



2023

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# Corporate Social Responsibility Report

## Foreword

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### Dear readers,

As a leading applied research organization, the Fraunhofer-Gesellschaft is well aware of its responsibility to strengthen the sustainability and future viability of industry and society through its work and innovations. Our employees develop their ideas into innovative solutions to tackle the major challenges of the 21st century and help attain the UN's Sustainable Development Goals (SDGs).

For Fraunhofer, corporate social responsibility (CSR) means systematically integrating the principles of environmental, economic and social sustainability across its entire organization. To implement this goal, we have developed an internal CSR structure that allows us to combine forces and respond to all these key issues through targeted measures. This structure includes elements such as an HR policy that focuses on employee needs and, crucially, a responsible approach to managing resources in our research operations. To fulfill our environmental responsibilities on a broad scale, we aim to intensify our efforts to make our internal processes and infrastructures sustainable. This is why we have established a dedicated Climate Neutrality task force to set Fraunhofer on a course for climate-neutral scientific operations.

Our interpretation of CSR also includes the principles of commercial responsibility, particularly the protection of human rights. Since joining the UN Global Compact in 2017, the Fraunhofer-Gesellschaft has committed itself to continuously supporting and implementing the ten principles of this international network. As we have now renewed our membership of the compact, we wish to emphasize this commitment once again and express how important it is for Fraunhofer.

This report represents a transparent account of our principles of responsibility and our continuous efforts in the area

of corporate social responsibility, as well as the measures we have taken to develop these principles internally. As in previous reports, we will once again take this opportunity to present selected examples of the ways in which our research contributes to the improvement of global sustainability.

We hope you enjoy reading this report.

Sincerely,

**Prof. Reimund Neugebauer**

President,  
Executive vice president for Corporate Strategy, Research and Communications

**Prof. Alexander Kurz**

Executive vice president for Innovation, Transfer and IP Management

**Prof. Axel Müller-Groeling**

Executive vice president for Research Infrastructures and Digital Transformation

**Elisabeth Ewen**

Executive vice president for Human Resources, Corporate Culture and Legal Affairs

**Dr. Sandra Krey**

Executive vice president for Finances and Controlling

# Profile of the Fraunhofer-Gesellschaft

## Fraunhofer in brief

Based in Germany, the Fraunhofer-Gesellschaft is a world leader in applied research. Thanks to its focus on developing key technologies for the future and commercializing its findings in business and industry, it plays a major role in the innovation process. A trailblazer and trendsetter in innovative developments and scientific excellence, the Fraunhofer-Gesellschaft is supporting research and industry with its inspiring ideas and sustainable scientific and technological solutions, and helping shape our society and our future.

At the Fraunhofer-Gesellschaft, interdisciplinary research teams work with contractual partners from industry and government to turn pioneering ideas into innovations, coordinate and implement key, system-relevant research policy projects, and strengthen the German and European economy through ethical value creation. International collaborations with outstanding research partners and companies from around the world brings the Fraunhofer-Gesellschaft into direct contact with the most prominent scientific communities and economic regions.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 30,000 employees, predominantly scientists and engineers, work with an annual research budget of around 3 billion euros, roughly two thirds of which stems from industry contracts and publicly funded research projects. The German federal and state governments contribute around another third in base funding, enabling the Fraunhofer institutes to develop solutions now to problems that will drastically impact industry and society in the near future.

The impact of applied research extends far beyond the direct benefits to specific customers. Fraunhofer institutes strengthen companies' performance and efficiency and promote the acceptance of new technologies within society, while also training the future generation of scientists and engineers that the economy so urgently requires. As a scientific organization, our most important success factor is our highly motivated employees and their trailblazing, cutting-edge research. This is why Fraunhofer offers its researchers opportunities to undertake independent, creative and yet also goal-oriented

work, thus helping our employees to develop professional and personal skills that will enable them to take up positions of responsibility within Fraunhofer itself or in universities, industry and civil society. Students involved in projects at Fraunhofer institutes have excellent career prospects, as they are given practical training and opportunities to interact with contract partners at an early stage in their career.

### Fraunhofer at a glance

<b>Name</b>	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
<b>Legal form</b>	(Non-profit) association registered under German law
<b>Institutes</b>	76
<b>Executive board</b>	<p><b>Prof. Reimund Neugebauer</b> President, Corporate Strategy, Research and Communications</p> <p><b>Prof. Alexander Kurz</b> Innovation, Transfer and IP Management</p> <p><b>Prof. Axel Müller-Groeling</b> Research Infrastructures and Digital Transformation</p> <p><b>Elisabeth Ewen</b> Human Resources, Corporate Culture and Legal Affairs</p> <p><b>Dr. Sandra Krey</b> Finances and Controlling</p>
<b>Headquarters</b>	Munich, Germany

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# About this report

## We act responsibly

Fraunhofer sees corporate social responsibility (CSR)<sup>1</sup> as our organization's wide-ranging duties in economic, environmental and social matters. This includes our responsibility in respect of our employees and the responsible use of resources. As a research organization, we primarily see CSR as a call to ensure that our research contributes to solving social challenges and that possible social and environmental consequences of our work are considered right from earliest stages of our responsible research processes. In other words, CSR means our contribution to sustainable development. We are setting out to fulfill this responsibility to an even greater extent, by continuously developing our organization further, formulating (sustainability) targets and launching initiatives and measures to achieve those targets; we then give a transparent account of the steps we have taken in our sustainability reporting.

during the 2020 to 2022 reporting period. In the interests of comparability and ease of reading, this report is also intended to serve as a compact overview of key issues and planned measures (see the Objectives and outlook section, p. 62). The body text of the respective sections provides information on the extent to which the targets set in the previous report were achieved. No fundamental changes have been made in comparison to the previous report.

### Organizational units that contributed to the report

This report was compiled on a collaborative basis. All the executive units and essential organizational units and committees of headquarters were involved in the process. Apart from the Corporate Think Tank and the communications department at headquarters, the main contributors were the HR and Legal Affairs and Compliance directorates, the Corporate Procurement, Supply Chain Management Strategy (SCM) and Research Buildings departments, the newly founded Climate Management department and the Transfer and Innovation Management section. The Science Policy and Research Coordination departments and our colleagues at the Fraunhofer Future Foundation also participated in the compilation process. To give the institutes and their employees the opportunity to take part, notices and calls for topic contributions were shared via the intranet and the Sustainability Network, along with other channels.

### Alignment with standards

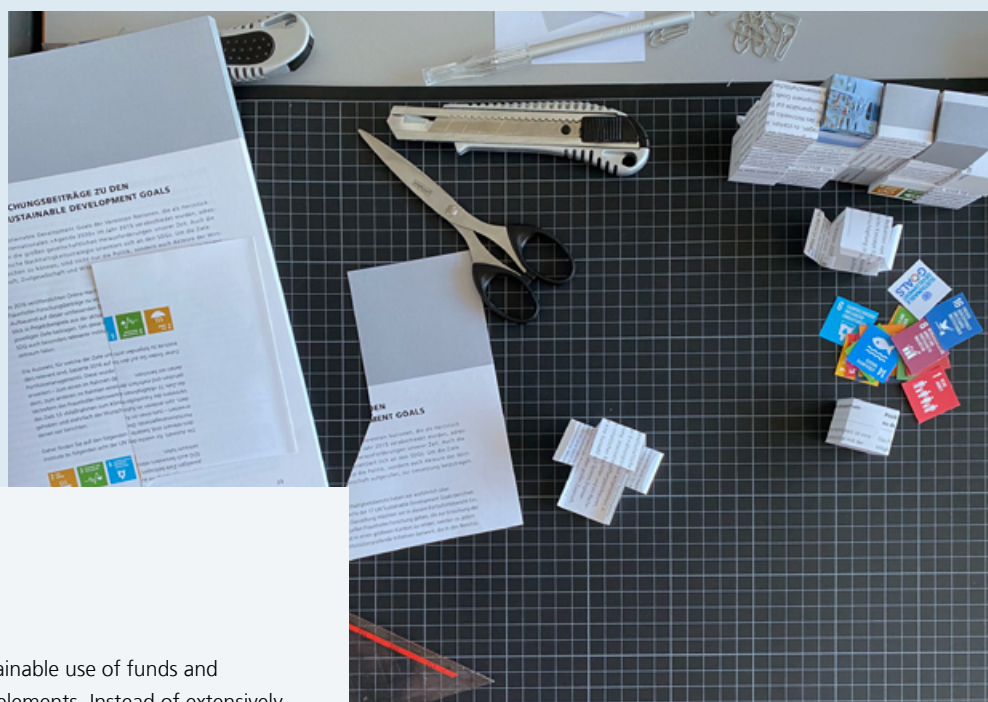
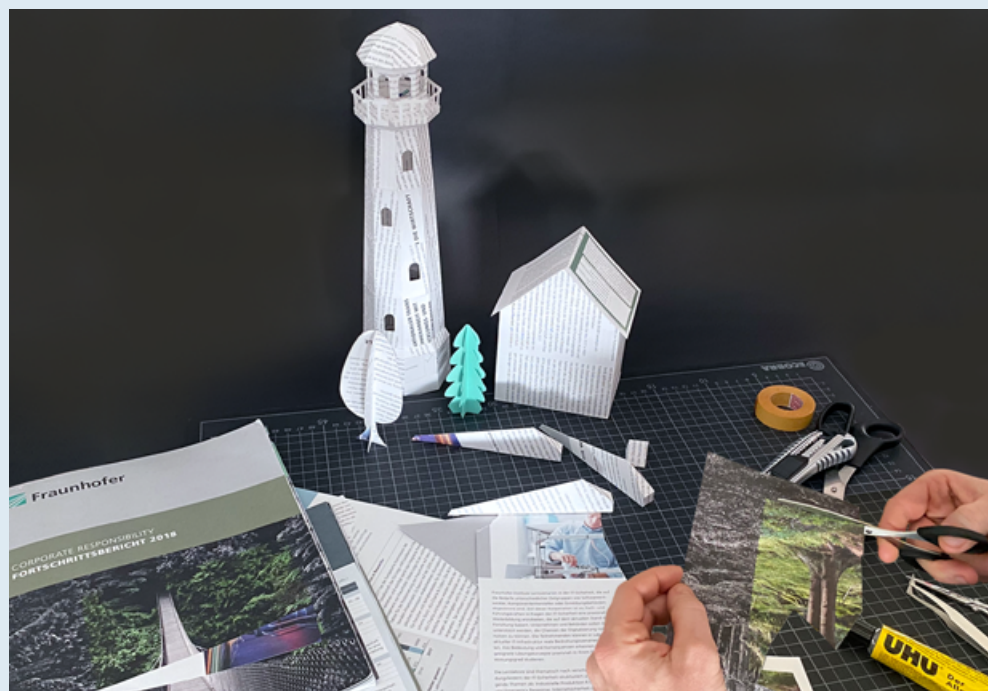
This report was compiled in compliance with the 2021 GRI standards, i.e., the Global Reporting Initiative's updated sustainability reporting format. In this way, we are preparing for the upcoming Corporate Sustainability Reporting Directive, which will lay down requirements and standards that we intend to follow in the future. This report contains details on all the sustainability topics at the Fraunhofer-Gesellschaft that we identified as essential in our analysis. The updated GRI reporting principles have been applied, meaning that the report

### Updated reporting

Since 2014, the Fraunhofer-Gesellschaft has compiled regular reports every two to three years on the impact of its work on the environment and society, along with the associated opportunities and risks. We informed our stakeholders of the corresponding targets, measures and key indicators in separate sustainability and CSR reports in 2014, 2016 and 2019. In addition, in 2021, we renewed our declaration of compliance with the German Sustainability Code, as we have done repeatedly since 2015.

Furthermore, since 2017, our organization's management report has included a dedicated chapter on corporate social responsibility, which details non-financial key indicators and sustainability activities. In this way, we are steadily progressing toward integrated reporting processes. This report is based on the previous corporate responsibility progress report from 2018, both in terms of content and structure, with the addition of specific details on the further developments that occurred

<sup>1</sup> Previously, we had used the term corporate responsibility (CR) to describe all our sustainability activities. Now, however, we have settled on the more conventional and comprehensive concept of corporate social responsibility, with a view to improving understanding and as a result of our explicit consideration of social concerns.



### Turning old into new

This CSR report focusses on the sustainable use of funds and resources – right down to the visual elements. Instead of extensively downloading images from the energy-intensive servers maintained by commercial graphics suppliers, the primary visuals for the report were created and photographed right on site at Fraunhofer. The only material used in staging the photographs was paper left over from old CSR reports, which were produced in printed format for the most part until 2018.





also covers the opportunities and risks associated with these topics. In issuing this report, we are fulfilling the United Nations Global Compact (UNGC) requirement for Communication on Engagement (COE). We have dispensed with external auditing for this report, as the essential, material details on corporate responsibility already formed part of the final audit of the 2021 management report (cf. the 2021 Annual Report, p. 137).

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### Key topics in this report

The topics for this report were selected as part of our most recent materiality analysis, which our most important stakeholders participated in. Once again, these topics have undergone fundamental changes in comparison to previous reports, in light of ongoing socio-political and economic developments.

### Stakeholder involvement in the materiality analysis

In a continuation of our efforts to include our stakeholders in our sustainability activities, we conducted a stakeholder survey on the materiality analysis in mid-2021. In the survey, we asked representatives of our most important stakeholder groups to

assess the materiality of a wide range of topics. Representatives from industry and science, government and civil society organizations, and our own employees were included in this process. While the survey concentrated specifically on the materiality analysis, it also provided a space for general feedback on the Fraunhofer-Gesellschaft's sustainability and CSR reporting. The content of the survey was based on the following quality criteria for sustainability reporting identified by the Global Reporting Initiative, the Institute for Ecological Economy Research (IÖW) and future e. V., an initiative by German SMEs: communicative quality, transparency and credibility, relevance and completeness.

### Key CSR fields of action

As in previous reports, we have defined our key fields of action based on the framework for research-specific sustainability management that Fraunhofer and the Leibniz and Helmholtz Associations formulated in late 2016, as part of the joint research project Sustainability Management for Non-university Research Organizations (LeNa), funded by the German Federal Ministry of Education and Research (BMBF). The goal of this framework is for the organizations to contribute to sustainability both through their core business activities of research and development and through their actual operations. The CSR

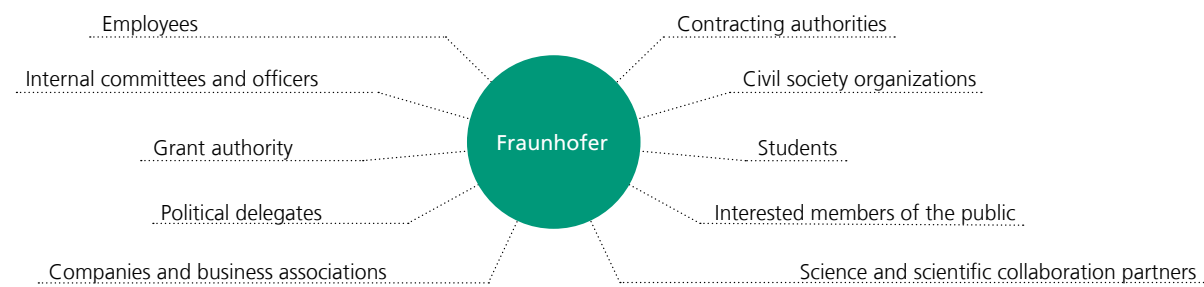
fields of action that Fraunhofer has established are divided into five areas of responsibility: governance, research and development, employees, resources and procurement, and social commitment. Our key topics were derived from these five areas (see the table on p. 8).

Although the issue of (knowledge) transfer is particularly relevant for Fraunhofer, it is not actually a CSR topic, but rather an inherent component of our responsibilities in the area of research and development. It is also integrated into the other areas of responsibility as an overarching topic. This issue plays an important role in determining the impact of our organization through a variety of channels, from communication with government and society and collaboration with industry at a national and international level, to patents, spin-offs, transfer via individuals and hardware. Fraunhofer's focus on technology transfer has made it a trailblazer and driver of innovative developments, allowing it to participate in shaping our society and our future. As such, the topic of transfer will be explicitly addressed in the Research and development section.

### The Fraunhofer materiality matrix

Fraunhofer's materiality matrix once again had an important role to play when it came to weighting the topics in this report. This matrix was developed further in the course of the stakeholder survey. The updated matrix incorporates the stakeholders' responses regarding what topics needed to be expanded or receive greater focus. In comparison to the previous report, this report puts much more emphasis on topics from the area of resources and procurement, especially energy consumption, greenhouse emissions and sustainable procurement. In light of this increased weighting, the Resources and procurement section (see p. 49) has been made much more extensive. When asked for their opinion on the most important aspects of sustainability management and reporting in a research organization, the stakeholders once again rated sustainability-related research activities (solutions for challenges facing society) very highly; in a new development, they also singled out responsible HR management as a top priority.

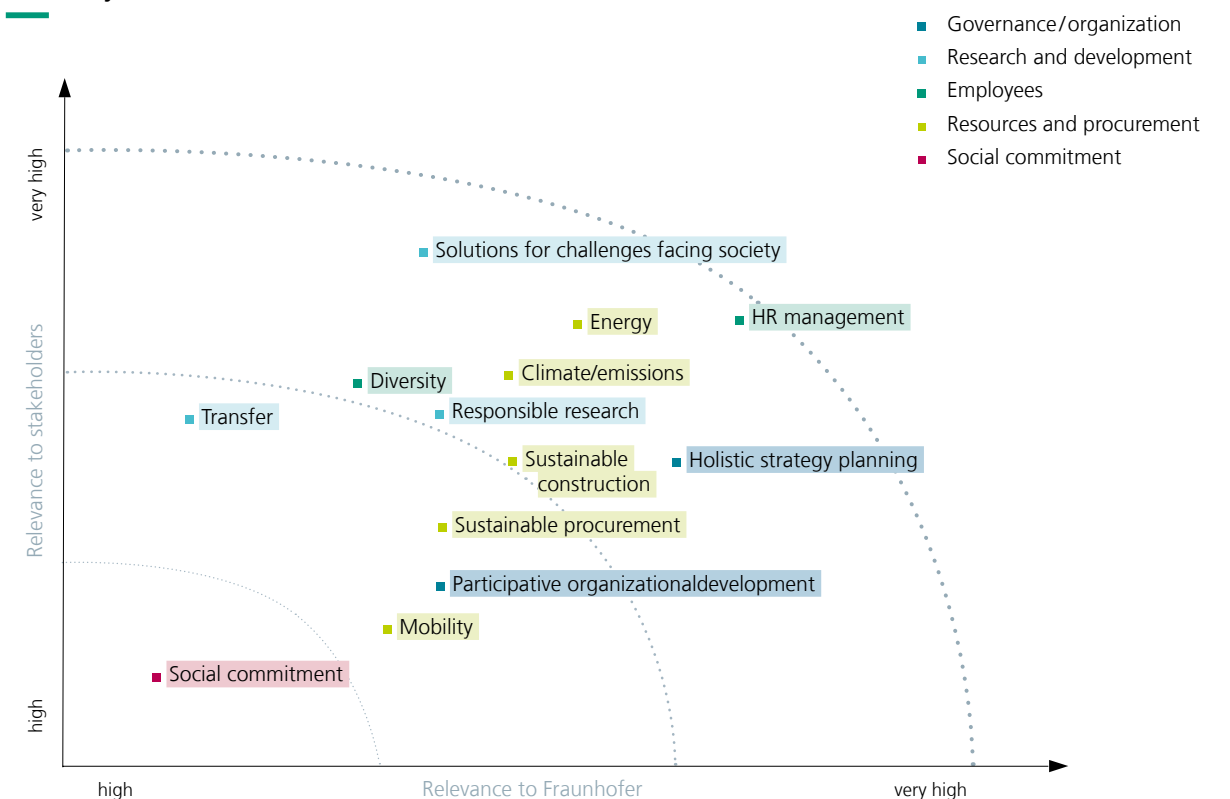
### Fraunhofer-Gesellschaft stakeholder groups



### Key CSR topics for this report

Governance/organization	Research and development	Employees	Resources and procurement	Social commitment
<ul style="list-style-type: none"> <li>Holistic strategy planning</li> <li>Participative organizational development</li> </ul>	<ul style="list-style-type: none"> <li>Responsible research</li> <li>Solutions for challenges facing society</li> <li>Transfer</li> </ul>	<ul style="list-style-type: none"> <li>Diversity</li> <li>HR management</li> </ul>	<ul style="list-style-type: none"> <li>Climate/emissions</li> <li>Energy</li> <li>Sustainable construction</li> <li>Sustainable Corporate procurement</li> <li>Mobility</li> </ul>	<ul style="list-style-type: none"> <li>General social commitment</li> </ul>

### Materiality matrix







# Governance

At the Fraunhofer-Gesellschaft, it is automatically understood that we must support and comply with the principles of responsible business practice. We firmly believe that integrity and a responsible approach to employees, partners, resources and research topics are the keys to long-term success. The foundation of this approach is responsible, forward-looking organizational governance.

