the children so enthusiastic," were some of the comments of the teaching staff, many of whom took advantage of their pupils' newfound enthusiasm to go more deeply into the subjects in lessons.

In 2018 and 2019 our staff also visited the pupils, as the DLR_School_Labs programme left the laboratories to go into schools – or more precisely, school halls. Our teams presented the DLR_Raumfahrt_Show

This entirely new format of scientific communication with and for young target groups helped DLR Young Scientists to reach out directly to around 160,000 children and young people in those two years alone.

The Center for Satellite-Based Crisis Information (ZKI) also provides temporary advisory services for events. For example, on German Unity Day in 2019, it provided support to the local and national police in Kiel, in tandem with the Institute of Optical Sensor Systems. Up-to-the-minute high-resolution satellite data were combined with 2D and 3D models of the immediate surroundings, enabling the police to plan how and where to deploy their resources before the event and to run various scenarios as realistically as possible. The illustration shows 3D images being prepared from 2D images.



The DLR_Raumfahrt_Show unleashed a wave of enthusiasm among the audience. Over 80,000 girls and boys attended DLR performances at venues in different towns and cities. Images: DLR

MORE EVENTS FOR SCHOOLCHILDREN

DLR offers many other services to schools, including a series of DLR_School_Info textbooks that are distributed to over 4000 schools each year, teacher workshops attended by more than 1000 educators annually, and the DLR_next¹² portal, which has become

quickly developed a series of online services, initially advertised under the title 'Science at Home', which elicited an enormous response. Home experiments, a robot-building competition in collaboration with the Institute of Robotics and Mechatronics, remote



Educational videos with suggestions for hands-on experiments: This is one of the new online offerings that are being intensified in DLR's promotion of young scientists.

one of the most popular German-language knowledge platforms for young people. The importance of DLR's online presence, developed over the years, has been particularly apparent during the COVID-19 pandemic, when hit rates soared. The crisis, which has had a far-reaching impact on everyday life at school, also had repercussions for the DLR Education and Outreach programme. In March 2020, we

workshops for schoolchildren – all examples of our rapid response to the new situation, making it possible to cover DLR subjects while children were off school. In addition to this, new formats such as DLR_School_Lab TV and carefully designed YouTube tutorials reached thousands of children at home.

¹² <https://www.dlr.de/next>

INITIATIVES FOR STUDENTS

The DLR jury selects the winning team of the 2019 NASA/DLR Design Challenge

The German portion of the 2019 NASA/DLR Design Challenge was won on 1 August by the Stuttgart University team with its HyBird design. This edition of the student competition was dedicated to connecting remote regions of the world with major cities.

The challenge was to come up with fresh ideas and solutions for small, environmentally efficient aircraft. With our fellow aeronautics specialists at NASA, we want the Design Challenge to encourage young people studying technical subjects to think outside the box, innovating and unleashing their creativity where necessary.

By performing detailed market analysis, fulfilling all the design criteria, skilfully combining technologies and configuring them in a creative way, the Stuttgart-based team emerged in the lead with the HyBird, a high-wing aircraft with large propellers at the tips of the wings and two propellers at the tips of the V-tail. The jury also considered their choice of a hybrid propulsion system with two turbines to generate electricity and the possibility of switching it off while cruising to be highly innovative in terms of energy efficiency.



GIRLS' DAY

At our Braunschweig, Bremen, Göttingen, Cologne, Lampoldshausen, Neustrelitz, Oberpfaffenhofen and Stuttgart sites, 400 girls were offered inspiring insights into the many fields of research undertaken by DLR: aeronautics, space, energy, transport and security. The girls

were given the chance to design their own Moon mission, try their hand at soldering and construction, and play with satellites as we showed them a variety of pathways into fascinating, future-forward careers in scientific research.



Participants in the DLR_Uni_Summer_School_2019
Image: TU Braunschweig/Maximilian Fuhrmann



The DLR institutes provide intensive mentoring for students during their internships or while doing their dissertations. DLR also organises numerous summer schools every year, some in cooperation with universities and others with foreign partners. Three such summer schools were held in 2018 and 2019: the Space Weather Camp, which was organised by Neustrelitz and held in conjunction with US and South African partners; the Space Propulsion Systems summer school in Lampoldshausen; and the DLR_Uni_Summer_School, an annual summer school dedicated to aviation held in Braunschweig.

A core element of these events, which are aimed at the study of related subjects, is to provide students with theoretical knowledge and, most importantly, practical experience through workshops. There are also ideas-based competitions such as the REXUS/BEXUS campaigns hosted by the DLR Space Administration, involving high-altitude rockets and balloons; and the NASA/DLR Design Challenge, which invites teams of students from the USA and Germany to develop visionary concepts in aeronautics. Both are described in detail in our latest report.

TRAINEES AND DLR STAFF HELP WITH CHRISTMAS FOOD DONATIONS IN BONN

Looking to share some Christmas spirit, in 2019 DLR Bonn ran a successful charity campaign gathering food donations for the needy in the local area. The initiative collected 510 packets of coffee and almost 400 long-life foods such as pasta, rice and sweet treats thanks to the efforts of DLR Project Management Agency staff in Bonn together with those from the DLR Space Administration and the Project Management Agency for Aeronautics Research and Technology. In 2019, the campaign was organised by DLR

Project Management Agency trainees for the first time. In the run-up to Christmas, the campaign team handed the donations to Wolfgang Grafen (Chairman) and Claudia Fischer (volunteer) of the 'Bonner Tafel' food bank in Bonn, so that the gifts could be distributed to those who needed them in time for Christmas. As well as food, 500 euros were donated to pay for petrol for the food bank. The three DLR sites in Bonn have been collecting donations since the campaign was first launched by an employee in 2011.



SUSTAINABLE CAMPUS DESIGN IN BONN

'Sustainable, characteristic and attractive' were the requirements for the design of the new Bonn Campus grounds. The project sought to promote biodiversity and offer nutrition for bees and other pollinators, to be presentable and suitable for events all year round, to stay within the budget and be low maintenance, to offer seating and to act as a fire assembly point. Under the leadership of Bonn Facility Management and a specially commissioned landscape architect, the sustainability working group of the DLR Project Management Agency, Firmengarten-AG of Bonn and various members of staff who are keen gardeners all contributed ideas and proposals. The design for the campus grounds was particularly focused on sustainability.

The participants put together a long list of plant varieties that fulfilled the criteria of 'native', 'food source for pollinating insects' and 'old varieties'. The plants you see there today include black elderberry, rowan, aquilegia, catnip, raspberries, lavender and old varieties of apple tree. In two of the larger spaces, nature lovers can enjoy mixtures of native wildflowers among the apple trees. There are also benches and a small pergola made of FSC-certified wood where people can relax on their breaks or hold open-air meetings.