## Organizational governance

Although the Fraunhofer-Gesellschaft is a decentralized organization, it has certain structures that facilitate centralized processes for strategic alignment and effective management. According to the statutes of the Fraunhofer-Gesellschaft, the executive board is responsible for the general management of the organization. Since 2022, the board has been composed of five executive units rather than the previous four. This realignment and expansion of the executive board's structure was deemed necessary in light of Fraunhofer's constant growth and addition of new research topics, along with the volatile conditions of the scientific system as a whole. This restructuring consisted of the expansion of the Innovation and Transfer executive unit to also cover the area of IP management and the creation of a new fifth executive unit, Research Infrastructures and Digital Transformation. The new structure will put an even greater focus on the areas of knowledge management, organizational culture and strategy, and science communication.

In May 2022, the senate elected three new executive vice presidents to the board. Prof. Axel Müller-Groeling, previously director of the Fraunhofer Institute for Silicon Technology ISIT, was elected as executive vice president for Research Infrastructures and Digital Transformation. Elisabeth Ewen is heading up the Human Resources, Corporate Culture and Legal Affairs executive unit and Dr. Sandra Krey, formerly Senior Vice President for Accounting, Shared Services & Finance Processes at MAN Truck & Bus SE, has taken on the role of executive vice president for Finances and Controlling. Prof. Reimund Neugebauer, the president of the Fraunhofer-Gesellschaft, has been chair of the executive board since 2013. All the executive vice presidents

were elected to their roles with a majority of the votes from the senate. Fraunhofer's governance structure is also defined by the directors of the 76 Fraunhofer institutes and research units, which are in turn organized into nine groups. The chairs of these groups together with the executive vice presidents form the presidential council. The main claims made regarding impact management in the area of CSR were reviewed by the executive board prior to publication of this report.

## Social commitment – supporting the UN Global Compact

In joining the UN Global Compact in 2017, Fraunhofer made a voluntary commitment to comply with and promote the compact's ten universal sustainability principles in the areas of human rights, labor standards, environmental conservation and corruption prevention. With over 21,000 participating companies and organizations, this UN initiative is the largest international corporate responsibility network in the world.

By joining the compact, we have undertaken a commitment to report on our progress regarding these principles of responsibility at least once every two years. Since then, we have fulfilled this responsibility in the form of a Communication on Engagement (COE) report, thus also repeatedly renewing our commitment to continue to support the UN Global Compact and its principles. This document serves as a COE report and will be published on the UN Global Compact's website.



it has been continuously further developed in order to meet the increasing regulatory requirements in the research sector

**Compliance**

For the Fraunhofer-Gesellschaft, Corporate Governance consists not only of automatic compliance with regulatory requirements, but also of being guided by values such as trust, respect and fairness in both internal and external relationships.

**Restructuring of the compliance management system**

In 2010 Fraunhofer established a Compliance Management System (CMS). Over 2015 and 2016, the system's suitability was audited, with a favorable result. Since then, it has been continuously further developed in order to meet the increasing regulatory requirements in the research sector. As regulatory requirements have become increasingly complex, the legal affairs department has had an ever greater role to play in many processes; consequently, the compliance office and its responsibilities were reorganized in 2022. The chief compliance officer delegated compliance management to the legal affairs department, where it is conducted with the support of the CMS. Topics such as the centralized management of compliance risks in matrix management structures, more efficient management of guidelines and the further development of Fraunhofer's Internal Control System (ICS) were further expanded, thus helping make the CMS more effective. Professional consultants support this process in terms of the further development laid down in the IDW PS 980 (new series) auditing standard, so that Fraunhofer can prevent violations of internal and external regulations even more effectively with its tried-and-tested CMS.

At Fraunhofer, we understand compliance as a business enabler, whereby the staff of the compliance department at headquarters are seen as trusted points of contact that are familiar with business processes and can create added value. For us, compliance in action means working out consistent measures that enable us to collaborate fairly within a framework of collectively defined guiding principles for responsible, successful research. The compliance framework serves a number of purposes, such as ensuring that monitoring processes are adapted for compliance by enabling different process participants with their own independent areas of responsibility and functions to interact in the CMS. Continuous inspections (e.g., inspections of all business locations for corruption risks<sup>1</sup>) are conducted by all employees as part of the established processes. Period inspections of regulatory and procedural requirements (e.g., regarding compliance with the monitoring process) are conducted by the topic owners in the department or the institute director/head of administration as part of the ICS. The CMS includes an anonymous, web-based whistleblowing system that both employees and external stakeholders can use to share information on possible violations at any time. All tips and reports submitted through the system are

handled by the Internal Auditing department as an independent entity, so that each case is processed and the effectiveness of the CMS is maintained.

The compliance department at headquarters is responsible for reviewing the effectiveness of the CMS as a system, by means of risk prioritization and appropriate further development in line with those risks. It is mandatory for Fraunhofer to establish four key functions (independent risk management function, compliance function, internal audit function and actuarial function). These functions are material elements of the governance system, intended to ensure adequate and independent control within the organization. Furthermore, the legal department is an important stakeholder, which fulfills a supporting role to ensure the effectiveness. Inspections by the Internal Auditing department facilitate the provision of an independent, objective and comprehensive assessment of Fraunhofer's ICS (an internal audit); as such, the department serves as a backstop for the organization's committees and executive board, thus providing an effective additional line of defense.

In addition, the innovative and flexible business model of a modern, socially responsible applied research organization requires that compliance be integrated into its culture, as the corresponding rules, roles and values must be communicated to all employees and demonstrated to them through the example of their managers. Mandatory training courses (e.g., on corruption prevention) for all employees support this integration process. Providing these courses requires a well-planned combination of cross-functional expertise, from teams such as HR, Communication and Legal Affairs and Compliance. Having the necessary mixture of personal responsibility and familiarity with guiding principles/regulations enables employees and managers to behave responsibly and comply with those regulations.

**Implementing the German Supply Chain Act**

One recent example of Fraunhofer's continuous efforts to fine-tune its CMS is the implementation of the German Supply Chain Act (Lieferkettensorgfaltspflichtengesetz, LkSG). The LkSG entered into force at the start of 2023, meaning that the Fraunhofer-Gesellschaft is now subject to the provisions it contains on managing risks so as to ensure respect for human rights and the environment within an organization's own business activities and supply chains. In compliance programs within the CMS, the duties of care that this gives rise to are adjusted to suit the risk situation in line with statutory requirements. Since December 21, 2022, Fraunhofer's declaration of its human rights strategy as adopted by the executive board has been available online on the Fraunhofer website.

[s.fhg.de/sustainability-standards-for-suppliers](https://s.fhg.de/sustainability-standards-for-suppliers)

**Holistic strategy planning – integration into the organizational structure and culture**

**New CSR structure**

CSR is a highly complex topic that affects virtually every business and organizational unit in Fraunhofer. Although sustainable development has played a key role at the Fraunhofer-Gesellschaft for more than ten years, the organization did not have a comprehensive, integrated CSR structure until this point. Previously, a number of CSR subcategories were addressed by the executive board team for Research and Development, while others were the responsibility of the HR executive unit. In 2018, a committee was established to oversee the area of CSR. However, although it succeeded in driving progress in some key topics, it proved not to be adequately operational. In particular, it could not do enough to address issues such as the practical implementation of and specialist work on new topics and areas of responsibility. In light of mounting social, political and industrial requirements and Fraunhofer's own aspirations in terms of achieving quality and contributing to sustainable development, it was necessary to establish a holistic coordination structure spanning all three core elements of sustainability. The goal of this initiative is to make CSR an inherent component of a comprehensive overall management system for our organization. To achieve this, we must integrate sustainability criteria and targets into Fraunhofer's general strategy. Our key fields of action for CSR fall within the five areas of responsibility: organizational governance, research and development, resources and procurement, employees, and social commitment. The necessary structure was defined and implemented in 2022, with the result that specific responsibilities and CSR topics were assigned to each of the executive units. With this new approach, all executive vice presidents of the Fraunhofer-Gesellschaft are taking on responsibility for this area, making a commitment

to sustainable development and taking action on the topics assigned to their executive units. The Think Tank in the president's executive unit is responsible for overall management of the CSR strategy process. Decisions are made in the course of the executive board meetings as events require.

**Peer learning through dialogue**

In recent years, this process has been supported by regular dialogues on sustainability issues and organizational structures with other research institutions, particularly the partners from the LeNa process (see p. 18). As part of the LeNa initiative, the representatives of the non-university research organizations collaborated with the German Research Foundation (DFG) to organize three specific workshops in 2022. These workshops gave the institutions the opportunity to share information on topics such as sustainable procurement, carbon footprints and carbon offsetting.

**New Climate Management department**

Climate protection has been one of Fraunhofer's key CSR focus areas since 2020, as a result of an analysis conducted by the CR Board in 2019. A dedicated Fraunhofer climate strategy (see p. 49) was developed for this purpose, and the executive board established the Climate Neutrality Task Force to implement it. The strategy consists of three elements: a climate fund and the climate protection projects that it finances; a network of climate neutrality officers; and the Climate Management department. The department coordinates the implementation of the climate protection projects and the climate neutrality officers network; it is also developing a topic-specific knowledge management system. It is attached to the Research Infrastructures and Digital



<sup>1</sup> There were no known instances of corruption during the reporting period.

Transformation executive unit and works closely with the procurement and construction departments, along with many other departments at headquarters.

### Participative and collaborative organizational development

Social and industrial developments are generally accompanied by changes in the scientific system, the organizational environment and the entire world of work. Likewise, the sustainable development targets require restructuring of processes and organizations, which impacts organizations' cultures and their employees. The success of our organization is substantially dependent on the knowledge and commitment of our employees. We want to harness and nurture these qualities. As such, the development of an organization should ideally involve employee participation and collaboration between its different units. This makes it possible to address specific challenges and targets along with individual expectations within a single, functional organizational structure. Taking a participative approach lays the foundations for an organizational culture that will be widely accepted by employees and in which sustainability will be practiced as a matter of course and continuously further developed.

#### Working conditions — New Work

Fraunhofer is responding to the changes in the world of work with measures such as the New Work@Fraunhofer initiative, which was launched back in April 2018. The goal of the initiative is to establish a flexible, collaborative, participative and customer-focused working and research environment for independent employees. To achieve this goal, Fraunhofer has adopted a number of different approaches to creating attractive conditions for employees and customers, including allowing for flexitime and flexplace working whenever reasonable and feasible. In a recommendation paper for policymakers, Fraunhofer put forward some concrete suggestions for arranging flexitime scientific work so as to make everyday working routines more flexible, thereby also increasing the attractiveness of non-university research organizations.

[s.fhg.de/zeitflexible-wissenschaftsarbeit](https://s.fhg.de/zeitflexible-wissenschaftsarbeit) (German only)

New ways of working and altered project and customer requirements are impacting organizational forms and structures too. This is why Fraunhofer needs agile modes of thinking and acting, and cooperative, customer-focused forms organization and collaboration. These may include new leadership models, self-organization, supportive training resources and modern working environments (see also p. 44). Fraunhofer is placing a particular emphasis on cross-institute collaboration, in order to augment the innovative strength of the organization as a whole. By creating strong networks that link institutes, people and knowledge, Fraunhofer fosters efficient, productive

collaboration. It is important that employees at Fraunhofer find their work meaningful in the long term; this is why the Fraunhofer-Gesellschaft is intensively driving employee participation in further developments regarding research topics and has made independent research work one of its primary values. To this end, Fraunhofer is also establishing goal-oriented collaboration formats for specific research topics (see p. 22).

#### Institute-specific integration

Approaches for promoting sustainable development and responsible conduct must be practiced primarily at an institute and employee level. While most Fraunhofer institutes focus intensively on sustainability targets in their research, some institutes have already integrated a comprehensive sustainability strategy into their organization and formulated their own sustainability goals. Two particularly notable examples here are the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT and the Fraunhofer Institute for Solar Energy Systems ISE; these two pioneers of the sustainable energy and raw materials transition have already had sustainability commitments in place for many years and have developed their organizations in line with this strategy. For example, Fraunhofer ISE has a stated goal of not only aligning its research and development work with sustainability targets, but also of making sustainability the guiding principle of all its other business processes. In this endeavor, employees and managers are treated as strategic partners in organizational development, which reflects the ISE's integrated HR management model.

[s.fhg.de/nachhaltigkeit-ise](https://s.fhg.de/nachhaltigkeit-ise)

Fraunhofer UMSICHT also has a holistic sustainability strategy, which was formulated and implemented with equal levels of involvement by employees, managers and institute management.

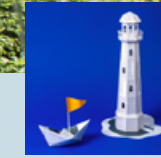
[s.fhg.de/nachhaltigkeit-umsicht](https://s.fhg.de/nachhaltigkeit-umsicht)

The Fraunhofer Institute for Wind Energy Systems IWES is also making considerable efforts in this area in line with its vision of actively contributing to the energy transition and supporting our society in its journey towards a more sustainable future. Building on this guiding principle, the staff at Fraunhofer IWES are developing their own wide-ranging strategy for implementing sustainability at the institute. This not only includes research, but also developing the organization further, for example, so as to ensure a fair, inclusive working environment, minimize internal resource consumption or promote dialogue with civil society through science communication. Fraunhofer IWES has set its own ambitious goals in this area.

[s.fhg.de/nachhaltigkeit-iwes](https://s.fhg.de/nachhaltigkeit-iwes) (German only)



*The sustainability officers at Fraunhofer ISI cycle to work whenever they can. Photo: Julia Weller/Fraunhofer ISI*



The Fraunhofer Institute for Systems and Innovation Research ISI appointed the first climate neutrality and sustainability officers who took office in March 2022. Socially engaged employees at the institute in Karlsruhe have been active in the field of sustainability for many years. Back in the 1990s, the ISI Power club, an initiative by ISI employees, installed a photovoltaic system on the roof of the institute at a time when Fraunhofer could not yet do this for legal reasons.

Some Fraunhofer institutes have already started publishing institute-specific sustainability reports — and many of these have been releasing regular reports for years. These institutes include:

- Fraunhofer Institute for Chemical Technology ICT
- Fraunhofer Institute for Solar Energy Systems ISE
- Fraunhofer Institute for Systems and Innovation Research ISI
- Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT

One new entry on this list is the Fraunhofer Institute for Translational Medicine and Pharmacology ITMP, which has published its first sustainability report for its Hamburg location (for the 2019 and 2020 reporting period).

[s.fhg.de/nachhaltigkeit-itmp](https://s.fhg.de/nachhaltigkeit-itmp) (German only)

Over the last three years, many other Fraunhofer institutes have seen the establishment of highly committed, bottom-up sustainability groups or committees that aim to drive more progress in sustainability within their own work, at their institutes and in research.

#### Fraunhofer Sustainability Network

One of the most important initiatives to be established in this field is the Fraunhofer Sustainability Network, an association of Fraunhofer institutes that have been engaging in solution-oriented research for sustainable development and working to integrate operational sustainability factors into everyday research practice since 2009. At present, the network consists of representatives from 26 institutes spanning all the Fraunhofer groups; these representatives hold regular network meetings to exchange ideas. The Sustainability Network played a significant role in the creation of the Fraunhofer climate strategy, particularly in terms of examples of best practice. Over

the course of that process and through greater use of digital channels, the network has been able to open up much more in recent years, for example, by establishing an organization-wide virtual dialogue platform that facilitates the sharing of information and open conversations around important topics. Around 440 members are currently active on the platform. In addition, members of the network have organized internal sustainability weeks one to three times a year since 2020; these events are open to all Fraunhofer employees with an interest in sustainability. During the events, the participants meet for an hour every morning to discuss various topics relating to sustainability and exchange scientific insights or their experiences with technical and organizational issues within Fraunhofer, such as sustainability reporting, for example.

#### Officers for climate neutrality and sustainability

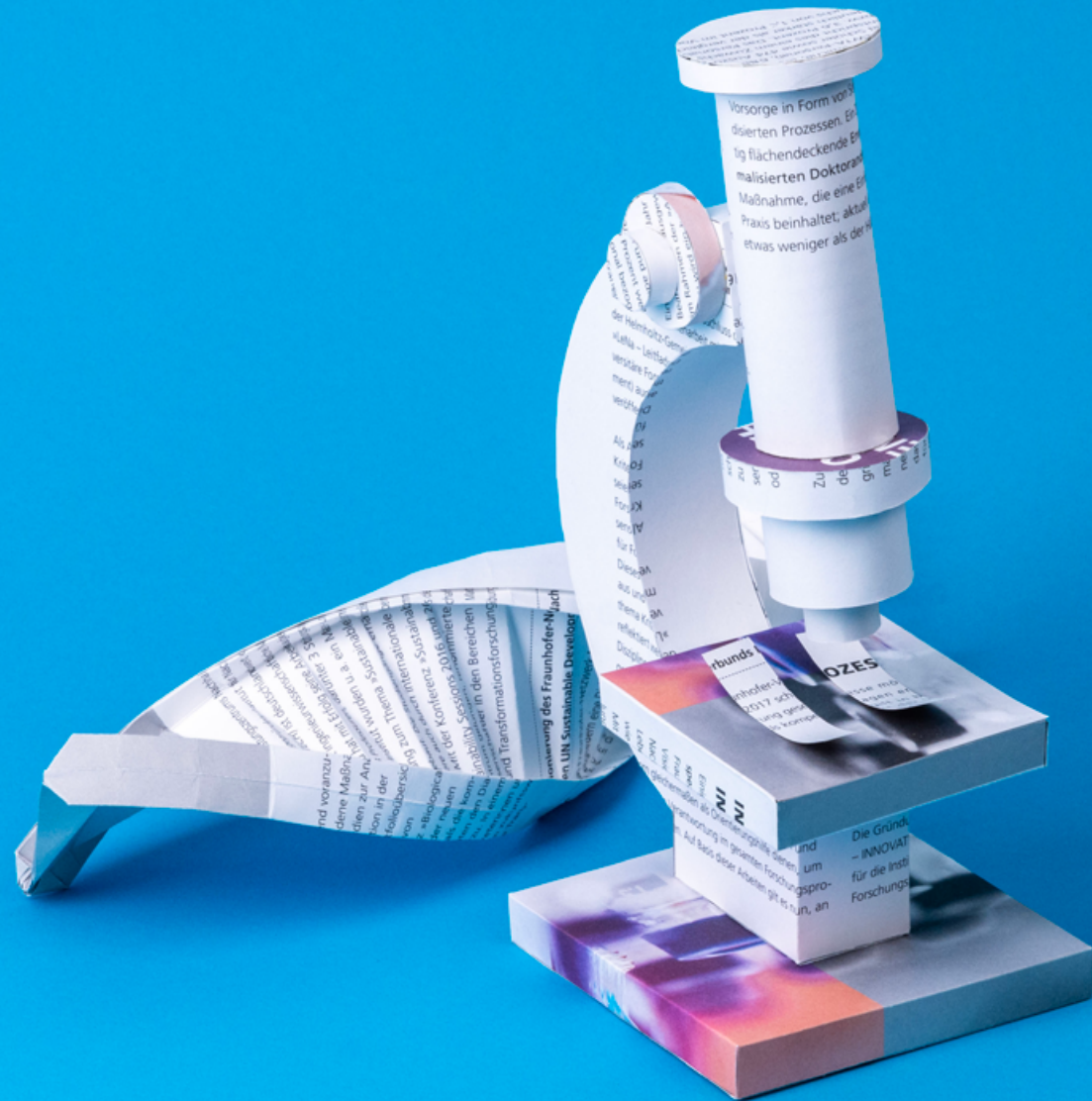
The Fraunhofer Climate Neutrality task force (see pp. 13 and 49) has established a network for officers for climate neutrality and sustainability; this network includes at least one employee per institute that was officially appointed to complete this task by institute management. The officers coordinate climate protection measures at their institutes and energetically drive these measures with a view to reducing emissions. The primary focus of the network is on exchanging knowledge with and learning from the other members, as each of Fraunhofer's 76 institutes have specific challenges to tackle depending on their size, location or primary sector.

While some institutes can contribute extensive sustainability expertise or have already implemented climate protection measures, others are only just starting out. The officers are also responsible for raising awareness among institute employees regarding the tasks involved in climate protection, both large and small, and motivating staff to play their individual roles in achieving the overall goal of restructuring the Fraunhofer-Gesellschaft to become a sustainable, climate-neutral research institution.



# Research and development

As Europe's largest applied research organization, we have a special mission to carry out. With our research solutions, we aim to do our part for the benefit of industry, the environment and society.



Through our scientific developments and diverse research findings, we are creating the conditions needed for a competitive industry and helping solve large-scale challenges facing society as a whole. We counteract possible negative consequences of our research activities through a variety of measures, such as adhering to the criteria of good scientific practice and responsible research processes.

## Scientific integrity

The rules and methods of good scientific practice form the basis for honesty and quality in research work; this scientific integrity is the ethical foundation for all Fraunhofer researchers. This scientific code for personal conduct is an essential prerequisite for collaboratively acquiring and exchanging knowledge on a global basis on the one hand, and advancing industry and society on the other.

In light of the new Guidelines for Safeguarding Good Research Practice released by the German Research Foundation (DFG) in 2019, we have extensively revised our internal regulation on this subject. All German universities and non-university research institutions were obliged by law to implement the DFG guidelines by 2022. In 2020, Fraunhofer became the first non-university research institution to comply with this requirement. In the process, factors such as performance reviews for researchers and quality assurance for project management were given equal consideration to legal and ethical issues. To fulfill these new and sometimes more extensive requirements, the Fraunhofer executive board initiated a support project, whereby the primary officers for good scientific practice received assistance

from experts in implementing the new guidelines. As part of this project, specific training courses have been offered for ombudspersons at the institutes and during onboarding of new employees. Quality assurance tools for projects are also being introduced, ranging from the mandatory conclusion of training agreements for the supervision of doctoral studies to the procurement of plagiarism checker software. In 2022, the procedure for dealing with whistleblowing reports set out in the corresponding internal regulation was used for the first time to resolve two instances of scientific misconduct that were submitted via the Fraunhofer whistleblowing system (see p. 12).

Prevention is an indispensable tool when it comes to avoiding misconduct. Prevention measures include communicating good scientific practice rules to junior scientists, regularly updating these rules and raising awareness around the topic among scientific employees. Responsibility for prevention is allocated to the individual institutes rather than a central body. To facilitate this process, around 150 ombudspersons (two per institute) meet twice a year to exchange examples of best practice and discuss topical issues. In addition, the ombudspersons have access to a secure digital platform where they can hold discussions at any time. Any individuals with specific questions can apply to the two central points of contact for advice. When considered in light of the 12,000 researchers working at Fraunhofer, the small number of incidents that occurred in recent years (two to three cases per year, primarily relating to authorship of publications) shows that the rules of good scientific practice are predominantly being followed.



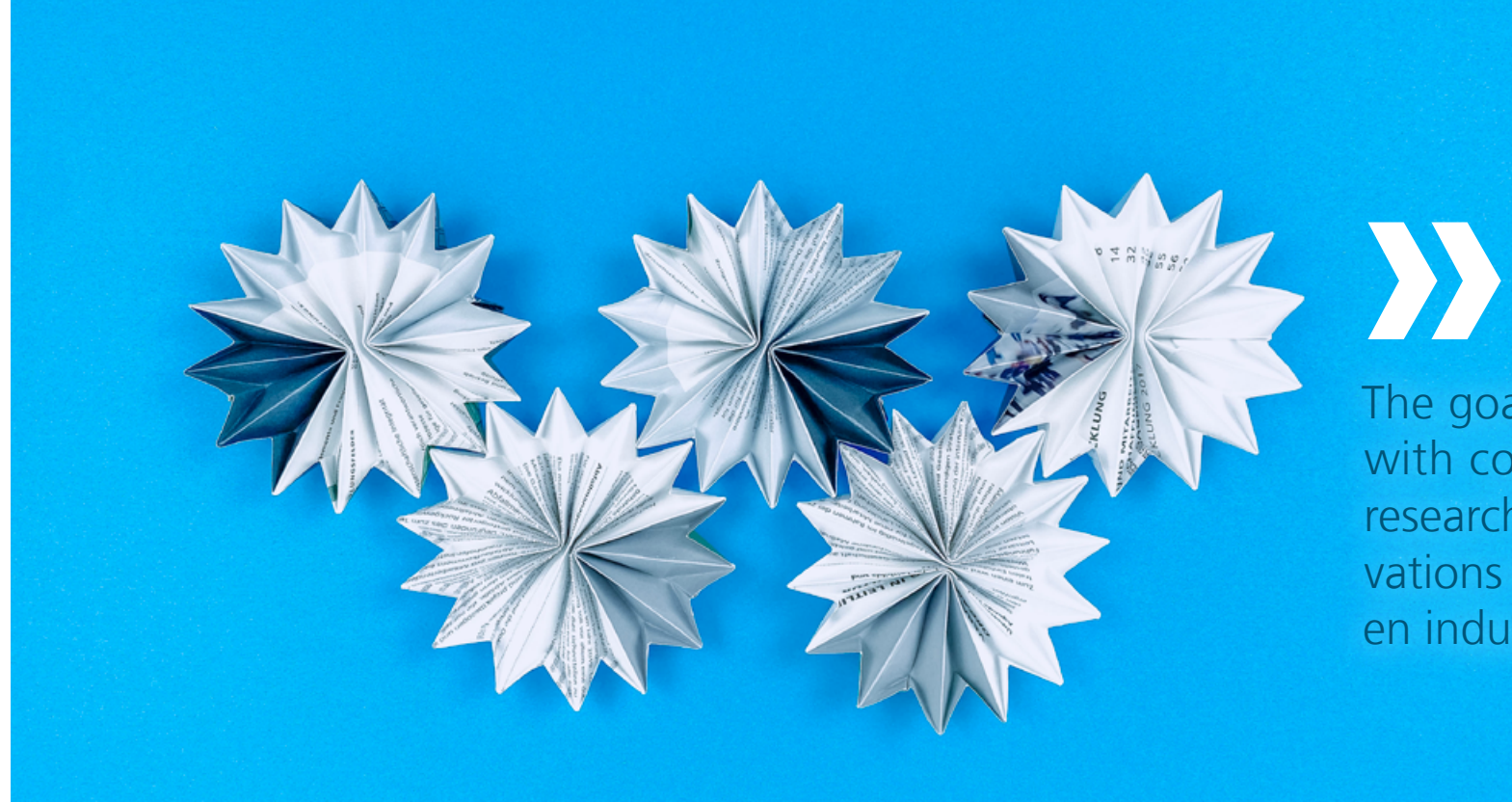
## Socially responsible research processes

Constant advances in knowledge and technological development and ever more complex challenges facing society impact our research work. The requirements and responsibilities in this area are also on the rise, as complex issues must be dealt with in a holistic way, thus creating a need for increasingly intercultural, transdisciplinary and interdisciplinary research work. On the other hand, research processes and results must be aligned with current public discourse and ethical issues.

### Socially responsible research

In 2016, the participants in the Research subproject of the BMBF-funded LeNa (Sustainability Management for Non-university Research Organizations) initiative developed a Framework for Reflection for socially responsible research. This framework represented an initial answer to the question of which criteria to apply within research processes in order to fulfill the social responsibilities of a research organization. The resulting criteria were independent of any specific research topic, and as they apply to all scientific disciplines, their importance should be reflected in all research processes. Encompassing topics such as ethics, consideration of consequences, prioritization of usability, transparency, interdisciplinarity and transdisciplinarity, these reflection criteria were intended to serve as an initial guide for researchers and managers with responsibility for research. However, over the years, it has become apparent that the practical use of these criteria, i.e., operationalizing them in daily research work, is still a difficult endeavor, particularly for research disciplines and topics that have only had limited contact with the area of sustainability until this point.

This is the jumping-off point for the LeNa Shape follow-up project. The joint research project was launched in 2021 and is running until 2023 and involves institutes from four non-university research organizations (the Fraunhofer-Gesellschaft, the Helmholtz Association, the Leibniz Association and the Max Planck Society) and a number of universities and is bringing experts from science, management and administration together. The goal of the project is to integrate the principle of socially responsible research at all levels of the scientific system, and especially to foster it within the everyday working lives of active research scientists. The researchers in this project are working on two issues, with a strongly practical approach: In module one of the project, LeNa Move, the team is exploring obstacles to implementation and developing a toolkit with resources to support the implementation of the LeNa framework for reflection within everyday research work. In 2022, three interactive workshops on this topic were conducted for Fraunhofer employees alone. In addition, a guide was developed in both print and digital form to serve as a simple memory aid and reference text, as well as providing complex tools for step-by-step implementation.



The goal of our work is to collaborate with companies in developing our research approaches and ideas into innovations that benefit society and strengthen industry in Germany and Europe.”

From the guiding principles of the Fraunhofer-Gesellschaft

The second module, LeNa Value, is expected to result in a description of narratives for outstanding, responsible research; these narratives will be used to demonstrate the extent to which the quality of research results can be increased when scientific activities are guided by a sense of social responsibility. Ethical foundations are also being incorporated into these narratives, and proposals for new criteria, measurement and analysis procedures, and approaches for implementing socially responsible research are being developed for this purpose.

A common feature across the two modules is the development of the methods and tools for addressing and implementing the criteria from the sustainable research reflection framework that have been lacking until this point. The goal of the modules is to identify conditions that are scientifically proven to help integrate sustainability into researchers' everyday work and align research processes with sustainability criteria. In addition, the principles of sustainability must also be integrated into the academic landscape and the scientific and innovation ecosystem.

[nachhaltig-forschen.de](https://nachhaltig-forschen.de) (German only)

### Ethical responsibility in science – ethics consultancy

For a research institution with a broad R&D portfolio and a strong focus on applied research, there are important ethical factors to be considered at a number of different levels. At Fraunhofer, there are general questions of research ethics to consider, such as the following:

- The choice of topics to include in the research portfolio (e.g., defense or stem cell research)
- Technology impact assessments (e.g., drones and carbon capture and storage (CCS)) and the selection of research partners (collaboration partners or customers from countries that do not share our value system)

At the project level, the ethical considerations mainly relate to questions around selecting and conducting R&D projects (socially responsible research). In projects with direct ethical implications (e.g., the involvement of test persons), the most important step is to obtain advice and approval regarding the ethical harmlessness of the undertaking. At the level of individual researchers, the primary factor to be considered is the possibility of ethical conflicts during projects (setting objectives, choosing partners, etc.) that must be taken into account as a result of diverging personal ideals.

In 2019, Fraunhofer established the Ethics Committee for Security-Relevant Research (REC), which can be convened on a case-by-case basis to formulate internal Fraunhofer-Gesellschaft recommendations or statements regarding ethical matters that require regulation. However, the services of this committee have yet to be called on. The implementation of ethical factors in R&D projects is also part of the abovementioned LeNa Shape initiative, the aim of which is to take the previous project's recommendations for how to account for the reflection criteria and concretely implement them in the research institutions (see the section on Socially responsible research on p. 18). These criteria include steps such as consideration of consequences. The new Fraunhofer internal regulation on good scientific practice already calls for all Fraunhofer researchers to develop exactly this kind of expertise in technology impact assessments and risk assessments.

It is increasingly common for funding organizations or collaboration partners to require a declaration of ethical harmlessness for R&D projects. These declarations state that there are no ethical issues to consider in the R&D project or that these issues have been addressed adequately by means of appropriate measures (e.g., by obtaining informed consent where test persons are involved). Fraunhofer has yet

to establish an ethics commission of that nature. If the demand for this form of attestation increases, Fraunhofer will investigate whether it has a need for an internal ethics commission for approving specific, ethics-related projects.

In project teams, situations may also arise whereby individual team members have divergent values and moral ideals — even beyond statutory or internal regulations — due to differences in their social and biographical backgrounds, with the result that they may take a critical stance toward collaboration partners, for example. Conflicts of this nature must be resolved by means of professional mediation. The follow-up project to LeNa Shape (see above) is also developing models for this purpose.

### Citizen participation in research and development processes

To tackle the complex and increasingly interconnected global challenges of our age, we need not only political regulations, but also technological solutions and innovations that can successfully initiate and support social, ecological and industrial transformations. In addition to active scientific dialogue across disciplinary borders, this calls for dialogue with technology users, i.e., with civil society.

Ensuring that innovations are relevant, helpful and successful requires social negotiation processes, transparency, dialogue and participation. One key way of achieving this involves including the civil population in research and development processes; this approach can also be described as co-creation, user insights and citizen science. The goal here is not just to increase acceptance of innovations in civil society, but rather to restructure the entire process of innovation to focus more on users and to include civil society in the development and use of technology. Including potential users in the research





The organizational tool developed in the SeniorDesignLab is intended to support the establishment of neighborhood networks. The idea and design behind the “Wir sind Nachbarn” (we are neighbors) tool were developed by Friederike Brings in collaboration with Fraunhofer UMSICHT and Folkwang University of the Arts as part of the +SeniorDesignLab project. Photo: Friederike Brings

and development process can give rise to vital inspiration for technological and social innovations, as well as enabling the consideration of differing viewpoints. This creates opportunities for users to articulate their needs in respect of products and technologies and facilitates discussions regarding the consequences of adaptations or going without. The diversity of the stakeholders included in the process also ensures that a comprehensive range of sustainability issues (i.e., planetary needs) are taken into account and enables increased democratization and openness in the scientific system. At the same time, it is necessary to make scientific working methods and the fundamental challenges of the scientific process, such as intersubjectivity, dialectics and the provisional nature of knowledge, transparent and to communicate them to civil society, while also reinforcing civil self-efficacy and participation (empowerment).

In this way, participative research and innovation processes could help make Fraunhofer research even more tightly focused on industry needs, while simultaneously helping to strengthen the dialogue between the world of science and civil society. The methods and areas of expertise required for this have already been developed by many Fraunhofer institutes and are being put into practice in projects within a wide range

of research fields. In 2021, a dedicated Public Formats and Initiatives department was established at Fraunhofer headquarters in Munich, with the aim of coordinating and reinforcing these approaches.

One practical example is the +SeniorDesignLab established by the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT in Oberhausen. The goal of this project, which was coordinated by the working group for User-centered Technology, was to work with senior citizens to develop products that would allow them to lead self-determined lives in their old age.

[seniordesignlab.de](http://seniordesignlab.de) (German only)

When they were evaluated by a jury at a later stage, the ideas developed by these mixed teams were universally deemed to be more creative and more user-centric — an effect that can also be proved scientifically. The researchers at Fraunhofer UMSICHT firmly believe that involving everyday experts in design processes is worthwhile, and have every intention of using this participative approach to a greater extent in other areas as well, so as to develop sustainable technologies and products with future viability.

The ongoing EU project FRANCIS (Frugal Innovation by Citizens for Citizens) is also providing an opportunity for members of civil society to take on active roles in research and innovation processes. As part of this project, the Fraunhofer Institute for Industrial Engineering IAO and the Fraunhofer Information Center for Planning and Building IRB have teamed up with a number of other partners to organize open innovation challenges, where interested users from marginalized demographic groups such as socially deprived or elderly citizens are asked to develop ideas for high-quality, simple and cost-effective (i.e., frugal) innovations and bring these ideas into application together with industry partners.

Responsible research and innovation aligned with the needs of society represents a central research field for Fraunhofer IAO's Center for Responsible Research and Innovation CeRRI. The center is developing new approaches and methods for ensuring that research projects and innovation processes are focused on user needs right from the outset. This means systematically asking stakeholders from civil society for their needs, requirements and possible consequences, taking diverse viewpoints into account and collectively shaping the future.

STADT.LAND.CHANCEN (city.country.opportunities) — a collaborative project by acatech — National Academy of Science and Engineering, CeRRI and Bayerischer Rundfunk, a Bavarian public broadcasting company — is an impressive demonstration of this approach. The project partners set out to explore how people would live in the future — whether in cities, towns

or villages — and what role technology and, in particular, bioeconomic innovations could play in these scenarios. To do this, they developed scientifically substantiated visions of the future under three broad headings: housing and construction, supply and community, and commuting and work. In order to allow citizens to participate in the project, these scenarios were posted on the initiative's website for public discussion:

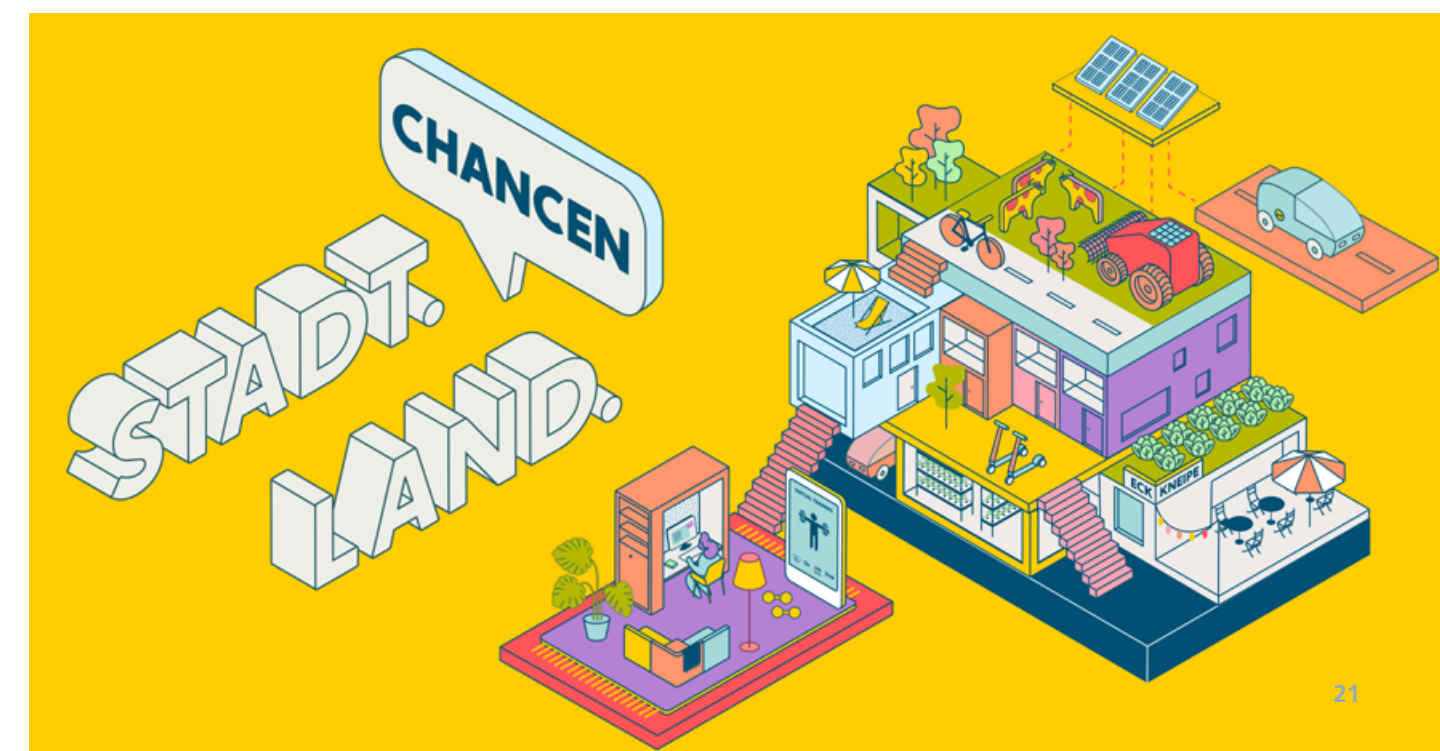
[stadtlandchancen.de](http://stadtlandchancen.de) (German only)

This initiative was accompanied by a survey conducted in summer 2021. Almost 9,000 citizens from urban and rural areas participated and shared their wishes and concerns regarding the future scenarios. The project results show that many people are very interested in harnessing bioeconomic innovations to increase sustainability, staying abreast of future social and technological issues and participating in urban and regional development processes.

### Research solutions for challenges facing society

At present, our society is facing numerous diverse, large-scale challenges: The transformation toward a sustainable society requires solutions for protecting the climate and biodiversity, conserving resources, combating diseases and securing energy supplies, to name but a few examples. The scientific world can and must make an essential contribution to this transformation.

Key visual from the STADT.LAND.CHANCEN project  
Illustration: Fraunhofer IAO



### Key research focus areas at Fraunhofer

As a worldwide leader in applied research, the Fraunhofer-Gesellschaft helps safeguard our society's future viability by means of sustainable solutions in a wide range of research fields. In 2020, to ensure that it can continue to contribute in this vital way, Fraunhofer identified seven strategic research fields that it could drive through high-profile activities combining the forces of various institutes and groups. The purpose of these strategic research fields is to promote Fraunhofer's social and cross-sector impact in these areas. Four of these research fields tie in with the topic of sustainability in a special way: For example, the Bioeconomy research field was established with the goal of developing pioneering innovations for a sustainable, biobased industry. Within the field of Resource Efficiency and Climate Technologies, Fraunhofer researchers are working on solutions that will help develop sustainable economic models, such as green economy, circular economy and bioeconomy systems, and will result in far-reaching transformation processes in society and industry. The Hydrogen Technologies research field drives the implementation of hydrogen technologies in practical applications, thus making a decisive contribution to the much-needed transformation of the energy and industry sectors toward sustainable value creation. In the Digital Healthcare research field, Fraunhofer is focusing its R&D activities on expanding German and European sovereignty in the area of pharmaceuticals and medical devices, improving the usability of medical data, decoding the immune system and defining transdisciplinary translation cycles so as to accelerate the

process of bringing innovative medical products and devices into application.

Protecting the climate is one of the most important tasks that our society faces at a global level, particularly when it comes to making the switch to renewable sources in our energy systems and decarbonizing our industry sector. Fraunhofer researchers are making vital contributions to this process, for example, in a number of initiatives focusing on hydrogen technologies (see p. 34) or in the Fraunhofer Group for Energy Technologies and Climate Protection. Founded in 2021, this group represents the Fraunhofer energy research institutes in political committees and research groups at a national and EU level. Through science-based advisory services, the group supports policymakers and industry in transforming the energy system and achieving climate neutrality.

One notable accomplishment in this area is the founding of the Fraunhofer Research Institution for Energy Infrastructures and Geothermal Systems IEG in December 2019. Since then, the IEG has been conducting research on integrated energy infrastructures, geothermal energy systems and energy systems integration at its seven locations.