NEW JOINER – AN INITIATIVE FOR NEW COLLEAGUES

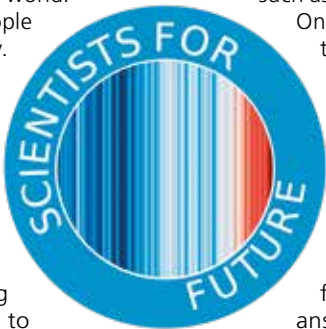
Getting to know each other, exchanging knowledge, networking: in 2019, the 'New Joiner' initiative gave new staff in the Society, Innovation and Technology department the opportunity to get together and network at the DLR Project Management Agency. Among other joint activities, they met up for lunches and a visit to the Christmas market. The aim of this grassroots initiative was to support newcomers during their arrival at DLR. Such interdepartmental networking also aims to help them identify with their respective fields, while

enabling them to join various social networks. The initiative seeks to encourage new colleagues to put forward their ideas and experience, which will in turn generate further dialogue and exchange. Based on this very positive experience, the DLR Project Management Agency is exploring how to expand this initiative throughout the organisation and develop it into a systematic way of providing support.

INVOLVEMENT IN SCIENTISTS FOR FUTURE

Many young people are currently protesting and taking part in the worldwide Fridays for Future movement to raise awareness of the need to protect the climate and preserve the natural world. The concerns and urgent pleas of these young people are entirely justified and must be taken seriously. These young people deserve our respect and attention, along with the full support of the scientific community.

That is why in 2019 scientists joined forces to form the Scientists for Future (S4F) initiative, which supports the Fridays for Future movement of schoolchildren and university students. One example of their efforts is presenting and discussing scientific information at joint events. This helps to refine the arguments for greater environmental protection and to back them up with more evidence. Getting the facts right is vital to forming a balanced and evidence-based view.



Numerous DLR researchers are involved in the S4F initiative. They have given their active support to numerous events and gatherings, such as days of action, panel discussions and school events. One particularly striking example was the event held at the Deutsches Museum in Munich in December 2019. Under the slogan 'Post-demo = pre-dialogue', school pupils and university students were invited to exchange views. At the launch event 'Climate Friday in the Museum' on 6 December 2019, the geophysicist and meteorologist Martin Dameris of the DLR Institute of Atmospheric Physics gave a talk on 'Climate change in Bavaria – the current situation and future prospects'. His talk was followed by a long discussion during which he answered the many questions raised by the young people in attendance.



Fridays for Future march in Munich

III.4 ORGANISATIONAL MEASURES

DLR MANAGEMENT SYSTEM

As always, over the last two years our research and innovation have been based on clear, transparent and consistent structures and processes. At DLR, we address the issue of sustainability not only in our research activities and the content of our research, but also by implementing sustainability solutions in our management processes. We do this using an overarching, organisation-wide system infrastructure, integral features of which include continuous monitoring and improvement. This approach plays a crucial role in DLR's general strategic and operational orientation and ensures research of reliable quality.

The approach is based on a management system that is geared towards the various requirements of the institutes and facilities and provides a framework for the subsystems of those institutes and establishments. The Executive Board is the decision-making body within the DLR management system.

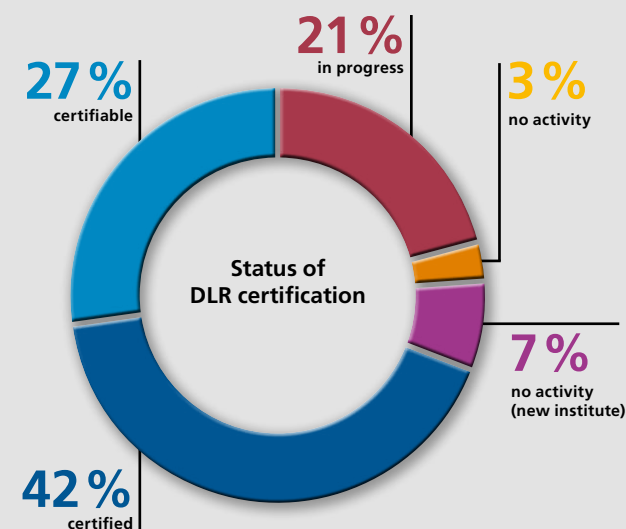
Quality management is an important topic at DLR and a management function in all areas of responsibility. The

Executive Board has appointed a quality management officer for DLR who, in addition to being responsible for quality management, assists the institutes and facilities in developing their own management systems and evaluates them impartially.

The DIN EN ISO 9001¹³ international quality standard for management systems is the minimum standard for all DLR institutes and facilities. Comprehensive certification will soon be achieved by all institutes and facilities. Newly established DLR institutes and facilities have taken the lead in setting up management systems.

Many institutes and facilities have integrated and certified sector-specific standards (VDA 6.2¹⁴, OHSAS 18001¹⁵, DIN EN ISO 14001¹⁶, DIN ISO 27001¹⁷) over and above the minimum standard.

At DLR we have three DIN EN ISO 17025¹⁸ accredited laboratories, one NADCAP¹⁹ accreditation and recognition by the Federal Aviation Authority for development and aviation operations.



Date: August 2020

Selection of certificates issued to DLR



¹³ International standard for the assessment and certification of quality management systems

¹⁴ Industry standard for the assessment and certification of quality management systems of service organisations in the automotive industry

¹⁵ International Occupational Health and Safety Management Standard

¹⁶ International standard for environmental management systems

¹⁷ International standard for information security management

¹⁸ Describes the general competency requirements for test and calibration laboratories

¹⁹ Test laboratory assessment system (National Aerospace and Defense Contractors Accreditation Program)



© Adobe Stock/bananenstaude

Our Executive Board has created new organisational framework conditions. Accordingly, we have begun to integrate other topics into the DLR management system, such as energy management, sustainability and environmental protection.

In September 2019, we successfully achieved DIN EN ISO 50001 standard in DLR-wide central energy management. More details on this can be found under 'Energy management'.

In future, we plan to integrate ISO 26000 sustainability themes into the DLR management system, along with our own ideas. One of the organisational steps that the Executive Board has taken in this direction was the appointment of a sustainability officer, who is now part of the steering committee for the DLR management system.



Sustainability-related measures are underpinned by standards in many areas. "Our colleagues in quality and product assurance coordinate the involvement of various DLR experts in national and international standardisation committees that address the various research activities in which DLR is involved,"



Guido Joormann

says Guido Joormann. DLR experts are actively involved in establishing norms and standards in over 70 organisations such as DIN, CEN and ISO. Sustainability is increasingly being embedded in the process. DLR is committed to ensuring that the Sustainable Development Goals (SDGs) are being considered and implemented.



Selection of certificates issued to DLR

FINANCE

In the area of finance, DLR distinguishes between Research and Operations, the Space Administration and the Project Management Agency. These are summarised in this section. For more de-

tailed figures, see the brochure ‘DLR in facts and figures’ and the various annual reports available online.