Also founded in 2021, the Fraunhofer Group for Resource Technologies and Bioeconomy aims to make a decisive contribution to the achievement of sustainability goals at a national, European and international level. By implementing ideas from

the fields of resource efficiency, bioeconomy, circular economy and the sovereignty of value creation cycles, the group intends to ensure responsible management of natural resources. This includes the supply of raw materials, energy, climate and environmental protection, and ensuring food and healthcare security.

Another key factor underpinning a sustainable society is public safety and security, that is, the protection of critical infrastructures (such as power and water supplies, telecommunications, and transportation, healthcare and finance systems) against flooding, terrorist attacks, and the impact of crime and international crises. However, the many dependencies that exist between people, technology and infrastructures in our modern, highly connected societies – also known as socio-technical systems – are extremely complex and have yet to be adequately analyzed for public safety and security issues. Fraunhofer SIRIOS was founded in Berlin in 2021, with the aim of drawing on the combined expertise of four Fraunhofer institutes to research and simulate these dependencies and the process of dealing with the outcome of disruptions. The German federal government and the state of Berlin are providing five years of start-up funding for Fraunhofer SIRIOS, which it will use at its base within a Fraunhofer FOKUS location to develop a research, testing and training environment for simulating complex safety and security scenarios that is unrivaled in Europe.

Overall, the Fraunhofer-Gesellschaft is making many significant contributions to the achievement of the UN's Sustainable Development Goals (SDGs) through its research. A selection of sample projects is presented on pages 26 to 35.

### Fraunhofer Future Foundation – sustainability in focus

Since its strategic restructuring in 2020, the Fraunhofer Future Foundation has been expanding Fraunhofer's research portfolio in the area of sustainability, in response to growing global challenges and the imminent transformation of our society. This expansion is primarily focused on everyday solutions that will facilitate a rapid social transformation to an ecologically intact, socially balanced and economically sustainable world. Every year, the foundation pays out around 5 million euros in funding to the Fraunhofer-Gesellschaft for this purpose. Taking the SDGs as their guiding principles, these projects predominantly aim to address the needs of civil society (see the funding projects on the right).

The foundation's sustainability advisory board reviews all project submissions for relevance and impact. A particularly challenging factor here is the question of which criteria can be used to measure sustainability within research projects. The foundation has commissioned the Fraunhofer Institutes for Industrial Engineering IAO and Systems and Innovation Research ISI to conduct a study on this issue and has also entered into dialogue with other research funding



*The newly founded Fraunhofer Center for the Security of Socio-Technical Systems SIRIOS celebrated its commencement of operations with an opening ceremony in the Futurium building in Berlin; around 100 guests and high-profile representatives from politics, security authorities, industry and research were in attendance. Photo: Paul Hahn/Fraunhofer FOKUS*



### Funding project: EDDA

Intelligent image analysis for efficient humanitarian aid in disaster-stricken regions

- Objective: Development of a software for analyzing drone images in real time to facilitate targeted planning of relief supply transportation in crisis- and disaster-stricken regions
- Institute: Fraunhofer Institute for Industrial Mathematics ITWM
- Funding period: 2021–2022

### Funding project: WiBACK – Connecting the unconnected

Objective: A low-cost, low-tech solution for installing radio masts to provide broadband internet in economically underdeveloped regions so as to promote digital participation and economic expansion

- Institute: Fraunhofer Institute for Applied Information Technology FIT
- Funding period: 2022

### Funding project: FAVRE – Concrete recycling to improve climate and resource protection

Objective: Development of a technology for breaking down old concrete and construction rubble via ultra-short flashes, thus helping protect the climate and conserve resources

- Institute: Fraunhofer Institute for Building Physics IBP
- Funding period: 2021



organizations that are working to address this complex, forward-looking field.

The Fraunhofer Future Foundation also sees collaborating with stakeholders from civil society at early project stages to be a key factor in responsible, needs-oriented research. This is why its funding programs are mainly aimed at researchers that include non-profit organizations in their project design processes. To encourage citizen participation, the foundation is also making explicit efforts to facilitate dialogue with the public, e.g., through informal video chat sessions like the Wissenschaftssofa (scientists on the couch) events.

However, a long-term participation process also entails giving citizens and stakeholders from civil society a say in funding allocation decisions. Although this approach had previously seen very little use in the world of science, the Fraunhofer Future Foundation tried it out for the first time in 2022 with its crowdfunding competition, ScienceForGood.

The Fraunhofer Future Foundation gave private individuals, non-profit organizations and companies the opportunity get involved in promoting a sustainable future and other social issues by helping to decide on the funding of applied research projects.



Chair of the Fraunhofer Future Foundation board, Prof. Hans-Jörg Bullinger (right) holds a discussion with researcher Dr. Volker Thomé (left), moderated by Sylvia Kloberdanz (middle) during a live broadcast of the Wissenschaftssofa (scientists on the couch) event at Fraunhofer IBP. Photo: Rafael Gramm/Fraunhofer IBP

### Outstanding research projects facilitate sustainable development

The Joseph von Fraunhofer Prize is awarded to Fraunhofer employees for outstanding scientific achievements that help solve practical problems. In 2021, the prize went to researchers at the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT for their work on redox flow batteries. These promising energy storage devices are still too expensive for market use, but the UMSICHT team have brought them significantly closer to market readiness. The researchers redesigned the manufacturing process entirely, making the stack – the key component of a redox flow battery – 80 percent lighter, 50 percent smaller and, above all, far cheaper to produce than conventional models. The spin-off VOLTERION GmbH was founded to bring this new product onto the market.

[s.fhg.de/joseph-von-fraunhofer-preis-2021](https://s.fhg.de/joseph-von-fraunhofer-preis-2021)

In 2022, the jury awarded the prize to a group of employees at the Fraunhofer Institute for Integrated Circuits IIS in recognition of their technology's importance for society. The IIS researchers' RFicient® chip is a particularly efficient chip for wirelessly connected devices; it saves up to 99 percent of the energy that was previously required, which extends battery service life enormously. It is estimated that the RFicient® technology will be installed in more than 50 million IoT devices in the coming years. Given that future energy consumption would otherwise increase massively as the number of wirelessly connected devices grows, there can be no doubt of this development's importance for society.

[s.fhg.de/joseph-von-fraunhofer-preis-2022](https://s.fhg.de/joseph-von-fraunhofer-preis-2022)

The Fraunhofer Prize for Human- and Environment-Centered Technology is awarded every two years for research and development achievements that make a significant contribution to improving human quality of life. In 2021, the prize went to three Fraunhofer institutes for their joint research project on improved vaccine development. Researchers from the Fraunhofer Institute for Cell Therapy and Immunology IZI collaborated with their colleagues at the Fraunhofer Institute for



One of the projects featured in the ScienceForGood crowdfunding competition in 2022: The Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB's Phosphate Catcher project centers on using natural proteins to keep water resources clean and provide valuable nutrients for agriculture.

Photo: Fraunhofer IGB

Organic Electronics, Electron Beam and Plasma Technology FEP and the Fraunhofer Institute for Manufacturing Engineering and Automation IPA to develop a procedure for inactivating pathogens within milliseconds using low-energy electrons – instead of the toxic chemicals that have been used up until this point. This would make vaccine production faster, more environmentally friendly and more cost-effective.

[s.fhg.de/fraunhofer-prize-for-human-and-environment-centered-technology-2021](https://s.fhg.de/fraunhofer-prize-for-human-and-environment-centered-technology-2021)

Every year since 2016, Fraunhofer and the High-Tech Gründerfonds (HTGF) have presented the Fraunhofer Founder Award to outstanding Fraunhofer entrepreneurs with innovative business ideas. To win the award and its 5,000 euros in prize money, the founder must have created a successful spin-off with an active market presence that provides products or services that directly benefit society. Particular weight is given to criteria such as technological originality, high innovation potential and an established market position.

In 2020, the Fraunhofer Founder Award went to the spin-off NexWafe. This start-up impressed all members of the jury, from both inside and outside of Fraunhofer, thanks to its novel, low-cost, resource-efficient procedure for manufacturing silicon wafers

for photovoltaic modules. This innovative technology can be used to produce wafers of any thickness while consuming a fraction of the energy, materials and capital required for pre-existing processes.

The following year, E-VITA GmbH, a joint venture by the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP and Ceravis AG, received the Founder Award for 2021. The company developed a process for eliminating fungi and germs from seeds using accelerated electrons, thus creating a proven, non-chemical and yet financially viable alternative method of obtaining germ-free seeds. At the end of the process, all that remains are clean seeds that contain no pollutants and will not release toxins that could harm humans or the environment.

# Contributing to the UN Sustainable Development Goals through targeted research

The 2030 Agenda launched by the UN in 2015 is recognized around the world as a set of guiding principles for global sustainable development. The 17 UN Sustainable Development Goals – SDGs for short – form the core element of the agenda. These ambitious goals address all social stakeholders in the fields of politics, industry, civil society and science. Fraunhofer is no exception and has taken the SDGs as an important guiding framework. From as early as our 2016 sustainability report, we have shared details on how Fraunhofer's research and development activities contribute to the UN Sustainable Development Goals. To this end, we have analyzed our entire organizational research portfolio and determined which of goals are particularly relevant to our research results and developments. We started by examining 6 of the 17 goals more closely. Over the course of our strategic further development in recent years and through dialogue with internal and external stakeholders, we have gradually expanded this list to include other sustainability goals with particular relevance for our research.

In this section, we will present some of our research activities, along with selected example projects concerning the following nine UN Sustainable Development Goals: SDG 2, SDG 3, SDG 6, SDG 7, SDG 9, SDG 11, SDG 12, SDG 13 and SDG 14.



## SDG 2 – Zero hunger



One of the UN's stated objectives is to create a world free from hunger and malnutrition. With the world's population continuing to grow, the aim of ensuring a secure, protein-rich food supply for every individual is of vital importance. Achieving this goal will require a productive, yet environmentally friendly and resilient agricultural and food production system.

Climate change, dwindling resources and supply chain uncertainty all pose major challenges for the global food industry. To counter these challenges and make Germany's food sector more sustainable, 13 Fraunhofer institutes are conducting research activities along with other partners under the auspices of the Fraunhofer Agriculture and Food Industry Alliance and collaborating to develop solutions along the entire value chain: from innovations in the fields of agriculture, product protection and analytics, through logistics and right up to new processing technologies to facilitate a circular economy.

[s.fhg.de/allianz-food](https://s.fhg.de/allianz-food)

### Future Proteins lighthouse project – for resilient, sustainable protein production

Proteins are essential for life, but they may be on the road to becoming a scarce commodity in global food supplies. Extreme weather conditions caused by climate change and soil and water pollution from the use of pesticides and fertilizers could endanger future protein supplies. One possible solution to this issue could be to tap into new protein sources, i.e., sustainable, mass-market alternatives to animal-based foods. In the Fraunhofer lighthouse project Future Proteins, six Fraunhofer institutes coordinated by the Fraunhofer Institute for Molecular Biology and Applied Ecology IME have been working since 2021 to develop new cultivation

systems and processes that could enable the extraction of nutrient-rich proteins from certain plants, insects, fungi and algae, so that they can be used in new products.

[s.fhg.de/future-proteins](https://s.fhg.de/future-proteins)

### Alternative options for food production

Bluu GmbH – a spin-off of the Fraunhofer Research and Development Center for Marine and Cellular Biotechnology EMB<sup>1</sup> – has developed an alternative to fisheries. The company specializes in producing cell-based fish made from real fish cells and cultivated in a bioreactor. This process does not come at the cost of animal welfare and the ecosystem, unlike the catching of wild fish – according to the Food and Agriculture Organization of the UN, around 90 percent of all fish stocks have been fished to the maximum safe level or are already overfished.

[bluu.bio](https://bluu.bio)

### Dairy-free cheese alternatives

The goal of the BMBF-funded project Kerbse by the Fraunhofer Institute for Process Engineering and Packaging IVV is to develop dairy-free cheese alternatives from pea proteins. These products will be manufactured according to traditional cheese production processes (i.e., microbial fermentation and ripening).

[s.fhg.de/kerbse-ivv](https://s.fhg.de/kerbse-ivv)

### Solutions for smart farming applications

In the Fraunhofer lighthouse project COGNAC, which ran from 2018 to 2022, eight institutes coordinated by the Fraunhofer Institute for Experimental Software Engineering IESE researched strategies and technologies for driving the digital transformation in agriculture. The researchers developed an intelligent system made up of digital software applications, autonomous field robots and new data collection sensors, which will allow farmers to achieve high levels of productivity while also adhering to the principles of sustainability and resource efficiency and maintaining product quality.

[s.fhg.de/leitprojekt-cognac](https://s.fhg.de/leitprojekt-cognac)



Domestic pea protein is the ideal raw material for fermented cheese alternatives. Photo: Fraunhofer IVV

The 2021 Joseph von Fraunhofer Prize was awarded to Fraunhofer FEP and its spin-off E-VITA in recognition of the technology they developed for chemical-free disinfection of seeds (see p. 25).

<sup>1</sup> This is an associated center of the Fraunhofer Research Institution for Individualized and Cell-Based Medical Engineering IMTE.





## SDG 3 – Good health and well-being

**Maintaining healthy lifestyles and promoting well-being in every age cohort are vital factors in sustainable development. This includes providing high-quality healthcare services, combating communicable diseases, and safeguarding access to medicines and vaccines.**

Fraunhofer's health research is structured based on the research fields of the 4D model: drugs, diagnostics, devices and data. In these fields, 45 Fraunhofer institutes are combining their expertise across disciplines to develop cost-effective solutions to a wide range of problems in healthcare provision.

In the future, transdisciplinary approaches will play a key role in driving innovation, as doctors will need to collaborate ever more closely with experts from other disciplines, such as engineers, scientists, computer scientists and mathematicians.

### Mini-robots for less invasive treatment

Researchers from the Fraunhofer Research Institution for Individualized and Cell-Based Medical Engineering IMTE and the Universität zu Lübeck are developing tiny swimming robots that can be magnetically steered to their site of action in the body. Once there, the »mini-submarines« dispense targeted medication, e.g., for chemotherapy, or carry out minimally invasive interventions in areas that are difficult to access.

In 2021, with the input of radiology experts from the University Hospital of Schleswig-Holstein, magnetic fields were used to successfully steer one of these micro-robots through a model of the middle human cerebral artery to the site of an aneurysm. Rotating magnetic fields cause the robot to twist, which generates a forward motion. The researchers track the movement of the microrobot via tomographic and real-time magnetic particle imaging, which uses magnetic

fields that do no harm to the body.

[s.fhg.de/magnetische-u-boote-imte](https://s.fhg.de/magnetische-u-boote-imte)

### The DeKonBot disinfection robot

Cleaning and disinfection tasks in buildings, especially healthcare facilities, play an important role in preventing transmission of viruses and hospital-acquired infections. This means that a variety of surfaces like door handles, light switches and handrails must undergo regular disinfection. To support cleaning staff in this task, 12 Fraunhofer research units have come together as part of the MobDi – Mobile Disinfection project to develop new technologies for robot-based cleaning and disinfection. One of the outcomes of this project is the Fraunhofer Institute for Manufacturing Engineering and Automation IPA's DeKonBot 2 disinfection robot – which represents a further advance on the first-generation model of 2020. Designing a cleaning tool that was flexible and compact, yet still capable of effectively disinfecting the widest possible range of objects, presented a particular challenge here.

[s.fhg.de/dekonbot2-ipa](https://s.fhg.de/dekonbot2-ipa)

### Primary medical care in remote regions

Fraunhofer researchers have been working with local partners in developing a mobile healthcare platform to ensure comprehensive primary care provision even in rural areas of South Africa. In March 2023, the platform was handed over to the Rhiza Babuyile NGO for a year-long testing period. The medicines, vaccines and examination equipment



*The DeKonBot independently disinfects objects such as door handles.*

*Photo: Rainer Bezl/Fraunhofer IPA*

carried on board allow rapid on-site provision of primary care to sick people and pregnant women. The care unit, which can be mounted on a commercially available pickup truck, also contains elements that function self-sufficiently, e.g., a water treatment system, a refrigerator and a telecommunications unit. This means the platform can be used even in areas that are particularly difficult to access.

[s.fhg.de/precare-ist](https://s.fhg.de/precare-ist)

For their innovations in the area of vaccine manufacturing, Fraunhofer IZI, IPA and FEP were awarded the 2021 Fraunhofer Prize for Human- and Environment-Centered Technology (see p. 25).



## SDG 6 – Clean water and sanitation

**Adequate water supplies and sanitation are fundamental aspect of sustainable global development. As such, enabling universal access to clean drinking water and sanitation facilities, as well as ensuring reliable sewage treatment and efficient water usage are core sustainability tasks.**

Nine Fraunhofer institutes have come together as the Fraunhofer Water Systems Alliance SysWasser with the aim of developing innovative solutions for sourcing and distributing drinking water, as well as the efficient handling and treatment of sewage. The alliance is a highly capable group that covers the entire water cycle value chain, and is also playing an active role in international projects.

### Fraunhofer innovation platform for water, energy and food security

In August 2020, the Fraunhofer-Gesellschaft and Stellenbosch University came together in a strategic partnership to establish the Fraunhofer Innovation Platform for the Water-Energy-Food Nexus FIP-WEF@SU. The aim of this long-term collaboration is to jointly develop need-driven, technological and cross-sector solutions for water, energy and food security in the South African region – for the benefit of its people and local environment. One of its goals is to bring together know-how and technologies in the field of water treatment and usage, so as to develop solutions for South Africa and the sub-Saharan states through joint research and development activities. With the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB as its primary coordinator, this initiative is addressing the entire water cycle and approaching the residual wastewater as a source of nutrients and energy. The FIP-WEF@SU aims to combine new process technologies and innovative sensors to develop solutions to issues ranging from the provision of clean drinking water right up to

full-system approaches to water reuse and recycling and hydrological modeling.

[fip.sun.ac.za](https://fip.sun.ac.za)

### Thuringian Water Innovation Cluster (ThWIC)

The Fraunhofer Institute for Ceramic Technologies and Systems IKTS launched the Thuringian Water Innovation Cluster (ThWIC) in collaboration with the Friedrich Schiller University Jena and the Ernst-Abbe-Hochschule Jena. The cluster was selected from numerous competitors to receive BMBF funding from 2023 under the Clusters4Future program. Led by the University of Jena, the scientists in this program will conduct research into new future-oriented approaches for a secure and sustainable water supply. Over the next nine years, up to 45 million euros in funding will flow into the development of new water technologies and research on how society handles this increasingly scarce resource.

[s.fhg.de/thwic-ikts](https://s.fhg.de/thwic-ikts)

### Water and climate protection at sewage treatment plants

RoKka – Sewage Sludge as a Source of Raw Materials and Climate Protection at Wastewater Treatment Plants – is a project that aims to recover raw materials from sewage; the project is being conducted in Baden-Württemberg under the European Regional Development Fund (ERDF) Bioeconomy Bio-Ab-Cycling funding program. At the municipal sewage treatment plant in Erbach, experts from Fraunhofer IGB are working with local stakeholders to research the recovery



*Clarifier at the Ulm-Steinhäule wastewater treatment plant*

*Photo: Marius Mohr/Fraunhofer IGB*

of valuable materials in innovative pilot plants located at sewage treatment facilities. The focus here is on recovering nitrogen and phosphorus – nutrients that can be used as fertilizer in agriculture or algae production – as well as separating CO<sub>2</sub> from the biogas generated during digestion. This can then be processed into basic chemicals. Using bioeconomic processes in the demonstration project represents an effective combination of water conservation and climate protection.

[s.fhg.de/rokka-igb](https://s.fhg.de/rokka-igb)





## SDG 7 – Affordable and clean energy

**Clean energy sources are a key factor in environmental and climate protection. Ensuring universal access to affordable, reliable, environmentally friendly and sustainable energy is the foundation of sustainable economic activity and the sustainable development of society.**

Contributing to the success of the energy transition is the aim of many institutes of the Fraunhofer-Gesellschaft. The Fraunhofer Energy Alliance combines the energy expertise of 19 Fraunhofer institutes. The alliance's research fields include energy system digitalization, renewable energies, energy system analysis, energy efficiency and storage technologies, and components for buildings and urban districts.

[s.fhg.de/allianz-energie](https://s.fhg.de/allianz-energie)

The applied energy research institutes that are members of the Fraunhofer Cluster of Excellence Integrated Energy Systems CINES are addressing the central technological and economic challenges of the energy transition. The objective of the cluster is to integrate high proportions of renewable energies into the energy system and market, despite fluctuations.

[cines.fraunhofer.de](https://cines.fraunhofer.de)

### Sustainable, high-efficiency tandem solar cells

Solar cells with the highest rate of efficiency harbor great potential, as they supply inexpensive electricity while requiring little space and consuming low quantities of materials. High efficiency levels mean facilitate the creation of new products, such as energy self-sufficient buildings or electric cars that can be recharged using solar cells. However, due to their physical limitations, the efficiency rate of silicon solar cells cannot be increased indefinitely. Tandem solar cells could offer an alternative here, as new absorber materials have made efficiency rates of over 35 percent a possibility. Moreover, the

enormous worldwide expansion expected in photovoltaics in the future means it will be necessary to systematically avoid the use of critical materials (e.g., lead) when manufacturing solar modules. This is where MaNiTU, the Fraunhofer lighthouse project coordinated by Fraunhofer ISE, comes in. Since 2019, six institutes have been collaborating on the project to develop low-cost, high-efficiency, tandem solar cells from sustainable materials. The initial results are expected in 2023.