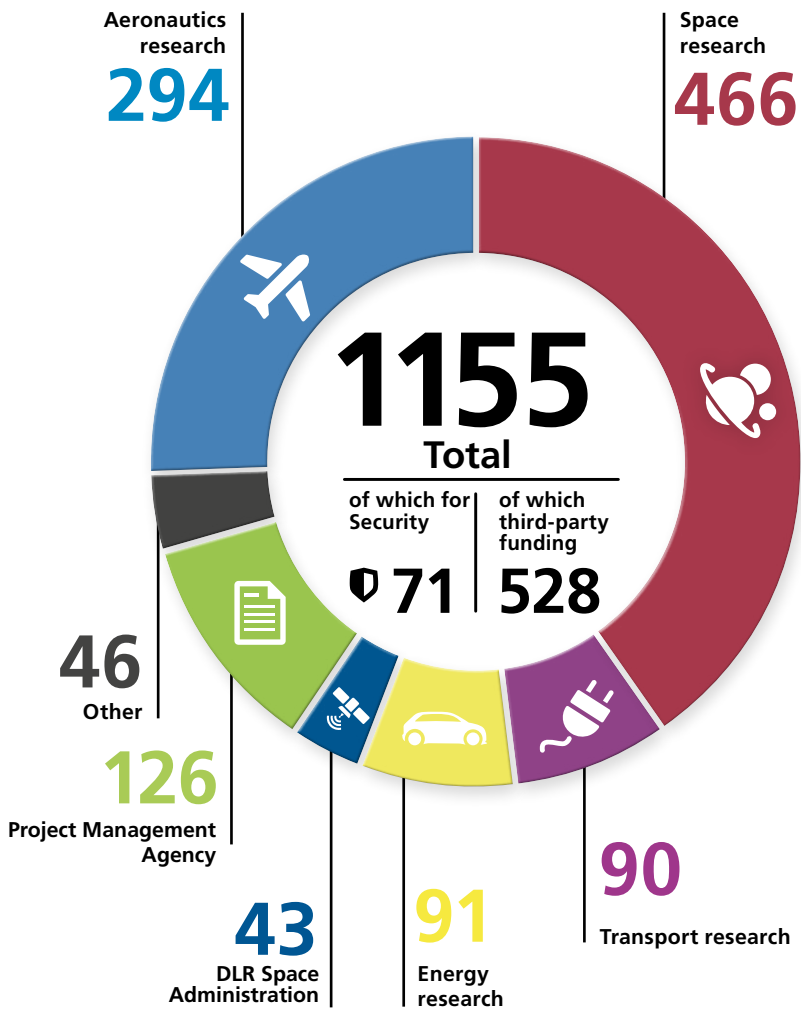
RESEARCH AND OPERATIONS

Some 90 percent of DLR in-house research, i.e. its research and operations, is covered by funding from central government, primarily via the German Federal Ministry for Economic Affairs and Energy; the remaining 10 percent comes from the federal states. DLR’s strong growth over recent years has led to the establishment of sites in almost all of the federal states, the only exceptions being Hessen, Rhineland-Palatinate and Saarland. The Helmholtz Association of German Research Centers is responsible for overseeing these funds. DLR also raises funding for its technology transfer and commissioned research from other sources, such as through contracts with industry. We apply for national and EU project grants. The success rate of applications for EU research funding

submitted by DLR researchers is generally above the average for Germany. The sum total of this third-party funding is one of many indicators of the practical relevance of the R&D services provided by DLR.

Internally, DLR allocates the funds for specific projects to institutes and facilities through service and resource agreements. The costs of infrastructure, administration and investments are determined in advance and deducted from the Research and Development budget. Everything is, of course, underpinned by due procedure and subject to annual approval by an external auditor.

DLR BUDGET

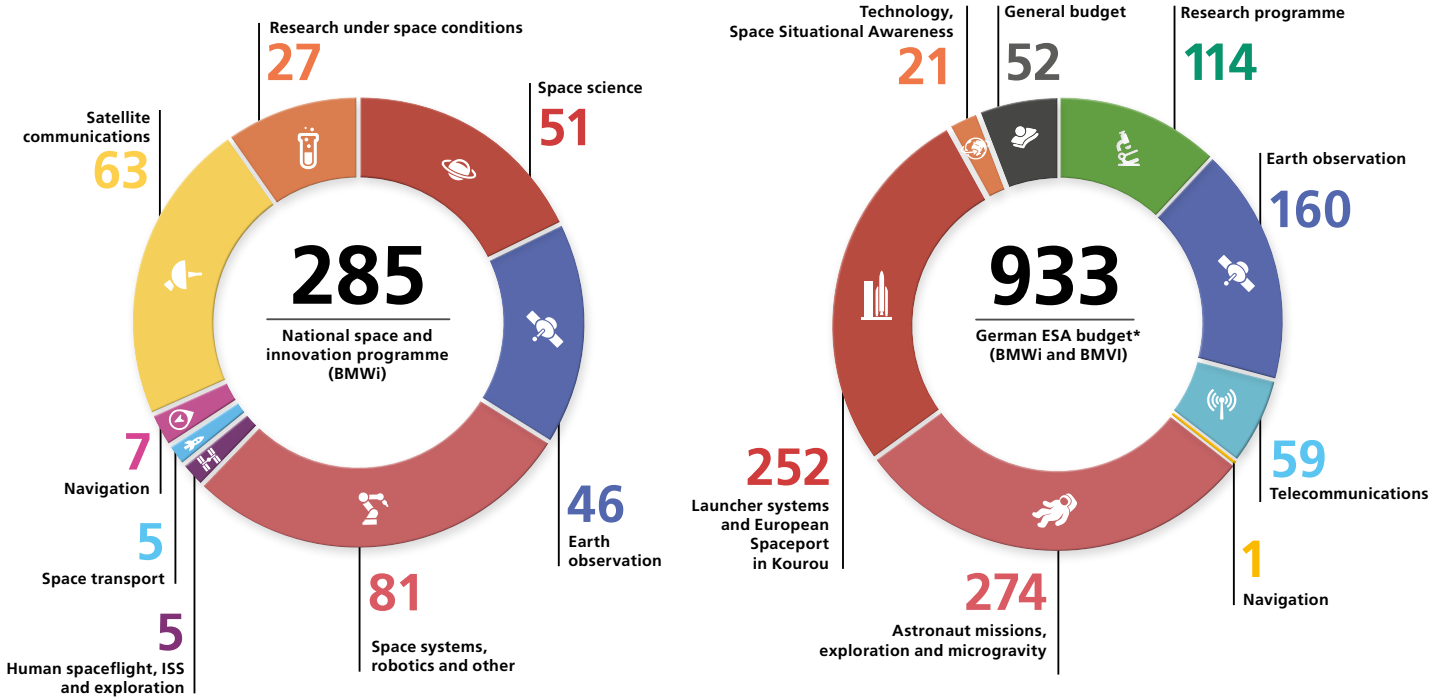


data in million euro Year: 2019 * Civil and defence research

DLR SPACE ADMINISTRATION

The DLR Space Administration is responsible for planning and implementing the German space programme. It covers all German space activities at the national and European levels. The Space Administration also makes and manages payments to the European Space Agency and EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites. The team of the DLR Space Administration helps to shape and supervise space flight matters within the relevant European research and innovation framework programme. The Federal Ministry for Economic Affairs and Energy is the main client for these services.

However, when it comes to areas such as Earth observation, navigation and satellite communications, the DLR Space Administration also works on behalf of other ministries, especially the Federal Ministry of Transport and Digital Infrastructure and the Federal Ministry of Defence. This allows us to ensure that public funds are being put to efficient use and helps us to keep German science and industry internationally competitive.



Year: 2019 Year: 2019

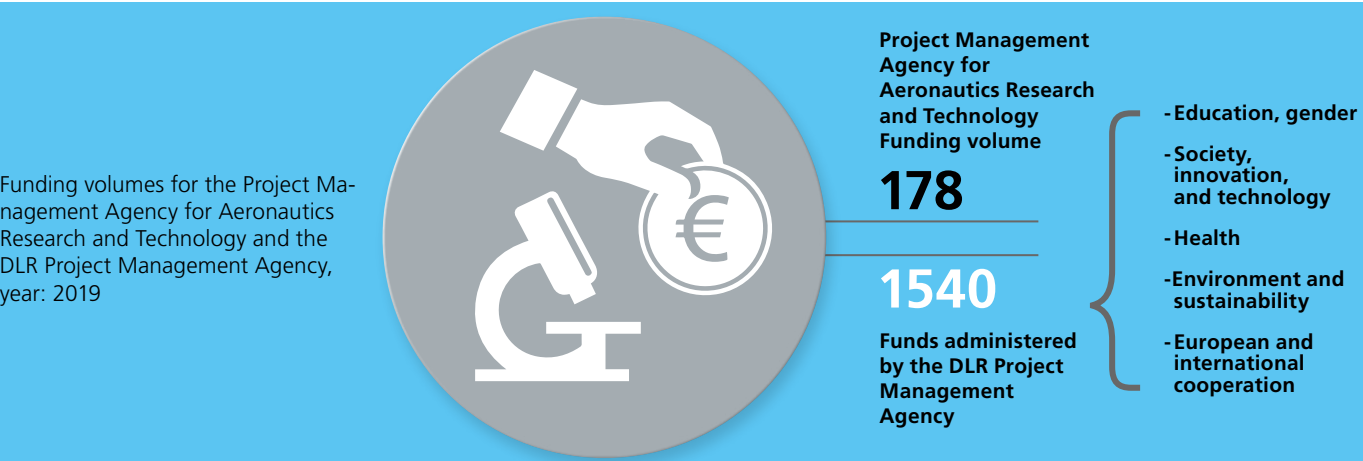
PROJECT MANAGEMENT AGENCIES

The DLR project management agencies are important service providers for German research, innovation and education systems. As one of the main project management organisations in the country, DLR-PT works primarily for government at the service of science, the economy and society. We also work for the European Commission, scientific organisations, educational institutions, associations and foundations at the regional, national, European and international levels. Our service portfolio, which ranges from analysis, consultancy and development through to support strategies and measures, meets a wide range of requirements in this respect. The field of Science, Innovation and Education completes DLR's research profile.

The Project Management Agency for Aeronautics Research and Technology supports the Federal Ministry for Economic Affairs and Energy

in implementing the aviation strategy, along with the states of Bavaria, Hamburg, Lower Saxony and Brandenburg, which have their own sponsorship programmes to supplement federal funding. Our Aviation Research Programme (LuFo) and our research and technology development projects in civil commercial aviation aim to boost Germany's profile as a centre for aviation. Our funding is focused on the following areas: aircraft noise reduction, urban air mobility and drone economy, AI/digitisation/automation, and hybrid electric aviation.

Both the funding volumes of the project management agencies are made up of the following funds, managed on a fiduciary basis.



COMPLIANCE

Numerous internal and external regulations define the daily work and activities carried out at DLR. As part of our digitalisation efforts, we are currently incorporating all of these into a regulation management system (RLM). This will also include the documents from the old organisational handbook (OHB), which will be discontinued in its previous form. The documents of the OHB will be presented in the RLM as DLR guidelines.

To us, compliance does is not just about adhering to legal and internal regulations; it is also about observing the fundamental ethical principles established in our organisational values. These include observance of human rights, labour standards, health and safety, environmental protection and the fight against corruption. This is another reason why we signed the UN Global Compact in early 2021.

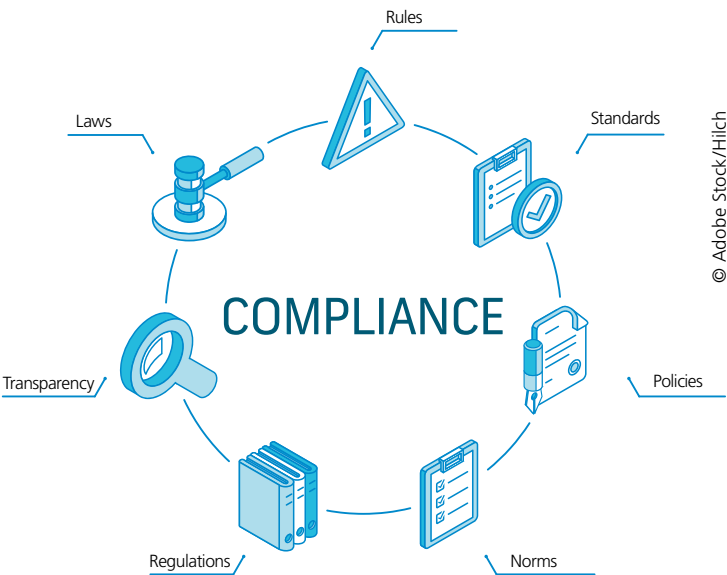
COMPLIANCE MANAGEMENT SYSTEM

The aforementioned values and regulations have been guaranteed since 2013 by the DLR compliance management system. This system includes regular staff training that raises awareness of the subject.

The main aim of our compliance efforts is to investigate the causes of major infringements and, if necessary, to take the appropriate

action under labour, civil or criminal law. As well as internal reports and complaints, grave infringements can also be reported anonymously via a special email address. We also have a website dedicated to compliance.

A variety of allegations of potentially severe breaches of compliance were investigated in 2018/2019. In four cases, action was taken under labour or civil law.



PREVENTING CORRUPTION

In order to prevent corruption and bribe-taking in any form, DLR has drawn up its own guidelines, which are available to all employees via the intranet. These are based on the federal government directive on prevention against corruption.