[manitu.fraunhofer.de](https://manitu.fraunhofer.de) (German only)

### New heat pumps for warming and cooling

Heat pumps are essential if we are to gain independence from fossil fuels; as such, they represent a key building block of the energy transition. However, economically viable operation is a challenge in this context, especially in view of the sharp rise in electricity prices. In addition, more and more refrigerants are being banned, which raises issues for the compressor-based systems in use today. Electrocaloric heat pumps could provide an alternative to current systems, as they promise to be significantly more efficient and require absolutely no harmful refrigerants. As part of the ElKaWe lighthouse project coordinated by the Fraunhofer Institute for Physical Measurement Techniques IPM, six Fraunhofer institutes are working to develop a new type of heat pump for heating and cooling. The researchers are developing electrocaloric materials that, when used in conjunction with an innovative system approach, could allow very efficient heat dissipation and have the potential to replace



The Fraunhofer IEG's own drilling rig BoRex (Bochum Research and Exploration Drilling Rig). Photo: Fraunhofer IEG

compressors in the long term.

[s.fhg.de/leitprojekt-elnkawe](https://s.fhg.de/leitprojekt-elnkawe)

### Roadmap for shallow geothermal systems

Shallow geothermal systems that tap into terrestrial heat at depths of up to 250 meters represent another important renewable heat source. Thanks to their high source temperatures, these systems are very efficient and can be scaled to suit any requirements and easily integrated into the cooling process. With the support of the German Geothermal Association (BVG), Bundesverband Wärmepumpe e. V. and Erdwärme Gemeinschaft Bayern e. V. the Fraunhofer Research Institution for Energy Infrastructures and Geothermal Systems IEG conducted a study in 2022 into the feasibility of ground heat pumps. The roadmap indicates the measures needed to drive the implementation of geothermal systems in practical applications.

[s.fhg.de/roadmap-oberflaechennaeh-geothermie-ieg](https://s.fhg.de/roadmap-oberflaechennaeh-geothermie-ieg) (German only)



## SDG 9 – Industry, innovation and infrastructure

**Sustainable industrialization and innovation and resilient and reliable infrastructures are all key requirements for economic and social prosperity. Sustainable value creation in industry must be achieved with the maximum levels of resource efficiency and lowest emissions possible.**

Working with and for industry to develop marketable, sustainable innovations is a core task for the Fraunhofer-Gesellschaft. These innovations require certain key technologies, that must be developed in order to enable sustainable value creation in industry. Under the National Action Plan for Fuel Cell Production, for example, Fraunhofer is pursuing the goal of developing new cost-effective manufacturing technologies for mass production of fuel cells — paving the way for the launch of the hydrogen economy.

[s.fhg.de/h2go-iwu](https://s.fhg.de/h2go-iwu)

### Competence center Green ICT @ FMD

The central element in sustainable industrialization is digitalization, as it facilitates savings in energy and resource consumption. At the same time, however, information and communication technologies' (ICT) own ecological footprint is growing. Digital solutions themselves must be made resource efficient if their potential for sustainability is to be harnessed. This is the goal of the new competence center Green ICT @ FMD, which was jointly established by Fraunhofer and Leibniz institutes collaborating within the Research Fab Microelectronics Germany (FMD). This new one-stop shop for green ICT issues deals with three key technological topics: sensor edge cloud systems, energy-saving communications infrastructures and resource-optimized electronics production. The center aims to test new solutions in collaboration with industry partners, for criteria such as their environmental impact. The project is financed by the BMBF as part

of the German federal government's Climate Action Plan 2030.

[greenict.de](https://greenict.de) (German only)

### ShaPID lighthouse project

The chemical industry is an indispensable element in a multitude of industrial value chains and an important driver of product development and innovation. The goal of making chemical industry production processes sustainable will require extensive development activities, as it will entail making material and energy conversion processes climate-neutral and circular in the future. Through ShaPID, an internal lighthouse project, Fraunhofer is driving practical advance developments aimed at establishing green chemical processes. Under the leadership of the Fraunhofer Institute for Chemical Technology ICT, the consortium is using new catalyst theories, reactive species and electrochemical processes to develop new chemical synthesis approaches. It is also focusing on optimizing synthesis processes, along with using new digitalization and automation methods to control and regulate these processes efficiently.

[shapid.fraunhofer.de](https://shapid.fraunhofer.de)

### Carbon2Chem® — a key step on the road to climate protection

As part of Carbon2Chem®, a collaborative project funded by the BMBF, a consortium of partners from industry and science is developing a solution that can be used anywhere in the world for converting waste and process gases from furnaces used in the steel, cement and

lime industries into precursors for fuels, plastics or fertilizers. Since 2016, this project, which is coordinated by Fraunhofer UMSICHT, thyssenkrupp AG and the Max Planck Institute for Chemical Energy Conversion (MPI-CEC), has been developing carbon capture and utilization (CCU) technologies and testing them at pilot-plant scale. The second phase is currently in progress and will drive the process of translating these results into industrial applications. The Fraunhofer-Gesellschaft has been receiving collaboration requests in this area from the industry and scientific sectors of countries like Japan, India and Singapore.

[s.fhg.de/carbon2chem](https://s.fhg.de/carbon2chem)



Carbon2Chem® pilot plant  
Photo: thyssenkrupp Steel Europe





## SDG 11 – Sustainable cities and communities

**Sustainable urban and regional development means making urban environments inclusive, safe, resilient and environmentally friendly. This includes features like sustainable transportation systems, affordable housing and civil protection measures.**

Solutions for sustainable transportation systems are being developed by the Fraunhofer-Transport Alliance. Sixteen institutes are jointly researching resource- and energy-efficient transportation technologies and pioneering mobility solutions that focus on climate protection and the needs of the end user.

[verkehr.fraunhofer.de](https://verkehr.fraunhofer.de)

The Fraunhofer Center for the Security of Socio-Technical Systems SIRIOS, which was founded in 2022, is dedicated to civil protection (see p. 23). In the Morgenstadt (City of the Future) initiative, Fraunhofer IAO has teamed up with cities, companies and scientific partners – among them many Fraunhofer institutes – to address the issue of sustainable urban development.

### Sustainable urban planning thanks to digital twins

Today, over half the world's population lives in an urban setting. The health-related, ecological and social challenges associated with increasing urbanization call for intelligent and sustainable solutions. The precise form such solutions might take, and how they would affect their urban settings can be investigated with the help of a digital twin. This can digitally recreate a city's real-life objects or processes to help simulate the effects of various possible measures. This is the context in which Fraunhofer IAO and some 20 international partners from industry, politics and research are participating in the Digital City Program – the first of three Urban Development Initiative (UDI) programs,

this project was initiated by Fraunhofer in 2021 in conjunction with the cities of Eindhoven and Helmond, the Eindhoven University of Technology and the Brainport Development. The aim is to use digital solutions to promote holistic, sustainable city planning. The digital twin uses existing data on mobility, climate, energy and noise, for example, to make complex topics visually accessible and to give decision-makers from politics, civil society and industry an extensive insight into complex urban issues. This method also allows researchers to systematically feed innovative ideas into concrete city development plans and test them out. The implementation phase began in the summer of 2021, giving Fraunhofer IAO the opportunity to put results from the Morgenstadt (City of the Future) initiative to use directly in regional and local contexts.

[s.fhg.de/digitalcity](https://s.fhg.de/digitalcity) (German only)

### Heat pumps in existing buildings

Supplying climate-friendly energy to existing multi-family housing is a major challenge for cities. LowEx Concepts for the Heat Supply of Existing Multi-Family Houses (LowEx-Bestand) is a group project that ran from 2016 to 2022, with funding from the German Federal Ministry for Economic Affairs and Climate Action (BMWK) and scientific support by Fraunhofer ISE. The researchers in the project collaborated closely with industry companies to analyze and (further) develop solutions for incorporating heat pumps and heat transfer and ventilation systems into multi-family housing. The key objective was to make methods of



*A multi-family building in the Durlach smart district in Karlsruhe. A PV system with a photovoltaic output of 60 kWp was installed on the roof. Photo: Fraunhofer ISE*

supplying heat to existing buildings more economically viable – particularly through heat pump technology – and to ensure operational quality, so as to achieve a more rapid market launch. Over the past two years, the components and models developed together with technology partners have been implemented in multiple demonstration projects: for example, using combined photovoltaic-thermal collectors, or combining air and ground as sources of energy for heat pumps. Other developments like efficient ventilation units for renovated buildings, as well as smart operational management strategies, were also successfully realized in the course of this project. The project has therefore made a significant contribution to achieving climate policy goals concerning heat supply in the building sector, especially in cities.

[s.fhg.de/lowex-ise](https://s.fhg.de/lowex-ise)

## SDG 12 – Responsible consumption and production



**Sustainable exploitation and efficient use of ever-scarcer resources form the basis for sustainable patterns of consumption and production. The UN goals encompass sustainable supply chains as well as waste prevention and a significant reduction in food waste.**

In order to sever the link between production activities and resource consumption as much as possible, the production-oriented Fraunhofer institutes have taken the lead in intensively researching technologies to make manufacturing processes more climate-friendly and resource-efficient. Under the Circonomy® brand for circular solutions by Fraunhofer, institutes are conducting research and development activities with the aim of bringing products, processes and services to market in line with the defined principles of circularity. One branch of these activities involved establishing the Fraunhofer Cluster of Excellence Circular Plastics Economy CCPE. Since the cluster was set up in 2018, its six Fraunhofer institutes have been examining how an entire value chain can be transformed based on the principles of the circular economy, using plastics as an example. In the process, they also analyze and take into account any likely economic and social effects.

[ccpe.fraunhofer.de](https://ccpe.fraunhofer.de)

### Waste4Future — from waste to raw material

With the aim of recovering valuable basic materials from waste products, researchers in the Fraunhofer Waste4Future lighthouse project, led by the Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS, are developing new recycling methods, along with solutions for conducting economic and ecological evaluations of them. This will make it easier to create a circular system for the carbon contained in plastic, by using material and chemical

recycling to turn it into a resource for the chemical industry. As such, Waste4Future is paving the way for a carbon circular economy, in which valuable new basic molecules are recovered from plastic waste and emissions are largely avoided. Today's waste becomes tomorrow's resources, which also reduces the industry sector's dependence on imported carbon resources such as crude oil and natural gas. Seven Fraunhofer institutes are combining their expertise in this project, most notably in the areas of sensors and sensor technology, sorting technology, and material and chemical recycling.

[waste4future.fraunhofer.de](https://waste4future.fraunhofer.de)

### Industrial manufacturing with no negative impact

As part of the Life Cycle Impact Zero project, which launched in 2022, researchers from Fraunhofer UMSICHT, the Wuppertal Institute and the Institute of Sustainable Nutrition (ISuN) at the FH Münster are developing and applying a comprehensive approach for environmental assessment at the new facility of electrolyzer manufacturer Enapter. This approach covers chemical manufacturing and electrolyzer production;



energy, water and waste handling; and all the interactions between companies and individuals. That includes not only the employees of the companies, but also stakeholders in upstream and downstream value chains, users of the technology and residents living close to the production facilities. The aim is to use these analyses as a basis to formulate concrete measures for avoiding negative environmental consequences. For more information, see here:

[s.fhg.de/press-releases-2022-life-cycle-impact-zero](https://s.fhg.de/press-releases-2022-life-cycle-impact-zero)

### Sustainable food production

In addition, Fraunhofer researchers are also developing targeted solutions for sustainable food production. One example is the REIF — Resource-efficient, Economic and Intelligent Foodchain research project. Here, the Fraunhofer Institute for Casting, Composite and Processing Technology IGCV is investigating the potential offered by artificial intelligence (AI) for optimizing predictability and controllability in industrial food production. Their goal is to establish an AI ecosystem that integrates stakeholders from all stages of the value chain in such a way as to reduce food waste at every stage.

[s.fhg.de/reif-igcv](https://s.fhg.de/reif-igcv)

*The new Enapter campus in Saerbeck. Photo: Enapter*





## SDG 13 – Climate action

One of the most pressing challenges of the 21st century is protecting the global climate. Measures must be taken immediately to combat the climate crisis and its effects, and to adapt to climate change.

While technology can help reduce emissions, energy and climate policy instruments are also highly important. Fraunhofer researchers are designing and evaluating energy and climate policy measures and helping decision-makers in the practical process of formulating the appropriate policy instruments.

Take, for example, the ARIADNE project – one of four projects conducted under the BMBF's Kopernikus funding program. Fraunhofer and the other members of the consortium are researching what policy instruments would be promote the success of the energy transition and help achieve the goals of the Paris Climate Accords. An initial scenario report (Deutschland auf dem Weg zur Klimaneutralität 2045) on the ARIADNE project, which was published in 2021, lays out the path toward transforming Germany into a climate-neutral country by 2045.

[s.fhg.de/szenarienreport-ariadne](https://www.s.fhg.de/szenarienreport-ariadne)  
(German only)

### Hydrogen lighthouse project by the BMBF

When it comes to developing climate-neutral energy systems, green hydrogen is a key element, as it can be used to store renewable energy. The German federal government adopted the National Hydrogen Strategy in 2020 in order to lay the foundation for Germany's entry into the hydrogen economy. The BMBF's three hydrogen flagship projects, running from 2021 to 2025, represent its core contribution to implementing this strategy – these projects are receiving a total of

740 million euros in funding and numerous Fraunhofer researchers are involved in them. As part of the industry-led lighthouse projects, over 240 partners from industry and science are working together to develop solutions for the German hydrogen economy. The H2Giga project focuses on mass producing large-scale electrolyzers, while the H2Mare project aims to produce green hydrogen at sea. Meanwhile, the TransHyDE project, coordinated by Fraunhofer IEG, is researching technologies for transporting hydrogen.

[wasserstoff-leitprojekte.de](https://www.wasserstoff-leitprojekte.de)

### KlimaKoop.Komm network

Many local authorities face a daunting challenge: while, on one hand, they are obliged to take measures to adapt to climate change, they must also contend with a strained housing market that requires the development of additional, affordable housing stock. In practice, this means that the measures for adapting to climate change often take a back seat. With this in mind, energy efficiency and redensification measures in neighborhoods could provide the perfect opportunity to shift the focus back to climate change. The real estate and housing industry is an important player here.



While there are implementation guidelines and resources in place for local authorities, the same cannot be said for the housing industry. Moreover, stakeholders in these processes rarely have the opportunity to collaborate with each other. Researchers at Fraunhofer ISI are investigating how local authorities can adapt to the climate in an economically viable way and achieve their climate protection goals, while also increasing the quality and affordability of housing.

To this end, Fraunhofer ISI is establishing a network linking municipal stakeholders in North Rhine-Westphalia and the housing industry – AKA, the KlimaKoop.Komm network. The goal is to establish a moderated process for systematically documenting experiences, discussing synergies and obstacles to collaboration and developing concrete approaches to collaboration. To this end, the researchers will select up to five sample neighborhoods, ensuring that these are as diverse as possible, in order to examine in detail the issues outlined above and develop scalable solutions; they will do this in conjunction with property-owning housing associations and local authorities.

[s.fhg.de/klimakoopkomm-isi](https://www.s.fhg.de/klimakoopkomm-isi)  
(German only)

*Reference-factory.H2 is a production system based on physical and virtual components. It can be used to create reference designs, and new or specifically optimized technology and automation solutions.*  
Photo: Fraunhofer IWU



## SDG 14 – Life below water

Oceans are the foundation of life. They are a source of nutrition, raw materials and energy, as well as a means of transportation. However, due to rising water temperatures and the increasing pollution of seas, they are severely endangered. This means that it is essential to safeguard underwater life, preserve the ocean ecosystem and use marine resources sustainably.

There are many forms of underwater research at Fraunhofer, from smart applications and systems for a sustainable maritime economy, such as robots that can be used to inspect and maintain underwater infrastructures, to the underwater test field (Digital Ocean Lab); not only that, but Fraunhofer is also developing solutions for recovering harmful munitions from the Baltic Sea. Fraunhofer researchers are also addressing the problem of microplastics – tiny plastic particles that severely affect underwater life, leading to ecological and health-related issues. The aim of their research and development activities is to develop an understanding of and thereby reduce the impact of microplastics on the environment.

### Procedure for analyzing marine microplastics

Smart Ocean Technologies is a new interdisciplinary research group with members from four Fraunhofer institutes. Since late 2020, it has been developing underwater applications on the Baltic Sea with the aim of making human use of the oceans more environmentally sustainable. The interdisciplinary team is working on an initial project to address the issue of microplastics in the oceans. Together, they are coming up with solutions for efficiently analyzing the concentration and distribution of plastic debris in the ocean and assessing the ecotoxicity and aging processes of plastic particles. The aim is to develop a technology platform that can operate on underwater vehicles and use a variety of sensors to analyze organic and inorganic pollutants in seawater right on the

spot — this would represent an important milestone in the fight against ocean pollution.

[smart-ocean.fraunhofer.de](https://www.smart-ocean.fraunhofer.de)

### LimnoPlast: Microplastics in rivers and lakes

Since 2019, researchers at Fraunhofer UMSICHT have been collaborating with 12 other European partners in the EU project LimnoPlast, with a view to better understanding the effects of plastic particles and fibers on rivers and lakes – after all, most plastics are produced and used on land and enter the ocean via rivers and lakes. In order to conduct a holistic investigation of the effects of microplastics on freshwater ecosystems, while also ascertaining their quantity and distribution, the project is combining research approaches from the natural and social sciences with environmental engineering solutions. The project is receiving just under 4.1 million euros of funding from the EU for a period of four years as part of the Horizon 2020 program.

[s.fhg.de/limnoplast-umsicht](https://www.s.fhg.de/limnoplast-umsicht)  
(German only)

### MicrofibrEX: Filter for textile microfibers

When synthetic microfibers are washed, significant quantities of microplastics enter the environment via the sewage system. To address this issue, researchers at Fraunhofer UMSICHT have developed a special filter module for washing machines. Existing solutions for separating microfibers predominantly use filter fabrics or non-woven materials, most of which are susceptible to clogging. Their service life is limited and maintenance is costly. MicrofibrEX takes advantage of the higher density of common microfibers compared to water and separates the fibers from the washing water through a centrifugation process. Pilot studies with demonstrators have been underway in a washing laboratory since mid-2022; from 2023, the UMSICHT team and their application partners will develop prototypes to market readiness in order to reduce the input of microplastics into our waters.

[s.fhg.de/bionische-mikroplastikfilter-umsicht](https://www.s.fhg.de/bionische-mikroplastikfilter-umsicht)  
(German only)



*The interdisciplinary Fraunhofer Smart Ocean Technologies research team in Rostock is working on using underwater vehicles to analyze microplastics in the oceans.*  
Photo: Fraunhofer IGD

# Transfer

Transferring knowledge to the worlds of industry, society and politics and dialoguing with these stakeholder groups – these activities are not only crucial to our mission as an applied research organization, but are also important factors in ensuring that research results are harnessed effectively.

## Transfer to industry

For over 70 years, the Fraunhofer-Gesellschaft has been helping to successfully transfer the technological knowledge and expertise generated by its institutes to industry and society by means of new products, services and processes. Many different transfer pathways are needed in order to commercialize technology successfully, including the following:

- Industrial projects and public-private partnerships
- Use of intellectual property (IP)
- Continuing education and training for industry
- Spin-offs and shareholdings
- Transfer via individuals
- Standardization

### Collaborations with SMEs

One of the Fraunhofer-Gesellschaft's fundamental transfer paths is conducting contract research for companies, especially in collaboration with small and medium-sized enterprises (SMEs). For example, in 2021, around two-thirds of all Fraunhofer customers were SMEs, accounting for approximately one-third of contract research revenue. In helping German SMEs develop products and technologies, the Fraunhofer-Gesellschaft is making an essential contribution to the national innovation system.

In addition, the Fraunhofer-Gesellschaft supports the acquisition of innovation expertise in medium-sized companies in order to further enhance Germany's competitiveness as a business location. A successful example of a contract research project is KoMoGER, which is helping Heckert Solar, an SME in Chemnitz, to set up a PV module production facility that is fit for the future. With the help of the Fraunhofer Institute for Solar Energy Systems ISE, the project team are developing a technology that can produce PV modules with an output of more than 400 W per module. Expanding German PV production and increasing the yield per module constitute essential

steps toward achieving the energy transition and reducing international dependencies.

### Patents and spin-offs

Patents and licenses represent another important transfer path at Fraunhofer. In 2021, for instance, Fraunhofer was named a Top 100 Global Innovator for the eighth time – a prize awarded on the basis of the quantity and quality of patent activities. In total, 7,620 active patent families were filed in 2021. Further key figures and measures relating to the exploitation of intellectual property rights in Fraunhofer research are presented in detail on page 21 of the 2021 Annual Report.

In addition to contract research and licensing, Fraunhofer's research results are also brought into application by means of spin-offs. Since 2019, for example, the AHEAD transfer program has served as a central funding platform for the commercialization of Fraunhofer technologies. In 2022, 65 of 75 project teams made it into the program. With the new sub-program, SDG Track, providing funding for sustainable project teams in line with the UN Sustainable Development Goals has also become a core component of AHEAD. In 2021, 22 Fraunhofer institutes established a total of 30 spin-offs.