The heads of the institutes and facilities are responsible for observing and implementing the anti-corruption guidelines. If they suspect corruption or bribe-taking, they are obliged to report it; the DLR internal audit team conducts continuous checks in this regard.

No corruption cases were reported in 2018/2019.



RISK MANAGEMENT

Our risk management system (RMS) has the task of identifying any threats to DLR's commercial and financial situation promptly and assessing, monitoring and controlling such risks. The ever-changing environment we work in makes risk detection an ongoing task. Effective risk management therefore requires the involvement of all staff and must be embedded in DLR's business processes. The RMS was set up in accordance with section 53 of the budgetary principles act (HGrG) and section 91 (2) of the stock corporations act (AktG). Annual training and refresher courses are provided as standard.

The RMS is the responsibility of the entire Executive Board. The primary responsibility lies with the Vice Chair of the Executive Board.

Responsibility for the operational management of the RMS lies with the Controlling department, where it is implemented by the RMS coordinator. At DLR, the RMS is supported by RiskCity software and divided into 22 constantly evolving monitoring areas such as strategy, personnel management, procurement, shareholdings and legal affairs, compliance, many of the DLR research areas and data protection. Each of these areas has an assigned risk coordinator and representative.

The annual report includes an annual audit of DLR's risk management system, which was also carried out in 2019. The auditor performing the annual audit confirms that management has taken the necessary steps to provide a suitable early-warning system for risks and that this system is capable of issuing early warnings of any developments that might pose a threat to the continued existence of the organisation.

- *Observation areas:**
1. Contract management
 2. HR management
 3. Finance
 4. Resource planning and control
 5. Strategy
 6. International relations
 7. Procurement
 8. Technical infrastructure
 9. Technology Marketing
 10. General legal matters
 11. Information and communications technology
 12. DLR Space Administration
 13. DLR Project Management Agency
 14. VO-RU joint ventures
 15. Transport research programme
 16. Space research programme
 17. Aeronautics research programme
 18. Energy research programme
 19. Security research programme coordination
 20. Compliance
 21. Commercial information systems
 22. Data protection

DIALOGUE WITH GOVERNMENT STAKEHOLDERS

Combatting climate change and meeting the 2050 climate objectives requires a shift in our economy and society towards greater sustainability, based on scientific findings and technological advancements. As a research institution, DLR plays an active role in these processes by contributing its expertise. It also achieves this by engaging with those involved in policy-making at the national and state levels.

We use conventional and innovative formats to bring the results of our wide-ranging research projects on issues such as environmentally friendly aviation, future energy systems or carbon-neutral transport, to name but a few, into the political discussion. For example, DLR researchers are regularly invited to give talks on sustainability before the national and regional parliaments. This may take place, for instance, within parliamentary working groups. DLR experts are also called to give expert opinions at committee hearings. DLR is represented at numerous events within the political sphere, be

they joint initiatives with other stakeholders or special scientific events. There are regular meetings at the executive and working levels with ministries responsible for aspects of sustainability. Visits to our sites also play an important role, as they give visitors the chance to experience science hands-on.

The importance of DLR as a partner in shaping societal processes has been particularly apparent during the phasing-out of fossil fuels and the adoption of measures to transform coal-producing regions. The new DLR institutes and facilities in the Lausitz and Rhineland mining regions will help guide the transformation process there. They allow DLR to further contribute towards the climate-neutral transformation of Germany as an economic centre.

DLR does not donate to political parties.



MP Hansjörg Durz learning about DLR research into the digitalisation of aviation at Augsburg in 2019

In October 2019 the Bavarian Minister of the Environment and Consumer Protection, Thorsten Glauber, visited the DLR site in Oberpfaffenhofen. The focus of the visit was the contribution of DLR's Earth observation research to environmental and climate protection.

IV. Concluding notes

IV.1 INFORMATION ABOUT THE SUSTAINABILITY REPORT

Since 2014, we have been issuing reports every two years²⁰. This report is a useful supplement to other DLR publications, our social media presence²¹ and our website at www.dlr.de.

We have compiled this sustainability report following internationally recognised Global Reporting Initiative standards (GRI, core option). These reporting principles were consulted both with regard to the contents of the report and in terms of its quality. At the end of the report you will find the GRI index of contents and the main figures for DLR, which have been checked by our Controlling department. The report is also in line with the 20 criteria of the German Sustainability Code (GSC)²². Like the previous report, this one is intended as a GSC declaration. Given DLR's entry into the UN Global Compact²³ the sustainability reports are a linchpin of its efforts. They contribute towards the UNGC Communication on Engagement and are published accordingly.



All of the facts and figures refer to the reporting period 1 January 2018–31 December 2019. The editorial deadline for content was 31 December 2020. Due to the coronavirus pandemic, DLR staff have been working from home since March 2020, and the altered working conditions and changes within the Executive Board delayed the report's publication to spring 2021. As a result, it includes ongoing developments from the whole of 2020.

We were able to use data from the certified energy management system this year for the environmental indicators. Changes are due to more precise readings. It has become possible to rely more on DLR's own figures and exclude external users. CO₂ conversion factors were updated in accordance with the sources listed below. For the first time, CO₂ emissions due to electricity consumption were based not on the German electricity mix for the year in question, but on the emissions values for hydroelectric power according to the electricity report²⁴. However, we have specified 5 g/kWh in place of 0 g/kWh, as some of our DLR sites are highly dependent on companies and external usage. For example, Lampoldshausen has gaps in the water data due to sewage sludge and excessive rinsing water. Determining some values for waste has proven problematic. Irregularities can be explained by changes in provider and the avoidance of empty runs with containers.

The conversions are based on the following sources:

- for solid waste, conversion factors from the Bavaria Statistics Office and the European EAV Waste Catalogue were used
- for conversion into CO₂ equivalents, factors from the Federal Environment Office and the climate-neutral trade calculator were used
- and heating values were based on data from the Wikipedia list and the Helmholtz Association.



ALL OF OUR MAIN THEMES ARE REPORTED ON THE BASIS OF THE GRI STANDARD (CORE OPTION) WITH THE OBLIGATORY GENERAL INFORMATION (102) AND ON A SUBJECT-SPECIFIC BASIS ACCORDING TO THE CORRESPONDING STANDARDS:

- | | |
|---|---|
| • (201) Economic performance | • (402) Labour/management relations |
| • (203) Indirect economic impacts | • (403) Occupational health and safety |
| • (204) Procurement practices | • (404) Training and education |
| • (205) Fight against corruption | • (405) Diversity and equal opportunity |
| • (302) Energy | • (406) Non-discrimination |
| • (307) Environmental compliance | • (413) Local communities |
| • (308) Supplier environmental assessment | • (414) Supplier social assessment |
| • (401) Employment | |

²⁰ DLR sustainability reports:
• https://www.dlr.de/dlr/Portaldata/1/Resources/documents/nachhaltigkeitsberichte/dlr_nachhaltigkeitsbericht_2016_17.pdf
• https://www.dlr.de/dlr/portaldata/1/resources/documents/2018/DLR-Nachhaltigkeitsbericht_2014_15_201115.pdf

²¹ Our social media channels:
Facebook: <https://www.facebook.com/DLRen/> Twitter: https://twitter.com/DLR_en
Instagram: <https://www.instagram.com/germanaerospacecenter/> YouTube: <https://www.youtube.com/user/DLRde>
Vimeo: <https://vimeo.com/dlr>

²² <https://datenbank2.deutscher-nachhaltigkeitskodex.de/Profile/CompanyProfile/13595/de/2017/dnk>

²³ <http://unglobalcompact.org/participant/142403>

²⁴ <https://strom-report.de/co2-deutscher-strommix/>

IV.2 STATISTICS OF THE YEARS 2017-2018-2019

FINANCES – BUDGET	YEAR 2017	YEAR 2018	YEAR 2019
Total	1001 m €	1035 m €	1155 m €
Aeronautics	253 m €	276 m €	294 m €
Space	402 m €	402 m €	466 m €
Energy	89 m €	83 m €	91 m €
Transport	73 m €	79 m €	90 m €
Security	of which 76 m €	of which 73 m €	of which 71 m €
DLR Space Administration	36 m €	38 m €	43 m €
Project Management Agency activities	104 m €	117 m €	126 m €
Other	49 m €	40 m €	46 m €

Institutional funding			
Total	507 m €	532 m €	628 m €
Aeronautics	178 m €	202 m €	215 m €
Space	210 m €	206 m €	271 m €
Transport	52 m €	53 m €	57 m €
Energy	44 m €	42 m €	55 m €
Civil security research	7 m €	11 m €	11 m €
Other (HGF and ETW)	16 m €	18 m €	18 m €

FINANCE – THIRD-PARTY FUNDING	YEAR 2017	YEAR 2018	YEAR 2019
Total third-party funding	494 m €	503 m €	528 m €
Third-party funding as share of total	49 %	49 %	46 %

Income from EU funding (DLR total)	43.2 m €	39.8 m €	52.5 m €
EU income Aeronautics	20.6	19.4	21
EU income Space R&T	7.3	7.4	6.9
EU income Energy	5.5	5.1	5.4
EU income Transport	3.4	4	4.6
EU income Security	–	–	–
Success rate EU applications (ratio accepted/submitted)	25 %	31 %	32 %
Coordinator ratio (ratio coordinator/total EU projects)	25 %	14 %	19 %

FINANCE – PROJECT MANAGEMENT AGENCY	YEAR 2017	YEAR 2018	YEAR 2019
PT Aeronautics Research Contribution to DLR third-party funding	6.5 m €	6.2 m €	8.1 m €
PT Aeronautics Research Funding volume	167 m €	153 m €	178 m €

DLR Project Management Agency Contribution to DLR third-party funding	97.7 m €	111.0 m €	118.7 m €
DLR Project Management Agency Funding volume	1279 m €	1434 m €	1540 m €
Health research	300	371	416
Environment, culture, sustainability	136	144	151
Educational research, integration, gender studies	433	461	444
European and international cooperation	65	71	78
Wissenschaftsjahre	10	10	10
Society, Innovation, Technology	335	379	442

FINANCE – DLR SPACE ADMINISTRATION	YEAR 2017	YEAR 2018	YEAR 2019
DLR Space Administration Contribution to DLR third-party funding	36 m €	38 m €	43 m €
DLR Space Administration Funding volume	1166 m €	1288 m €	1236 m €
National programme	274 m €	285 m €	285 m €
Space Science	52	56	51
Earth observation	51	48	46
Space Systems Technology, Robotics and others	74	78	81
Human spaceflight, ISS, Exploration	7	6	5
Space transportation	6	5	5
Navigation	9	7	7
Satellite communications	40	54	63
Research under space conditions	34	31	27

ESA	YEAR 2017	YEAR 2018	YEAR 2019
Total (incl. BMVI et al.)	860 m €	929 m €	933 m €
Research programme	109	112	114
Earth observation	173	155	160
Telecommunications	42	52	59
Navigation	4	1	1
Astronaut missions, exploration and microgravity	205	310	274
Launcher systems and European Spaceport in Kourou	262	223	252
Technologie, Exploration, Space Situational Awareness	15	24	21
General budget	50	52	52

RESEARCH	YEAR 2017	YEAR 2018	YEAR 2019
Technology Marketing			
Income from licences	6.7 m €	2.9 m €	2.4 m €
Company spin-offs	3	9	5
Investments in technology transfer projects	4.5 m €	4.5 m €	6.5 m €
New independent technology transfer projects	15	15	19
DLR intellectual property	3655	4032	4193

Results			
Number of peer-reviewed publications	2876	3261	3.055
Number of peer-reviewed open access publications	1028	1370	1297
Share of open access, percent	31	50	54
Number of ISI-/SCOPUS peer-reviewed journal contributions	1136	1186	1218
Number of ISI-/SCOPUS peer-reviewed open access journal contributions	448	598	656
Number of conference contributions	3181	2290	2918
Number of ISI-/SCOPUS conference contributions	273	329	285
Conference contributions (per scientific staff member, institutes and facilities)	0.06	0.07	0.06
Calls to universities	6	10	22
Lectureships taken	441	593	456
Diploma, Masters and Bachelor’s dissertations	671	691	690
Dissertations	161	135	107
Postdoctoral qualifications	5	6	5

NETWORKING	YEAR 2017	YEAR 2018	YEAR 2019
Sponsorship agreements (with industry)	34	20	23
DAAD-DLR Research Fellow	80	103	120
ESA (higher-grade staff)	2118	2145	–
DE (staff)	441	416	–
DE (share of staff)	19.1 %	19.7 %	–
DE (share of funding)	22.7 %	23.1 %	–
FR (staff)	506	442	–
FR (share of staff)	21.9 %	21.9 %	–
FR (share of funding)	22.7 %	24.3 %	–
IT (staff)	420	391	–
IT (share of staff)	18.2 %	17.5 %	–
IT (share of funding)	14.6 %	11.8 %	–
GB (staff)	250	239	–
GB (share of staff)	10.8 %	11.1 %	–
GB (share of funding)	7.9 %	8.4 %	–
SP (staff)	205	197	–
SP (staff)	8.9 %	8.5 %	–
SP (share of funding)	4.0 %	5.2 %	–