This dynamic start-up activity is encouraged through the Fraunhofer-internal spin-off bonus, which gives Fraunhofer institutes rapid, adequate compensation for the loss of knowledge carriers and intellectual property (IP) that occurs as result of spin-offs. Moreover, since 2016, Fraunhofer and the High-Tech Gründerfonds (HTGF) have presented the Fraunhofer Founder Award to outstanding Fraunhofer entrepreneurs with innovative business ideas. The prize – which, in 2022, was awarded alongside the unprecedented sum of 50,000 euros – is presented in recognition of a successful spin-off with an active market presence that provides products or services of direct benefit to society. Particular weight is given to criteria such as technological originality, high innovation potential and an established market position. For a brief profile of the award winners for 2020 and 2021, see page 25.

### Continuing education

The Fraunhofer Academy trains innovation stakeholders across Germany and Europe with the aim of transferring key technologies for a livable future into application. The transformation toward a sustainable society involves numerous fields of action,

which require companies to take extensive measures to transmit expertise to their employees or give them a new strategic focus. As such, the continuing education and qualification programs for specialists and managers in industry and public administration represent an important transfer channel for Fraunhofer.

With initiatives such as the European Learning Lab Battery Cells ELLB and the European Battery Business Club EBBC, Fraunhofer aims to meet the acute need for training in the battery sector and close the current skill gap. The first courses will begin in 2023, mostly in the form of digital and online training. The Fraunhofer Academy has also successfully developed its first pilot training courses on the topic of hydrogen. Continuing education is also a key element of hyBit, a large-scale, BMBF-funded hydrogen research project that was launched in 2022 with the aim of setting the Bremen/Lower Saxony region on a course for an efficient hydrogen economy. Fraunhofer's contributions to the project include defining the required expertise profiles for the future hydrogen economy and developing adequate training resources.

### High-performance centers for practical approaches to future-oriented topics

The Fraunhofer high-performance centers are an essential technology and knowledge transfer tool for our organization. These centers are guided by the principle of close collaboration between university and non-university research institutions and industry companies. Fraunhofer institutes, universities, colleges and other non-university research institutions collaborate with companies and stakeholders from civil society at a single location and on a specific topic with the aim of quickly bringing innovations into application and thus promoting the economic and social benefits of research and development. From their first launch in 2015 (with the subsequent initial evaluation phase that lasted until mid-2019) up until 2021, a total of 21 performance centers have been established in Germany. To consolidate this achievement, Fraunhofer implemented an omnibus model in 2022, whereby all centers were transferred over to a synchronized three-year funding phase. During this period, the centers will be evaluated on an annual basis; at the end of the three-year period, the overall results of these evaluations will be used to determine which centers will continue after 2025. The first evaluation took place in May 2022. The evaluation criteria included the quality and ambition of the transfer roadmaps formulated by the high-performance centers and an array of self-selected transfer highlights that illustrate their actual impact. The following two highlights have been included as examples:

#### Transfer highlights

As part of a strategic partnership, the Kaiserslautern-based High-Performance Center Simulation and Software-based Innovation and BioNTech AG developed a software platform to

help plan and control production processes for mRNA-based drugs — like the COVID-19 vaccine — and cancer drugs for individual patients. Fraunhofer ITWM and BioNTech have created a software that allows the company to effectively control its own production network and individual process stages. This development made for a significant contribution to the fight against the COVID-19 pandemic; and their expertise will remain in demand in the future for the development of individual mRNA-based drugs and customized treatments.

At the Center of Excellence in Photonics in Jena, the Fraunhofer spin-offs ConstellR GmbH (a spin-off of the Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI) and SPACEOPTIX GmbH (a spin-off of the Fraunhofer Institute for Applied Optics and Precision Engineering IOF) have joined forces with their parent institutes to develop a new form of space telescope that has been recording the surface temperature and water cycle of our planet from the International Space Station ISS since late February 2022. This measuring instrument is the prototype for a constellation of micro-satellites, which in the near future will provide extensive quantities of data to help protect the environment, thus creating added value for science, industry and society. The primary origin of this successful collaboration can be traced back to the Elevator Pitches 2020 initiative, held by the startup platform, Digital Innovation Hub Photonics DIHP, and funded by the state of Thuringia.

### Sustainability research in engineering

Founded in 2015, the High-Performance Center Sustainability in Freiburg was one of the first established high-performance centers — from the outset, it has been engaged in engineering research with the aim of promoting sustainability. Following the principle of the high-performance centers, the five local Fraunhofer institutes are collaborating with the University of Freiburg, developing innovative and sustainable products and services in collaboration with and for the industry sector. The focus is on four key topics: sustainable materials, energy systems, resilience engineering, and ecological and social transformation. The center's goal is to transfer research results to industry and society with maximum profit.

In March 2021, the High-Performance Center Sustainability entered its third financing phase, with funding from the Fraunhofer-Gesellschaft and support from the BMBF. In addition to new research projects, some demonstrator projects from phase 2 were continued in the form of scale-up projects. The center also launched a joint research project in early 2021: the I4C — Intelligence for Cities project, which is focused on using AI to help cities adapt to climate change. The project will explore AI-driven methods of improving cities' capacity to adapt to climate change and the resulting extreme weather events.

 [leistungszentrum-nachhaltigkeit.de](https://leistungszentrum-nachhaltigkeit.de)



In 2022, the High-Performance Center Sustainability passed the omnibus evaluation, which means it will now receive funding for the long term. Four of its research projects are receiving funding and continuous efforts are underway to expand the range of services offered along the Fraunhofer transfer paths based on the needs of the stakeholders involved.

### Transfer to society

An important aspect of Fraunhofer's work is providing publicly accessible information on research results and scientific developments. The goal is to guide the social discourse and necessary transformation processes and to increase society's level of acceptance toward science.

#### Science communication and dialogue channels

Fraunhofer's major science communication channels include the well-established, quarterly Fraunhofer magazine, which in addition to having a circulation of 32,000 copies (in German and English), is also available for free online. Another important channel is Research News, our press newsletter, which provides 3,800 German- and 4,600 English-speaking subscribers with our latest research results every month. Beginning in 2021, these offerings have been supplemented by videos showcasing our research projects and award ceremonies and a podcast series where Fraunhofer researchers report on their work. Here, Fraunhofer research topics — including cyber security, defense and the energy/climate crisis — as well as our solutions and projects are presented in a detailed, easily comprehensible journalistic style.

The Fraunhofer-Gesellschaft and its institutes are also increasing their social media presence. Fraunhofer's use of shared hashtags across a variety of social media channels ensured that it was able to generate a high level of awareness, wide reach

and many social media interactions over the course of this reporting period. Take, for example, the successful #WeKnow-How campaign: Aimed at a broad target group (media, politicians, companies and interested citizens), the campaign focused on innovative developments and future technologies, showing how Fraunhofer is helping industry and society manage the consequences of the COVID-19 pandemic, the climate crisis and the war in Ukraine.

Events with citizen participation were, for the most part, not held until 2022 due to the pandemic. Fraunhofer-wide, a total of 66 such events were organized in 2022. Under the leadership of the new Public Formats and Initiatives department (see p. 20), for example, Fraunhofer appeared at the highly publicized The Roofs festival, which was held to mark the 50th anniversary of the Olympic games in Munich. Some 11,000 visitors dropped by the Fraunhofer Technology Roof to take in the varied program. Open days are another common type of participatory research/dialogue event run by Fraunhofer — in fact, many of the institutes have been organizing these for years. In 2022, as part of the second Stuttgart science festival, the five Fraunhofer institutes in Stuttgart opened their laboratories and experimental fields to the public under the motto sustainable living with Fraunhofer. Their visitors were invited to take part, experience and gain new insights into topics such as the mobility of the future and sustainable living and working environments.

#### Open access: Learning from the pandemic

Open access is an essential component of the open science movement, which aims to ensure that research processes are openly accessible to and can be reused by as many people as possible. In compliance with the FAIR (findable, accessible, interoperable and reusable) principles, Fraunhofer supports the development of open access as a scientific publishing standard by establishing and expanding suitable infrastructures and centralized services.

Particularly during the coronavirus pandemic, it became apparent that research results need to be made available to the public as quickly and transparently as possible, in order to allow for a rapid exchange of research results. Open access publications provide a particularly important opportunity for dialogue and collaboration between science, industry and civil society, thereby accelerating innovation cycles. In the spring of 2020, the World Health Organization called for publications on COVID-19 to be made freely accessible under an open access policy. This contributed enormously to improving scientists' understanding of the SARS-CoV-2 virus and allowed them to develop vaccines in a short space of time.

In the coming years, greater levels of openness in science, and the resulting transparency, visibility and usability of research results will lead to a further acceleration of scientific progress. One of the stated goals of the open science movement is stronger involvement of stakeholders from civil society in research processes (i.e., citizen science). In addition, engaging in dialogue with the public ensures that the needs of society can be identified more effectively and research results more easily communicated.

With Open Access, start-ups and medium-sized companies without their own research and development units are also free to integrate research results into their own innovation processes. Only by openly sharing and collectively using research results will it be possible to effectively counter global challenges such as climate change.

Over the past five years, the proportion of open access publications among the Fraunhofer-Gesellschaft's scientific output has nearly doubled, reaching 50.5 percent in 2021 (first publications are classified as gold open access, while second publications are classified as green open access; valid as of: December 2022) — and this figure is set to grow further in the future.

### Transfer to politics

The Fraunhofer-Gesellschaft maintains constant contact with policymakers through its various dialogue and consultation channels, sharing Fraunhofer experts' knowledge and their recommendations for action with the German government, federal ministries and political parties.

#### Dialogue channels with policymakers

With the change of government in 2021, the Fraunhofer-Gesellschaft was tasked with establishing new, long-lasting relationships with no less than three parties of different political persuasions. As such, over the course of 2022, Fraunhofer representatives arranged approximately 100 appointments with selected stakeholders from the legislative and executive branches that exercise above-average influence in their respective areas of expertise. These discussions with ministers, state secretaries and members of the German federal parliament (Bundestag) focused on topics concerning Fraunhofer in the fields of science, innovation and economic policy.

Moreover, in its dialogue with policymakers, the Fraunhofer-Gesellschaft focused on high-impact events: Fraunhofer Morning Radar is an event held in the Bundestag for members of parliament and representatives of the German government, whereby Fraunhofer experts provide information on relevant technological topics, make recommendations for political action and respond to questions on current affairs. The event was held six times in 2021 and 2022, mostly in online form due to the pandemic, with a focus on the following topics: Health research and research on the carbon-neutral transformation of industry (both 2021), the future of construction, cybersecurity, energy and resource sovereignty, and defense research (2022).

In 2022, Fraunhofer established a new event format. The lunch with Fraunhofer (Fraunhofer zum Lunch) event is aimed

The Fraunhofer-Gesellschaft  
at The Roofs festival  
in Munich, 2022  
Photos: Markus Jürgens/  
Fraunhofer





at employees of the Bundestag and the German government ministries. The goal of the sessions is to further promote networking between employees from the world of politics and Fraunhofer experts. In 2022, the event was held three times at the Fraunhofer Forum Berlin, focusing on digital mobility, digital health research and bioeconomy and receiving a positive response from the executive and legislative branches.

#### Involvement in political advisory committees

Fraunhofer participates in various committees that serve as advisors to the political world, providing the knowledge policymakers need as a basis for their decisions. In addition to Fraunhofer's continuous involvement in innovation policy committees, other noteworthy activities from the reporting period include its participation in the High-Tech Forum, the Innovation Dialogue advisory body, the German federal government's council on future issues (Zukunftsrat) and the German Advisory Council on Global Change (WBGU).

During the 19th legislative period, the High-Tech Forum served as the German federal government's central advisory body for implementing its Hightech Strategy 2025 (HTS 2025). It consisted of 21 specialists from the worlds of science, industry and society. The role of chair was shared by Christian Luft, State Secretary at the BMBF and Prof. Reimund Neugebauer, president of the Fraunhofer-Gesellschaft. The forum analyzed important issues relating to Germany's future viability as a hub for research and innovation, and offered advice on the formulation of a strategic structure for and the further development of the HTS 2025. In 2021, the High-Tech Forum produced a report summarizing all its advisory papers to date. This report was published on April 21, 2021 as part of a results conference held in hybrid format. There, Prof. Reimund Neugebauer, representing the advisory panel, handed over the final recommendations for a future innovation strategy to the German government — the recommendations were printed on synthetic DNA. The forum explicitly called for greater participation, courage and practical action when it comes to achieving the sustainability goals. It also emphasized the importance of reinforcing a mission-oriented approach to innovation policy with the aim of bringing more cutting-edge research results into application. Other recommendations included simplifying the process of founding a scientific start-up and creating more experimental spaces and effective avenues for citizen participation.

For more than ten years, Innovation Dialogue has served as a reliable, independent advisory board for the German federal government. In 2021, the Fraunhofer president participated in the preparation of dossiers on the resilience of supply chains and value creation networks and the journey from promoting technological cold frames to self-sustaining ecosystems. During the closing session of the 19th legislative period of the Bundestag in 2021, the round table provided advice on creating, bolstering and developing excellent ideas from research and

development into self-supporting, internationally competitive industry ecosystems.

Since 2022, the Fraunhofer-Gesellschaft has been represented on the Zukunftsrat, the committee succeeding the Innovation Dialogue body, by its President, Prof. Reimund Neugebauer. The Zukunftsrat, which is headed up by German Chancellor Olaf Scholz, serves as an independent, confidential, expert advisory body to the German government on issues relating to future innovation and research policy. Its goal is to leverage the potential of research and companies to strengthen Germany's position as an innovation hot spot and to complete the transformation to a social-ecological market economy in an optimal way.

The WBGU is an independent scientific advisory board that analyzes problems concerning global development and the environment and develops recommendations for action and research in this field. In 2020, the second Fraunhofer scientist was appointed to the advisory council — the first being Prof. Ina Schieferdecker, who, as director of the Fraunhofer FOKUS institute, was also a member of the WBGU until 2019. Prof. Anke Weidenkaff is a professor in the field of materials engineering and resource management at the TU Darmstadt and head of the Fraunhofer Institute for Materials Recycling and Resource Strategies IWKS.

Fraunhofer is also positioning itself within the relevant bodies and projects at an EU level to drive forward the green and digital transformation. By participating in European initiatives such as Hydrogen Europe Research (HER), Bio-based Industries Consortium (BIC), the European Energy Research Alliance (EERA) and the Solar PV Industry Alliance, Fraunhofer contributes to shaping the European research and innovation agenda as part of the European Green Deal and REPowerEU.

Fraunhofer has not made any input into current legislative processes. Furthermore, the Fraunhofer-Gesellschaft does not make donations, including to political parties.

#### International transfer

In order to rise to global challenges, we must combine forces within international networks. In order to gain insights from others and apply technological advances in an international context, it is important to transfer knowledge and technology across national borders.

Since 2018, Fraunhofer has been operating the secretariat of the international organization WAITRO (World Association of Industrial and Technological Research Organizations), as part of the WIN4S project funded by the BMBF. One of their core aims was to expand WAITRO into a global network of researchers



Researchers and industry representatives from across the world at the 2022 WAITRO Summit in South Africa  
Photos: Ignus Dreyer

that contribute to realizing the United Nations Sustainable Development Goals through demand-driven collaborations with industry. Another goal is to significantly advance the development of scientific structures in countries with emerging markets and developing countries. To this end, they are focusing on the following aspects:

- The digital open innovation platform SAIRA was developed with the support of the Fraunhofer Institute for Applied Information Technology FIT — through this platform, users worldwide that are active in research or work in the public or private sector can establish new partnerships based on their needs. This will break down existing barriers, especially when it comes to collaboration between the Global North and South, and establish sustainable development as a core element in the long term. One result of these efforts is the SMARTinFood project. The participating partners from Spain, Thailand, South Africa and Nigeria are working together to find solutions to combat nutrient deficiencies in particularly vulnerable regions.
- Expansion of the WAITRO network: The digitalization of the organizational infrastructure (e.g., member management, communications) allowed the network to expand to more than 150 organizations. Stakeholders in the private sector were also granted access to the network in order to promote the exploitation of research results.

- Additionally, efforts were made to drive the expansion of the programs and services offered by WAITRO: The digital transformation has made it possible to remove many barriers to availing of WAITRO's services. In 2021 and 2022, there were over 30 workshops held on the topics of sustainability and innovation; in addition to that, there were two innovation competitions and a virtual conference (with over 1,000 participants).

The 2022 WAITRO Summit in South Africa was a particular highlight — this event was conceived as an international information and networking event with a major focus on supporting UN SDGs. One particularly noteworthy result of the summit is the establishment of five new working groups, which each focus on one SDG (2, 3, 6, 7 and 17).



# Employees at Fraunhofer

**“Our success relies on the knowledge and enthusiasm of our employees for applied research. Fraunhofer offers its staff excellent work conditions paired with a high degree of autonomy.” (From the Fraunhofer-Gesellschaft’s guiding principles)**

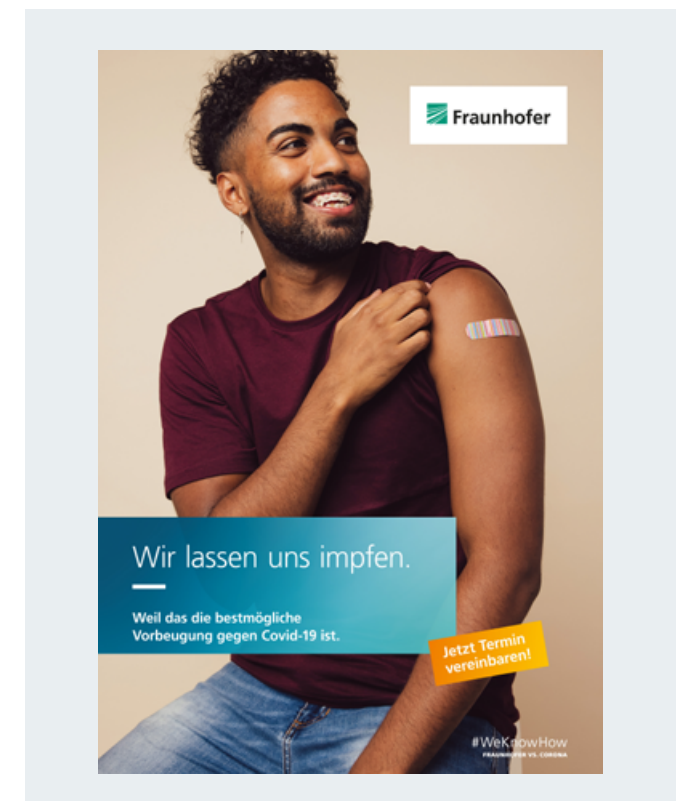
## The Fraunhofer-Gesellschaft as an employer

Due to global megatrends such as the digital transformation, Fraunhofer institutes must secure and increase their performance and innovation levels. In this context, the way that the institutes structure their working arrangements is crucial to determining their ability to adapt to changing circumstances. This also makes a decisive contribution to the organization’s innovative capacity, attractiveness as an employer and resilience, especially in difficult times (such as the COVID-19 pandemic). Thanks to Fraunhofer’s extensive measures to increase employer attractiveness and create correspondingly excellent working conditions, it is consistently placed on stern magazine’s annual top employers list. In January 2022, the Fraunhofer-Gesellschaft took sixth place in this list of the 50 best employers. Given the increasing competition for skilled employees, Fraunhofer’s attractiveness as an employer is particularly important, as are its efforts to actively protect this position.

## Dealing with coronavirus

The Fraunhofer-Gesellschaft maintained its responsible approach to its employees during the COVID-19 pandemic. As such, it implemented comprehensive protection and hygiene measures at the very start of the pandemic and enabled its employees to work from home. Moreover, in 2021, Fraunhofer collaborated with BAD, the company medical service, to implement a Fraunhofer-wide vaccination campaign, thereby ensuring the basic immunization of employees. In addition to this initial campaign, employees were offered booster vaccinations from December 2021 – a move that was well received by employees. In the end, the majority of vaccinations took place in January and February 2022. In taking this measure to protect

its own employees, the Fraunhofer-Gesellschaft demonstrated the value that it places on employee welfare and highlighted the excellent working conditions at the organization.



*Motif from the Fraunhofer-wide vaccination campaign for basic immunization of employees.*



## HR management

At the end of 2021, Fraunhofer had 30,028 employees, 21,640 of whom were research, technical or administrative staff (RTA staff), 7,877 were students and 511 were trainees. Due to the prohibition on offering different payment levels to holders of positions in the same salary category, we are obliged to apply the terms of the German Federal Collective Bargaining Agreement for the Public Service (Tarifvertrag für den öffentlichen Dienst, TVöD) in individual employment contracts. For management staff in the scientific field, we are authorized to apply pay scale W in accordance with the German Federal Pay Act (Bundesbesoldungsgesetz, BBesG) and state salary laws. Fraunhofer comes to agreements with trainees regarding the application of the rules of the TVAöD. Students are paid according to the collective bargaining rules of the German federal state and receive employment contracts. The employment and remuneration of interns at Fraunhofer is governed by the German Federal Government Guidelines on the Employment of Interns (Richtlinie des Bundes zur Beschäftigung von Praktikantinnen und Praktikanten, Praktikantenrichtlinie Bund).