ECONOMIC ACTIVITIES	YEAR 2017	YEAR 2018	YEAR 2019
Resources			
Electricity (consumed) MWh	82,427.59	73,152.46	70,037.74
Electricity (generated) MWh	4481.18	12.89	2104.33
	Cogeneration systems	–	2089.00
	Photovoltaic systems	12.89	15.33
District heating MWh	18,843.94	26,014.57	24,761.41
District cooling MWh	4303.93	4729.16	4257.62
Gas m³	4,263,036.50	25,364.67	29,289.96
Fuel oil L	1,479,525.00	9890.63	8253.00
Drinking water m³	111,311.00	126,057.79	115,796.83
Waste water m³	167,324.00	140,511.29	114,556.16
Waste (t)	8586.83	2365.50	2204.49
	non-hazardous	8510.71	2118.63
	hazardous	76.13	85.86

Transport

Number of aircraft	9	9	9
Total flying hours (DLR research fleet)	732	1229	1329
Litres of kerosene (DLR research fleet)	902,067	1,318,160	1,188,458
Number of vehicles (research and company vehicles)	62	70	106
	Electric	12	15
	Hybrid	4	4
	Hydrogen	1	2
Fuel in litres (company vehicles)	–	65,769	58,203
	Diesel	57,190	49,078
	Petrol	8578	9124
Business travel (claimed)	56,546	58,379	61,608
Flown kilometres	–	50,858,580	54,591,521
CO ₂ from flights (kg)	7,750,045	7,990,086	8,265,449
Railway kilometres (Pkm)	–	13,040,673	13,880,996
CO ₂ from rail travel (kg)	–	0	0

Catering services

Meals (average / 270 working days per year)	555,750	477,849	500,878
Cologne	135,000	119,610	132,705
Braunschweig	121,500	99,289	98,435
Göttingen	47,250	36,100	35,460
Oberpfaffenhofen	184,500	131,459	142,675
Stuttgart	67,500	40,250	41,540
Lampoldshausen	43,856	44,761	43,190
Neustrelitz	–	6380	6873

Quality and product assurance

Current certifications	36	34	35
Current accreditations	12	12	13
Number of DLR auditors	31	33	36
Audit performance	81 %	86 %	85 %

Number of staff (experts) on standardisation committees (DIN, ISO etc.)	49	71	75
Number of committees on which staff are active	57	71	73
Number of committee places occupied by staff (experts)	100	132	134

PERSONNEL	YEAR 2017	YEAR 2018	YEAR 2019
Staff	8436	8444	8960
Average age	40.0 Years	40.0 Years	40.0 Years
Total scientific staff	5103	6353	6741
Scientific staff in institutes and facilities	4542	4825	5039
Payroll in euros	513,058,070	549,412,668	591,965,602

Development

Long-term contracts	4847	4855	5029
Temporary contracts	3589	3589	3928
Teleworking	766	880	1019
Parental leave	131	124	134
	of which men in %	16.1	20.1
	of which women in %	80.2	79.9
Severe disabilities	231	269	285
Total percentage of women	32 %	33 %	33 %
	in management positions	19 %	22 %
	scientific staff	20 %	22 %
Further education, days per person	1.7	2.4	2.8
Mentoring pairs	9	10	10

Education and outreach

Young scientists	33	27	20
Graduates (internal/external)	996	989	1096
Trainees	237	243	239
Number of DLR_School_Labs	13	13	13
Visitors to DLR_School_Labs	39,735	37,316	37,369
Trainer workshops	801	1378	1777
School student placements	440	379	407
Schools supplied with teaching materials	6000	6000	4200

Occupational safety

Accident trends (accidents at work or while travelling to and from work per 1000 people)	7.8	7.4	6.6
Average BG ETEM-insured operations	22.5	22.7	22.3
National average according to DGUV	25.0	26.7	24.0

International

Nationalities	83	84	95
Incoming			
Visiting scientists (excl. scientific staff and personnel)	386	464	543
Percentage of scientific staff at institutes and facilities (stay > 1 month)	8.50 %	9.62 %	10.68 %
Outgoing			
Foreign secondments (people)	51	50	59
Foreign secondments (months)	426	469	430
Percentage of scientific staff at institutes and facilities (stay > 1 month)	1.12 %	1.04 %	1.16 %
Foreign offices	4	4	4
Research stations abroad	3	3	3

LARGE-SCALE RESEARCH FACILITIES	YEAR 2017	YEAR 2018	YEAR 2019
Research facilities	184	178	177
Used for internal research	75 %	72 %	70 %
Used for transfer and contract research	25 %	28 %	30 %
Number of institutes/facilities operating research facilities	25 (of 40)	25 (of 40)	24 (of 40)
Number of sites with facilities	17	17	17

IV.3 GRI CONTENT INDEX

GRI Standard	Description	Page number, information and/or URL
GRI 101: FOUNDATION		
General disclosures		
GRI 102 General disclosures	Organisational profile	
	102-1 Name of the organisation	2 (www.DLR.de)
	102-2 Activities, brands, products and services	11
	102-3 Location of headquarters	11
	102-4 Location of operations	11
	102-5 Ownership and legal form	11 (registered association in the public interest)
	102-6 Markets served	11 (mainly Germany)
	102-7 Scale of the organisation	82–85
	102-8 Information on employees and other workers	43–49
	102-9 Supply chain	58–59
	102-10 Significant changes to the organisation and its supply chain	none
	102-11 Precautionary Principle or approach	13, 79
	102-12 External initiatives	8, 11, 81
	102-13 Membership of associations	11
	Strategy	
	102-14 Statement from senior decision-maker	7
	Ethics and integrity	
	102-16 Values, principles, standards and norms of behaviour	13 (www.DLR.de, keyword Guidelines)
	Management	
	102-18 Management structure	12
	Stakeholder involvement	
	102-40 List of stakeholder groups	14
	102-41 Collective bargaining agreements	11
	102-42 Identification and selection of stakeholders	14
	102-43 Approach to stakeholder engagement	14
	102-44 Key topics and concerns raised	16–17
	Reporting procedures	
	102-45 Entities included in the consolidated financial statements	12
	102-46 Defining report content and topic boundaries	14, 81
	102-47 List of material topics	17
	102-48 Restatements of information	none
	102-49 Changes in reporting	none
	102-50 Reporting period	01.01.2018–31.12.2019
	102-51 Date of most recent report	23.02.2021
	102-52 Reporting cycle	every two years
	102-53 Contact point for questions regarding the report	2, 7
	102-54 Claims of reporting in accordance with the GRI Standards	81
	102-55 GRI Content Index	86–88

GRI Standard	Description	Page number, information and/or URL
GRI 200 ECONOMIC TOPICS		
Topic-specific standards		
Economic performance		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundaries	11
	103-2 The management approach and its components	11
	103-3 Evaluation of the management approach	11
GRI 201 Economic impact	201-1 Directly generated and distributed economic value	76–79
	201-4 Financial support received from government	76
Indirect economic impacts		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundaries	60–61
	103-2 The management approach and its components	60–61
	103-3 Evaluation of the management approach	60–61
GRI 203 Indirect economic impacts	203-1 Infrastructure investments and services supported	60–61
Procurement practices		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	58–59
	103-2 The management approach and its components	58–59
	103-3 Evaluation of the management approach	58–59
GRI 204 Procurement practices	204-1 Proportion of spending on local suppliers	59
Fight against corruption		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	79
	103-2 The management approach and its components	16, 79
	103-3 Evaluation of the management approach	79
GRI 205 Fight against corruption	205-1 Operations assessed for risks related to corruption	79
	205-2 Communication and training about anti-corruption policies and procedures	79
	205-3 Confirmed incidents of corruption and actions taken	79
GRI 300 ENVIRONMENTAL TOPICS		
Energy		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	52
	103-2 The management approach and its components	52
	103-3 Evaluation of the management approach	52
GRI 302 Energy	302-1 Energy consumption within the organisation	56, 84
	302-4 Reduction of energy consumption	52, 84
Environmental compliance		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	53, 78
	103-2 The management approach and its components	53, 78
	103-3 Evaluation of the management approach	53, 78
GRI 307 Environmental compliance	307-1 Non-compliance with environmental laws and obligations	54
Supplier environmental assessment		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	58
	103-2 The management approach and its components	58
	103-3 Evaluation of the management approach	58
GRI 308 Supplier environmental assessment	308-1 New suppliers that were screened using environmental criteria	59, 66

GRI Standard	Description	Page number, information and/or URL
GRI 400 SOCIAL TOPICS		
Employment		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	43–46
	103-2 The management approach and its components	43–46
	103-3 Evaluation of the management approach	43–46
GRI 401 Employment	401-1 New employee hires and employee turnover	73, 85
Labour/Management Relations		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	11, 50
	103-2 The management approach and its components	50
	102-3 Evaluation of the management approach	11
GRI 402 Labour/management relations	402-1 Minimum notice periods regarding operational changes	11
Occupational health and safety		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	67
	103-2 The management approach and its components	67
	103-3 Evaluation of the management approach	67
GRI 403 Occupational health and safety	403-1 Workers representation in formal joint management–worker health and safety committees	50
	403-4 Health and safety topics covered in formal agreements with trade unions	51, 67
Training and education		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	44
	103-2 The management approach and its components	44
	103-3 Evaluation of the management approach	44
GRI 404 Training and education	404-1 Average hours of training per year per employee	85
Diversity and equal opportunity		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	47–49
	103-2 The management approach and its components	47–49
	103-3 Evaluation of the management approach	47–49
GRI 405 Diversity and equal opportunity	405-1 Diversity of governance bodies and employees	47–49
Non-discrimination		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	47
	103-2 The management approach and its components	47
	103-3 Evaluation of the management approach	47
GRI 406 Non-discrimination	406-1 Incidents of discrimination and corrective actions taken	49 (www.DLR.de, keyword equality)
Local communities		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	68–73
	103-2 The management approach and its components	68–73
	103-3 Evaluation of the management approach	68–73
GRI 413 Local communities	413-1 Operations with local community engagement, impact assessments, and development programmes	68–73
Supplier social assessment		
GRI 103 Management approach disclosures	103-1 Explanation of the material topic and its boundary	58
	103-2 The management approach and its components	58
	103-3 Evaluation of the management approach	58
GRI 414 Supplier social assessment	414-1 New suppliers that were screened using social criteria	59

IV.4 PEER REVIEW

A report of this kind is ambitious and vast in scope. Fully understanding the content in all its complexity requires broad expertise. For this reason and others, we are grateful to our peer reviewer, the Fraunhofer Association, for examining the DLR Sustainability Report 2018/19. We are also grateful for their critical insight, constructive review and cooperation.

The basis for this peer review dates back several years to our joint participation in the LeNa sustainability guidance project. Since then, both parties have made significant steps towards greater sustainability. The aim of our collaboration is to introduce systematic peer learning and encourage regular exchange. Together, we are looking at the entire spectrum of content and organisational aspects relating to sustainability.

For both parties, this cooperation has given rise to particularly interesting ideas and innovative approaches to the further development of sustainability management for non-university research organisations.



Munich, 17 February 2021

Peer review of the DLR Sustainability Report 2018/19

Having had the opportunity to peer-review the German Aerospace Center (DLR) Sustainability Report 2016/17 in October 2018, we are now pleased to do so again for the DLR Sustainability Report 2018/19. As partners in the 'sustainability management for non-university research organisations' (LeNa) project funded by the German Federal Ministry of Education and Research (BMBF), these peer reviews are not a formal study of the sustainability report, but rather an expression of our endeavour to inspire one another with this form of learning together and striving for joint improvement.

The review focuses on the widely accepted quality criteria for sustainability reporting: transparency, credibility, materiality and completeness.

This report successfully presents the broad range of activities carried out by DLR regarding sustainability research and provides an overview of the operational implementation of its research activities in terms of 'researching and working sustainably'. The increased emphasis on DLR's core sustainability themes is a particularly positive development when compared with the previous report.

Using the structure set out in the LeNa guidance documents makes the relevant topics and measures of the DLR sustainability programme easy to see at a glance. It is also encouraging to see that DLR has ensured the broad participation of the stakeholders it identified by revising its materiality analysis. By combining the two primary focuses of sustainability management for non-university research organisations defined in the LeNa project, DLR demonstrates its credibility and gives readers who are not familiar with its practices a clear insight into its everyday research activities. We also find that DLR's innovative capacity has been particularly well presented. The report provides current answers to the major sustainability challenges of the day, from developing sustainable fuels and alternative building materials, to coordinating a research platform for addressing climate change. As noted in the previous peer review, it would be interesting to find out what proportion of DLR's total research volume is accounted for by 'research for sustainability'.

DLR's extensive and diverse public outreach activities, such as the DLR_School_Labs and the Space Show, have heightened societal acceptance of the need to conduct fundamental research that can, in the later stages of the research process, contribute towards concrete technological developments that have a significantly reduced impact on nature and the environment. ►

At the same time, the report illustrates the reality of the widely held belief that sustainability is a tough nut to crack. In contrast to the significant advances we all hope for, especially in the further development of sustainability management, real improvements are most often made in small but important steps. While the fact that DLR meets the 20 criteria of the German Sustainability Code (GSC) shows how successfully the issue has been embedded in the organisation, it has not yet succeeded in providing the underlying data required (particularly regarding environmental management figures) to allow for a complete assessment of its sustainability performance. This is a challenge that non-university research organisations in general face when reporting on their progress.

By joining the United Nations Global Compact (UNGC) at the start of the year, DLR has shown how seriously it takes its international responsibility for the sustainability of its research activities.

It is hoped that DLR will continue to use its expertise and experience in developing robust sustainability management and integrate them with the sustainability-related research conducted within the LeNa community in the future. DLR continues to inspire LeNa partners to participate in this experience and to apply and further develop sustainability management within their own institutions.

We look forward to continued constructive exchange and peer learning with DLR in future.



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