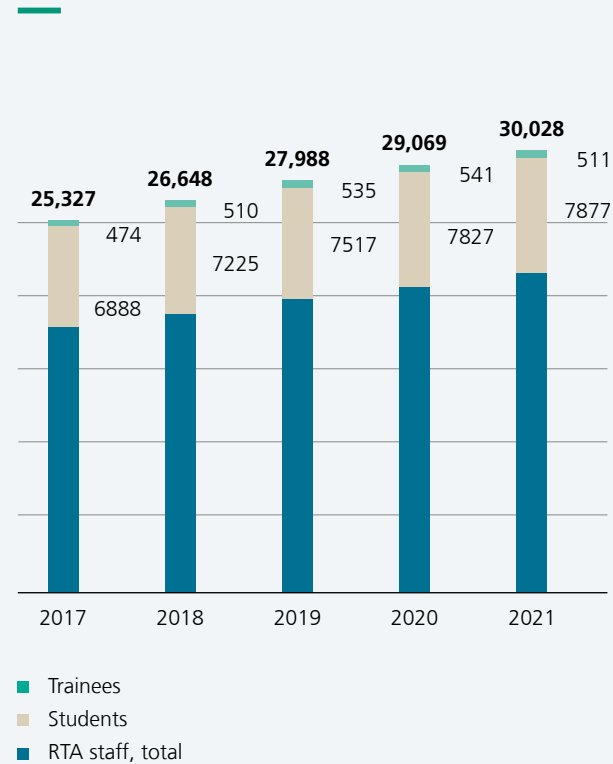
In addition, the Fraunhofer-Gesellschaft also employs third parties as consultants and service providers. The contracts for commissioning these services contain clauses on compliance with the Act Regulating a General Minimum Wage (Mindestlohngesetz, MiLoG) – compliance with these clauses is explicitly confirmed by contractors.

Through its strategic action areas, the HR Management division at Fraunhofer is bolstering the knowledge and enthusiasm of employees, as well as establishing and further developing the ideal working conditions to allow them to flourish.

The New Work@Fraunhofer initiative aims to create a flexible, collaborative and customer-oriented working and research environment for self-determining employees, thereby contributing strategically important added value. In particular, this relates to innovative strength, employer attractiveness and resilience of the organization. By the end of 2021, around 40 institutes (with an additional five in 2022) successfully integrated New Work into their respective organizational structures through a series of ten modules (TAKE OFF, SYSTEMATIZE and DEVELOP). The institutes concerned set different priorities, from establishing the conditions for flexible working hours and locations and introducing agile working methods to designing new workspace models that are adapted to new working routines. As it stands, a total of around 15,000 employees are directly or indirectly involved in New Work activities.

Team charter processes have proven to be a successful tool for implementing New Work. The team charter tool is used to ensure that managers and employees can reach an agreement on how they want to work together in the future. Around

**Employees**  
(number at year-end)



115 team charter workshops have now been held at various institutes, in most cases coinciding with the institute's revision of work council agreements on flexible working hours and locations.

The Fraunhofer-Gesellschaft continues to realize its overarching mission to transfer knowledge via individuals through its Careers with Fraunhofer program, which is based on a comprehensive HR development strategy aimed at supporting employees' individual career planning processes. The employee development meeting is and will remain the core element of individual career planning; at Fraunhofer, it is carried out in the form of a development meeting. Individual development planning processes are based on Fraunhofer's development and career paths (both internally and with regard to conventional next-step careers in industry, academia or self-employment), which are consolidated through defined qualification fields, topics and measures.

Thanks to the widespread introduction of a digitalized career planning tool, every Fraunhofer institute has had access to a standardized platform to support development planning since 2022. As such, development planning is a clear, traceable, criteria-based process; meanwhile, the electronic workflow

ensures that the individual process steps are carried out. At the same time, a learning management system was introduced to serve as a standardized learning platform, bundling all of the training resources available to Fraunhofer employees and making them more easily accessible.

Career programs for specific target groups promote the creation of networks across institutes: For top and senior management, there are the Vintage Class and Advanced Management Class programs; female scientists and female scientific managers have access to the TALENTA program, while young professionals can take part in the Step Forward program. A new development program designed as part of the implementation of the Doctorate with Fraunhofer code of conduct is available to the supervisors of employees pursuing their doctorate.

To evaluate these measures in the context of the overall HR development strategy, exit surveys are systematically conducted with departing employees, in order to collect data on various issues, such as the extent to which they felt they were supported in their development planning process.

## Diversity

The aim of diversity management is to create a working environment where every employee can participate on equal terms — irrespective of their ethnic origin, gender, religion, ideology, physical or other impairment, age or sexual identity.

In 2021, for example, the Equal opportunities support program was developed to assist institutes in implementing equal opportunity structures. This core component of this program is the topic-specific workshops provided for the institutes and Fraunhofer headquarters; these give inspiration and create opportunities for dialogue around best practices and peer-group networking in order to drive equal opportunities at the institute concerned. According to the participating institutes, the key added value of these events had to do with the recruitment of more female scientists, the further development of on-site recruiting processes and the implementation of measures by newly formed steering groups. Since 2013, TALENTA, a targeted and holistic support and development program, has been a keystone in Fraunhofer's efforts to promote equal opportunities in research and leadership. As of the end of 2021, there were 781 female scientists eligible for this comprehensive support, including career development and research time, and training and networking events; all these measures are aimed at helping them achieve career goals such as completing their doctorates, further developing their leadership skills or enhancing their scientific visibility at Fraunhofer. The program is subject to regular evaluation, whereby the impact of the program is investigated, along with its focus on the needs of scientists and institutes and, as a consequence of this,

its efforts to continuously adapt and develop its overall model. In 2021, 72 female scientists were accepted to the program.

At the end of 2021, the proportion of employees with severe disabilities was 2.6 percent (compared to 2.8 percent in 2020). The Fraunhofer-Gesellschaft aims to bolster its commitment to promoting inclusion and putting additional effort into recruiting, developing and retaining employees with disabilities. Since 2022, the Corporate Culture — Diversity section has been driving the development of an overall strategy for integrating inclusion into Fraunhofer's organizational culture and structures. That same year, Fraunhofer also joined forces with the Max Planck Society and other members of the Alliance of Science Organizations to develop a joint inclusion initiative. Their primary goal is to set an example for inclusion in research and increase the visibility of their commitment to inclusion on the occasion of the International Day of Persons with Disabilities 2023.

In 2021, the Fraunhofer-wide framework agreement with pme Familienservice covering services in emergency childcare, home and elder care, and life coaching was extended for a further two years. Also included here is the pme Academie, which includes webinars, e-learning courses and tips for living mindfully every day. The framework agreement was expanded in summer 2021 to include an unplanned support package for those affected by the German flooding disaster. This package



For years, the Fraunhofer Institute for Material Flow and Logistics IML, which works and conducts research across all fields of internal and external logistics, has been an active member of the Fraunhofer Sustainability Network for many years, playing a key role in shaping the New Work@Fraunhofer initiative. It is not surprising that the IML is also one of the first institutes to have implemented these concepts in its own day-to-day activities. The current works council agreement has laid out the new framework conditions for working at the IML from February 24, 2022. As part of this, the institute has implemented initial concrete measures in selected pilot areas, focusing on the following topics: Desk sharing, hybrid models, remote working options (particularly in conjunction with research infrastructure) and collaboration tools and formats to support agile working with customers.



provided, among other things, a special emergency hotline, income and budget counseling, emergency psychosocial support and a concierge service (home help, repair services, errands, etc.). The service was expanded in 2022 in view of the outbreak of war in Ukraine to include various additional measures in this time of crisis, including a conversation hotline and a crisis intervention service, in order to support employees and employee family members affected by the impact of the war.



## 18 institutes were awarded the Fraunhofer Family Logo over the 2019–2021 period.

Since 2019, the Fraunhofer-Gesellschaft has had its own seal of quality known as the Fraunhofer Family Logo, which is awarded to Fraunhofer institutes with outstanding work-life balance conditions. The re-certification process was originally scheduled for 2022, but was postponed until 2023 in light of the COVID-19 pandemic. In 2022, Fraunhofer carried out a reduced certification process that gave institutions the opportunity to access initial funding; meanwhile, those that have already received the award can continue to use their Family Logo until re-certification takes place in 2023. Between 2019 and the end of 2021, 18 institutes were awarded the Family Logo.

In the Fraunhofer-specific cascade model, Fraunhofer has set transparent goals for increasing the proportion of female scientists at its various organizational levels by 2025. At level 3 (scientific employees without management responsibilities), the target for the year was achieved with the proportion of women reaching 24.3 percent. The target was also reached at the management level with a figure of 16.8 percent. In contrast, despite a slight increase of 3 percentage points, the target of a 13 percent proportion of female employees at the top management level was not achieved.

The sourcing team established in 2020 is working toward the goal of recruiting more women for institute management positions. Since its founding, the team has identified more than 1,600 potential female candidates both nationally and internationally and has contacted more than 780 of them. Since 2020, the sourcing team has overseen 16 appointment procedures. Of these, six were successfully completed by the end of

2021, with the candidates that were actively approached obtaining a position. An additional six procedures were completed in 2022. Female candidates were appointed to three of the roles, two were filled by male candidates and one appointment procedure was terminated.

Fraunhofer is also striving to increase the proportion of women on the advisory boards at the institutes by 4 percentage points each year. The measures adopted by the Research Coordination department and the efforts being made on the institute side are having an impact: the target for 2021 was achieved, with the proportion of women in the institutes' advisory boards reaching 26.5 percent (2020: 22.3 percent).

Unconscious bias is an important topic in diversity management. The aim is to create a culture of equal opportunity and diversity. The Fraunhofer-Gesellschaft has developed a comprehensive strategy for employees and managers in order to raise awareness of the impact of unconscious bias and train them in how to approach it and reduce its negative impact on HR decisions and the sense of workplace unity. The strategy included a presentation module on lectures and training modules in management seminars and an e-learning course on making fairer decisions in everyday research, which was developed together with an external provider in 2021 and made available to all institutes in 2022. The digital training program has since supported employees and managers in taking a more conscious

approach to unconscious bias, helping them to adopt more diverse perspectives in decision-making situations.

The Fraunhofer funding program Diversity celebrated its ten year anniversary in fall 2021. The areas receiving funding were progressively expanded to include the topics of inclusion (2016) and intercultural collaboration (2019). By the end of 2021, the program had provided funding for 196 projects, amounting to a total volume of 1.8 million euros; the year 2021 saw 26 of these projects receive funding amounting to 182,000 euros. The institute-specific initiatives funded in 2021 include strategies for raising diversity awareness, particularly as regards unconscious bias, innovative accessibility measures for people with disabilities and virtual work-life balance services tailored to the challenges posed by the pandemic.

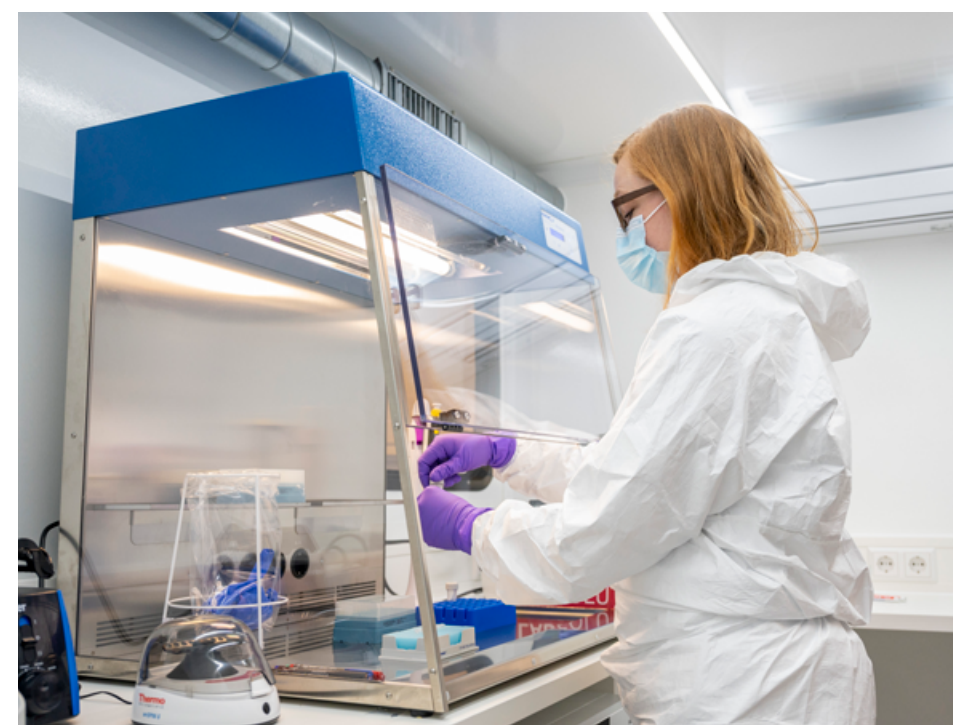
Equal opportunity principles form the foundation of the innovative strength of the Fraunhofer-Gesellschaft and represent an essential component of our overall organizational culture. As such, Fraunhofer welcomes and supports the EU Commission's promotion of equal opportunities in research and innovation. For example, Fraunhofer was able to introduce its Gender Equality Plan (GEP) in 2022 – a new funding criterion for research organizations that is mandatory for participation in the Horizon Europe program. The plan will be updated annually.

In addition to containing a voluntary commitment on the issue by the executive board, the GEP provides information on the state of gender distribution and gives an overview of targets, measures and programs for promoting equal career opportunities at Fraunhofer. In accordance with the stipulations of the EU Commission, Fraunhofer has published its voluntary commitment to promoting equal career opportunities on its website and the Gender Equality Plan on the intranet, where it can be accessed by all employees.

### Occupational health and safety

#### Number of occupational accidents

The number of accidents at the Fraunhofer-Gesellschaft has remained consistently low in recent years. In 2021, the number of reportable occupational accidents per 1,000 full-time employees at Fraunhofer stood at 1.82. This figure includes accidents where the injured party is killed or seriously injured to such an extent that they are unable to work for more than three days (cf. section 193, German Federal Code of Social Law (Sozialgesetzbuch, SGB) VII). According to statistics from the German Social Accident Insurance (DGUV), this puts the Fraunhofer-Gesellschaft well below the average figures for the industrial sectors in Germany (19.78) and the administrative professional association responsible for the Fraunhofer-Gesellschaft (13.76).



A Fraunhofer employee develops a virus test as part of the crowdfunding project 2detect by the Fraunhofer Institute for Molecular Biology and Applied Ecology IME. Photo: Fraunhofer IME



# Resources and procurement

The activities of a research organization in which more than 30,000 employees at over 100 locations work to earn an annual volume of around 3 billion euros in revenue go hand in hand with a corresponding demand for materials, equipment and energy. In order to minimize the ecological impact of our research activities, the responsible use of resources is a matter of central importance to Fraunhofer.

## Ecological responsibility in our scientific operations

In addition to developing sustainable research solutions and contributing to the overall transformation of society toward improved sustainability, resource efficiency and climate protection, Fraunhofer is also taking on the responsibility of restructuring its internal processes and infrastructure to make them more sustainable and, in particular, climate friendly. By combining technology development and its application in its own processes, Fraunhofer can continue to position itself as an authentic, relevant partner for industry, which, increasingly, is also both aiming and obliged to achieve its own environmental and climate goals. As we see it, the fact that our actions explicitly support the cause of global climate justice and seek to protect future generations' rights to an intact and livable environment means that they have a direct impact on human rights. What is more, we cannot identify any relevant impact on human rights, except in the area of sustainable construction and sustainable procurement.

### Climate strategy

Climate protection is a central topic at all decision-making levels of the Fraunhofer-Gesellschaft. Based on a greenhouse gas footprint recorded for the first time in 2020, scientists developed a roadmap that can be concretely implemented and which outlines dedicated measures for reducing greenhouse gas emissions. On the basis of this roadmap, Fraunhofer has set itself an ambitious climate protection goal: to reduce its greenhouse gas emissions and achieve climate-neutral scientific operations by as early as 2030. Any remaining emissions that still require offsetting after the target year must be almost entirely eliminated by 2045 at the latest.

## Measures for reducing greenhouse gas emissions

In order to reduce emissions, measures will be implemented across all of the scopes influencing our carbon footprint. With regards to scope 1 emissions, the focus is on reducing oil and gas consumption through energy renovation, efficiency measures, the replacement of fossil fuels with renewable energy and electrification. To this end, detailed renovation roadmaps are being developed for pilot properties, with consultation provided by engineering firms. In order to reduce scope 2 emissions, which arise primarily from the use of electrical energy, Fraunhofer is urgently pursuing three different approaches: First, energy efficiency measures will ensure a reduction in energy demand; second, there will be efforts to expand self-generated electricity supplies via photovoltaics; and third, the remaining energy demand will be covered by green electricity. Planned measures for reducing relevant scope 3 emissions – for instance, those caused by commuting and business travel, which account for around a quarter of the footprint – include the accelerated expansion of charging infrastructures, improved public transport services, regulations for mobile working and new guidelines for climate-friendly business travel.

### Integrating change within the organization: Climate Neutrality task force

Implementing an ambitious climate strategy requires integrating the strategy within the structure of the organization – to this end, a permanent Fraunhofer Climate Neutrality task force has been established. Along with the officers for climate neutrality and sustainability, who have been appointed by the respective institute management of each Fraunhofer institute, the task force includes a new Climate Management department at the Fraunhofer-Gesellschaft headquarters, which is





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Across Fraunhofer, the overall capacity of the photovoltaics systems that have been installed, are in construction or are planned for the future has reached 9 MWp.



The new photovoltaics system on the institute roof at Fraunhofer IDMT in Ilmenau  
Photo: Fraunhofer IDMT

responsible for the climate strategy and for coordinating measures. The department is supported by scientists from institutes with the relevant expertise, as well as a dedicated fund for the implementation of these measures. One of the department's tasks will be to allow the entire organization to harness the wide range of expertise available at the institutes. Moreover, the experience gained from measures that have already been implemented multiple times, from the use of industrial heat pumps to the application of innovative control technology and new storage media, will also be made available for the joint project.

### Energy

As an applied research organization, the Fraunhofer-Gesellschaft works closely with industry. Production systems often have high energy consumption levels – in particular, the cleanroom technology used at many sites and the operation of laboratories and cooling equipment. Along with gas and district heating, which is used to cover our heating requirements, our electricity consumption of just under 237 million kWh<sup>1</sup> a year (as per 2021 figures) is largely responsible for our carbon footprint.

### Self-generation of electricity via photovoltaics (PV)

One of the most important steps in reducing the emissions

associated with electricity consumption is to increase the amount of self-generated electricity. To this end, an internal PV financing program has been developed to promote the construction and expansion of Fraunhofer's own PV systems on the roofs of its properties since the beginning of 2021, with the electricity produced being almost exclusively for Fraunhofer's own consumption. As of the end of 2022, there are 43 photovoltaic systems with a total capacity of just under 9 MWp in planning or under construction at Fraunhofer – some have already been completed. Delivery bottlenecks for modules and inverters are currently delaying the connection of operational systems. However, a PV system with 542 modules and 200 kWp installed on the roof of the Fraunhofer Institute for Digital Media Technology IDMT in Ilmenau is most likely set to be connected to the grid in spring 2023.

### Adopting green power across Fraunhofer

Additionally, Fraunhofer has decided to procure clean electricity for the entire organization, beginning when the next framework agreement takes effect in 2023. Despite turbulent developments on the energy markets and the rising cost of electricity from late 2021, Fraunhofer has adhered to this decision, achieving a share of 100 percent green electricity. In the short term, guarantees of origin will continue to serve as the primary means of certifying green electricity use. In the

medium term, this step will be supplemented by additional, individual solutions and direct power supply contracts, which will have a concrete impact on the expansion of renewable energy capacities.

### Energy efficiency

Another important factor in achieving a higher level of climate protection is to ensure the efficient use of energy. Currently, energy audits are being conducted at all institutes, with engineering firms providing consultation in the form of specific recommendations for all sites. In order to build up process knowledge, energy efficiency and climate protection networks were established, following the example of the state-funded LEEN100plus networks. Aside from this, there are also preparations underway for the widespread introduction of energy management systems (EMS) in the Fraunhofer-Gesellschaft in accordance with ISO 50001. Some pilot institutes are on their way to achieving certification or have already done so.

### Impact of the war in Ukraine on energy supply

The suspension of gas supplies from Russia in 2022 as a result of the war in Ukraine has had a major impact on the institutes' energy supply situations. Possible bottlenecks in gas supply, combined with the recent proclamation of the second level of the gas emergency plan in July 2022 and declining natural gas supply volumes during summer 2022, gave cause for concern regarding both the general safeguarding of scientific operations and the viability of the research infrastructure – which is both extremely sensitive in terms of technology and highly expensive, and in many cases requires a steady supply of at least a basic amount of energy. All possible short-term energy-saving measures were explored at the institutes and, where possible, implemented directly – through this, Fraunhofer contributed to efforts to overcome the energy crisis for society as a whole.

### Mobility

#### Business travel

In terms of resource use, employee mobility, in particular business travel, naturally plays a major role in the Fraunhofer-Gesellschaft, as it does for most research organizations. The world of science is largely characterized by collaboration and (worldwide) dialogue, which requires physical, and in particular, international mobility by researchers. As such, the volume of air travel tends to be high. In 2020 and 2021, Fraunhofer employees' opportunities for business travel in Germany and abroad were severely limited by the pandemic. Numerous conferences, trade fairs and other events were canceled or,

where possible, replaced by online events. This meant that the volume of business travel, particularly by airplane, plummeted in 2020, with CO<sub>2</sub> emissions from business flights decreasing almost 90 percent compared to 2019, from 23,007 tons to 3,142 tons<sup>2</sup>. Emissions fell as low as 1,427 tons in 2021, but rose again significantly over the course of 2022.

The same is true for rail travel: In 2020 and 2021, the distance traveled by rail decreased sharply, declining from about 35.9 million passenger kilometers (pkm) in 2019 to just under 8 million pkm in 2020 and a mere 4.3 million pkm in 2021. As of 2022, many events and meetings can once again be held in person, and as such, the number of rail trips has seen a significant increase. In 2022, the figure stood at 18 million pkm, reaching almost 60 percent of the 2019 figure, i.e., the year before the pandemic broke out. According to the framework agreement arranged for Fraunhofer between the federal government and Deutsche Bahn, rail travel is carbon neutral and, as such, has no impact on the Fraunhofer-Gesellschaft's CO<sub>2</sub> emissions.

### Ensuring sustainable and environmentally friendly business travel

With the return to in-person events, the volume of business travel will continue to increase in the future. The volume of flights taken by Fraunhofer employees is expected to increase once more, primarily as a result of Fraunhofer's participation in international conferences. Nevertheless, Fraunhofer's stated objective is to reduce air travel to the necessary minimum and use more climate-friendly alternatives whenever possible, such



In 2016, the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP in Dresden became the first Fraunhofer institute to introduce certified energy management in accordance with ISO 50001. On the basis of this energy management, a total of 24 energy efficiency measures have since been developed and successfully implemented at the FEP. In total, almost 650,000 kWh of energy are saved each year.

<sup>1</sup> The electricity consumption figures relate to the volumes purchased under the Fraunhofer-wide framework agreement. This covers about 93 percent of total electricity consumption. Some of the institutes are located directly at university buildings and in some cases are closely linked to each other in projects, making it difficult to clearly define and record the exact use of electricity.

<sup>2</sup> To account for the overall impact that our flights have on the climate and the particularly pronounced greenhouse effect of emissions at high altitudes, we calculate total emissions using a Radiative Forcing Index (RFI) of 2.7.

as rail travel, for example. While some institutes already have specific guidelines for environmentally friendly and sustainable business travel, these guidelines have not yet been developed for the Fraunhofer-Gesellschaft as a whole. However, the Fraunhofer-Gesellschaft has already defined some general conditions and concrete recommendations for action to ensure that business travel is sustainable and environmentally friendly, particularly by reducing air travel.

**Offsetting air travel**

Since 2020, Fraunhofer has offset unavoidable airplane emissions for all of its institutes. In 2020 and 2021, emissions were offset via atmosfair compensation projects. Concretely, this involved providing support for a pioneering solar plant project in Senegal and a small biogas plant in Nepal. These projects facilitate secure, affordable, clean energy supplies in poor, decentralized regions, primarily for private households. There are plans to adopt a similar approach to offsetting flight emissions from 2022.

**Alternatives to business travel**

Whenever in-person contact is not required, telephone or video conferences represent a concrete alternative to business trips. Modern, user-friendly telecommunications equipment is available at the Fraunhofer institutes. The use of video conferencing systems and software has become a regular part of the working world, particularly due to the influence of the pandemic. Video conferences present an ideal alternative to business trips, which are usually time- and resource-intensive — this is especially true of information events and regular project meetings where the team members already know each other. In the future, virtual meetings will continue to play an important role in reducing the volume of business travel — a solution that will also have a positive effect on improving the work-life balance of Fraunhofer employees.

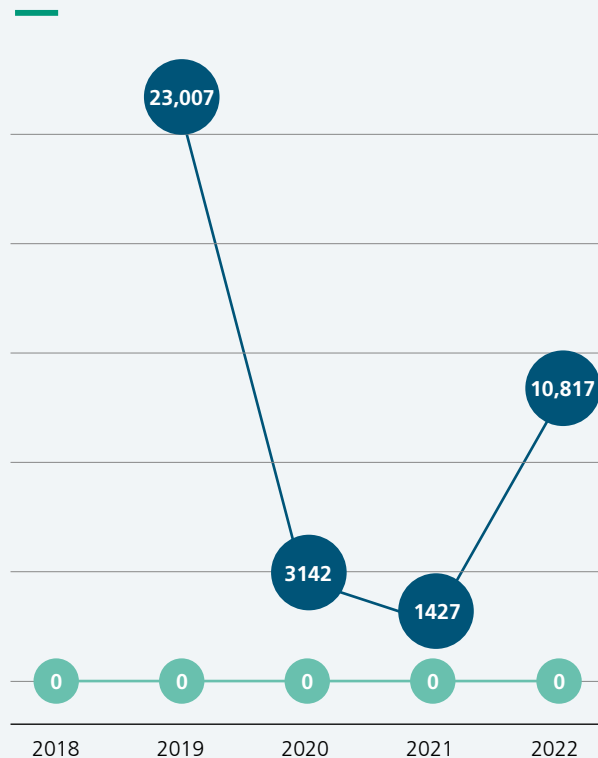
Business travel in Fraunhofer-owned cars accounts for only a small proportion of greenhouse gas emissions. Nevertheless, the use of passenger cars with alternative drive systems, in particular fully electric cars, will be promoted further in the future.

**Environmentally friendly commuting**

Organizations with large personnel volumes, such as the Fraunhofer-Gesellschaft, must consider employees' daily commutes when measuring their impact on the environment, especially in terms of greenhouse gas emissions. In summer 2020, for the first time, the Fraunhofer-Gesellschaft recorded the emissions

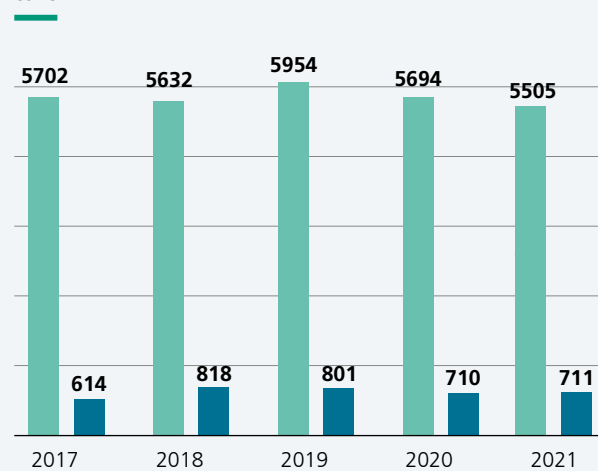
3 Since the decision to offset air travel in 2019, flight-related emissions have been calculated using the VDR standard with a Radiative Forcing Index (RFI) of 2.7 in order to take into account the total climate impact of flights taken by Fraunhofer employees. In the interests of transparency, these are reported accordingly. In previous reports, the lower values of CO<sub>2</sub> emissions were presented according to GRI/GHG.

**CO<sub>2</sub> emissions from business trips by Fraunhofer employees, in metric tons<sup>3</sup>**



- Flight emissions calculated according to the VDR standard + RFI 2.7 (recorded from 2019)
- Rail travel: Carbon-neutral due to inclusion in the framework agreement between the federal government and German

**Volume of waste produced by Fraunhofer institutes, in metric tons**



- Non-hazardous waste
- Hazardous waste

generated by commuting via an employee survey. In 2019, the figure stood at 0.65 t CO<sub>2</sub>e per employee and 18,382 t CO<sub>2</sub>e for the Fraunhofer-Gesellschaft as a whole. Due to the pandemic, many employees made use of the option to work from home from 2020 to 2022 – as such, it can be assumed that the commuting volume decreased significantly between 2020 and 2021. Although a survey on this topic is not planned until the beginning of 2023, feedback from the institutes and headquarters indicates that many people have taken advantage of the opportunity to work from home. Participants in the commuting survey also frequently cited a desire to work from home. In order to reduce emissions in the long term, it is important to reduce the commuting volume or avoid commuting altogether. By agreeing on flexible working models, the Fraunhofer-Gesellschaft can allow people to work from home and reduce some of the commuting volume, even after the pandemic. In addition, the Fraunhofer-Gesellschaft promotes the use of environmentally friendly means of transportation as much as it can, e.g., by providing sheltered, secure bicycle parking areas to ensure that their infrastructure is bicycle friendly, installing charging facilities for electric bicycles and providing employees with changing and showering facilities.

When asked about the use of environmentally friendly means of transportation, a large proportion of respondents (46 percent) said they would like to see improvements in local public transportation, including better connections, more regular service and fewer transfers, as well as financial support, for example in the form of special discounted travel passes for employees (JobTicket). This was not possible for Fraunhofer for a long time, as the organization receives public funding. However, thanks to a 2022 edict by the BMBF, Fraunhofer is now permitted to grant the subsidy to its employees. To put this authorization into practice, a central works council agreement on the JobTickets was concluded between the Fraunhofer-Gesellschaft and the central works council in 2022, thus laying out a framework for the granting of the subsidies.

**The LamA – Charging at Work project**

This is where another Fraunhofer climate protection project comes in: The research and infrastructure project LamA – Charging at Work, which is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi), was launched in 2018 with two key aims: establishing e-charging infrastructure and promoting research in this field. It formed part of the Immediate Action Program for Clean Air, which addresses districts with high levels of NO<sub>x</sub> pollution. By the end of 2022, the project had overseen the successful installation of nearly 500 charging points at a total of 38 Fraunhofer institutes. As of mid-2021, standard operations had already begun at just under half of the charging stations.

[lama.zone](https://lama.zone) (German only)

The charging infrastructure is available to different user groups depending on location; it can be used by Fraunhofer's own company vehicles, employees' private vehicles or third parties. As such, LamA is making an important overall contribution to climate-friendly mobility in Germany. From 2023, the model is set to be rolled out to locations that have not yet been included in the project, thereby further expanding the charging infrastructure at Fraunhofer.

**Waste generation**

The Fraunhofer institutes have appointed dedicated officers for managing operational waste and documenting this activity in waste registers and annual reports. Due to the nature of the organization, figures on the current volume of waste generated by the Fraunhofer-Gesellschaft as a whole can only be made available some time after the fact. According to the 2020 and 2021 figures, Fraunhofer institutes generated 5,694 and 5,505 tons of non-hazardous waste and 710 and 711 tons of hazardous waste respectively. The fluctuations in hazardous waste can largely be explained by the fact that some projects generate more waste than others, and the amount of waste



Fraunhofer employees regularly take part in the Stadtradeln (city cycling) campaign – a nationwide initiative to promote cycling in support of climate protection and quality of life, this includes colleagues at the Fraunhofer Institute for Reliability and Microintegration IZM. In September 2021, 55 Fraunhofer employees at the three Fraunhofer locations Berlin, Dresden and Cottbus swapped their cars or public transport for their bicycles and, as a team, covered a total of 16,181 km in 21 days. In addition to a very good 28<sup>th</sup> place in the overall ranking, the cyclists sent a clear signal for climate protection in daily life while doing something for their general health at the same time.

[s.fhg.de/cycling-against-climate-change](https://s.fhg.de/cycling-against-climate-change)



Photo: Fraunhofer IZM





*The newly constructed gold-certified building at Fraunhofer IWKS in Alzenau  
Photo: Rainer Taepper/  
Fraunhofer IWKS*

cannot always be controlled directly. Moreover, waste that is only generated occasionally or in small quantities is collected over the course of multiple years in order to reduce disposal effort and transportation costs.

### Sustainable construction

The Fraunhofer-Gesellschaft has long set out certain core measures for sustainable construction as a prerequisite for planning processes for buildings. The lifecycle approach ensures that an optimal ratio of investment and maintenance costs is achieved and that any leeway in the budget is put to appropriate use, all with a view towards economical, resource-efficient and reliable operations. It is common practice to involve users and operators in planning. Fraunhofer's wide-ranging leadership role in applied research allows it to apply innovative, market-ready technologies from the construction industry at an early stage and in a targeted manner. High demand for rapid, recurring adaptations to research buildings so as to suit changing usage requirements requires a flexible, long-term approach to designing floor plans and building structures. The physical qualities of workspaces have become a valuable tool for recruiting talent in the context of the increasingly intense competition to attract qualified, dedicated employees. The use of checklists guarantees that specific standards regarding New Work, occupational health and safety, accessibility and gender-sensitive construction are observed in the planning process.

### Ensuring higher standards with BNB certificates

Construction projects with costs exceeding 2 million euros must now be certified according to the criteria of the Assessment System for Sustainable Building (BNB), which guarantees, first, that the projects comply with all assessment criteria in terms of sustainability and, second, that their compliance with these criteria is comprehensibly documented such that it can be audited at a later stage. The higher standards serve to protect the global climate and reduce the various ways that construction sites pollute the environment, which also protects the health of company employees and local residents.

### Research buildings with special requirements

To fulfill its mission, in many cases, the Fraunhofer-Gesellschaft needs special buildings with laboratories, technical equipment, offices and conference rooms, often in close proximity to research, teaching and industrial facilities. This means that when it comes to providing research infrastructures, constructing new laboratories continues to be a key task. However, structural further development of existing campuses, renovations the extensive existing stock and increasing the use of existing buildings – the embodied energy – are constantly becoming more important. For this reason, conventional planning targets are being adapted to meet the demand for climate-neutral buildings and properties. The Fraunhofer-Gesellschaft intends to consciously steer this process and make it more accepted within society. The increased use of digital tools and incorporation of modern, agile organizational structures and participative working methods will also help reflect the dynamics of current developments, including in the construction planning process, and provide the project teams with meaningful support.

### Gold- and silver-certified new buildings

During the reporting period, two new buildings were completed and successfully received certification in accordance with the German federal government's guidelines for sustainable building. The Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS constructed two new institute buildings at its locations in Hanau and Alzenau, utilizing recyclable materials to a great extent. Both buildings were certified by the BNB in the Laboratory Buildings category, through a process that involves measuring specific requirements against a virtual reference building. This allows unique buildings to be objectively compared to one another in terms of their level of sustainability. The building in Hanau has a wide range of different functional specifications, and achieved excellent results that fulfilled the requirements for silver standard. Its sister building in Alzenau met the gold standard, making it only the second laboratory building in Germany to be given this distinction.

### Lightweight and eco-friendly construction

The Fraunhofer-Gesellschaft has constructed a number of other buildings with correspondingly high sustainability standards, even piloting pioneering technologies in some cases. One example is the new building at the Center for Light and Environmentally-Friendly Structures ZELUBA® at the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut, WKI. In collaboration with the Technische Universität Braunschweig, the researchers at this center are developing modular, hybrid construction systems using renewable building materials. The institute's own premises, a multistory building that contains both laboratories and facilities, was constructed using a combination of hybrid-timber building methods, under realistic conditions and in compliance with legal requirements. One specific challenge here was ensuring compliance with fire protection requirements and vibration standards while using a large proportion of renewable resources.

Whereas the Fraunhofer Principles of Cooperation previously ensured compliance with social standards, our Sustainability Standards for Suppliers (formulated internally in 2022) set out explicit requirements for our contractual partners to comply with social standards, particularly human rights.



At some Fraunhofer locations, the roofs of the buildings provide homes for bees: two bee colonies have been living on the roofs of the Fraunhofer headquarter in Munich since 2022, for example. With care provided by contracted beekeepers and some particularly insect-friendly rooftop foliage, this setup is making a small contribution to biodiversity and insect protection, and in the future, will provide around 40 kg of honey per year.



*Photo: Ludger Reuter/Fraunhofer*

### Sustainable procurement

Procurement processes at Fraunhofer are carried out partly on a centralized basis, and partly on a decentralized basis. For centralized procurement of products and services, all tenders for new framework agreements and projects created since 2016 have, wherever feasible, been tied to product- and service-specific social and environmental criteria. In 2022, a number of measures were put in place to drive the integration of sustainability criteria into procurement processes across the organization. All staff in the Corporate Procurement department were required to take part in a training course on the subject of sustainable procurement. The aim of this training was to provide the employees with basic knowledge on the topic and enable them to request that sustainability criteria are fulfilled in compliance with law when handling tenders.

In addition, the Sustainable Procurement guidelines were developed to help with the implementation of procurement processes that are legally compliant and take environmental and social considerations into account as a matter of priority. These guidelines were published internally by the executive vice president for Research Infrastructures and Digital Transformation as working instructions. They consist of further information and work documents including a list of positive and negative resolutions and sustainability criteria and instructions on integrating these into the documentation for calls for tenders, as well as other resources, examples of use cases and blocks of standard text.

Complying with criteria relating to human rights also plays a crucial role in Fraunhofer's procurement processes. In this context, the Sustainability Standards for Suppliers were also created in 2022. These standards contain requirements relating to human rights and the environment. Fraunhofer holds its direct suppliers to these standards and requires them to take appropriate measures to ensure compliance with the standards along their own supply chains. As of January 1, 2023, the sustainability standards are part of all Fraunhofer contracts. The measures described in the standards ensure that suppliers are selected with care, taking into account any environmental and social risks that may be associated with them.

Furthermore, in 2022, Fraunhofer successfully implemented an abstract risk analysis for its entire active supplier base for the first time. This first analysis indicated a very low supplier risk in Fraunhofer's supply chain. Fraunhofer achieved excellent results, particularly when compared to other participants in the market. The new LkSG has implemented additional duties of care, such as the adoption of a declaration of principles, adjustments to risk management processes, the establishment of a supplier management team and the expansion of the whistleblowing system. These measures ensure that procurement at Fraunhofer is carried out in a socially and environmentally responsible manner, on both a centralized and decentralized basis.



# Social commitment

For legal reasons, Fraunhofer cannot make non-profit donations at an institutional level. As such, Fraunhofer relies on other methods of social commitment beyond its actual business purpose. These include approaches such as providing extensive support for young scientists, special events and collaborations, and supporting Fraunhofer employees in their social commitments.



## Young scientists

For many years, Fraunhofer has been actively supporting the next generation of STEM scientists by getting children and young people interested in the fields of science, technology, engineering and mathematics (STEM). The Fraunhofer STEM programs start from as early as kindergarten and support children and young people throughout their entire education up to their university studies – with the goal always being to get young people excited about research and nurturing their talents. At each stage of the process, the participants are engaged with in a way that is precisely tailored to their age and level of knowledge.

Fraunhofer has developed various methods to do this, which have been used extensively for years. They include a creative competition for daycare centers and interactive workshops for young people with an interest in STEM as part of the Fraunhofer Talent School program for students in grades 9 to 12. In this program, Fraunhofer researchers show the young people how technical and scientific solutions are researched in practice. Then there is also the Talent Take Off study guidance program, which supports participants from high school through to successful studies in STEM subjects. At the start of the pandemic, the programs were moved online, allowing almost all of them to continue in this way. One exception was the Fraunhofer Accident Prevention School at Fraunhofer IVI, which was able to take place through in-person events at schools even during the pandemic. Overall, over 2,000 children and young people took part in the online and in-person events in 2021. Since fall 2022, all programs are once again taking place in person.

In addition, many Fraunhofer Institutes regularly participate in regional or national initiatives in Germany such as the annual Girls' Day and the Jugend forscht (young researchers) competition, e.g., through facilitating numerous regional competitions and providing funding on a nationwide basis for prizes in the areas of mathematics/computer science.

[jugend-forscht.de](https://jugend-forscht.de) (German only)

Some Fraunhofer Institutes, such as the Fraunhofer Institute for Integrated Systems and Device Technology IISB, have also created their own initiatives. In June 2022, Fraunhofer IISB helped with the Kristalle (crystals) project week at the Montessori School Herzogenaurach, which also laid the foundations for the planned collaboration between the institute and the school. As part of the project week, children in fourth and fifth grade at the Montessori School Herzogenaurach had the chance to learn more about the unique features of an important material – semiconductor crystals. These are not only used in the microchips in smartphones and computers, but also in LED lighting and electric cars. The students were able to play the role of researchers and – fitted out with white coats, protective glasses and gloves – grow their own alum crystals. Experts from Fraunhofer IISB were there to help them every step of the way.

[s.fhg.de/mint-projektwoche-kristalle-iisb](https://s.fhg.de/mint-projektwoche-kristalle-iisb) (German only)

Looking to another successful program, employees at the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS celebrated the 20-year anniversary of their Roberta® – Learning with Robots initiative in 2022. Since 2002, this



training program by Fraunhofer IAIS has been coaching teachers both within Germany and internationally. Certified Roberta teachers build and program exciting hardware with their pupils, helping them learn digital skills and the importance of creativity. Using this approach, the initiative has already trained more than 3,500 teachers and reached over 650,000 students.

The initiative also includes the Open Roberta programming platform, which now has over 10 million users worldwide. In 2022, artificial neuron networks were integrated into the platform for the first time to allow users to intuitively experience and understand AI algorithms using visual programming language. In addition to innovative robot construction systems, experiments and teaching materials for specific target groups, the initiative also includes support resources and further training aimed at encouraging students to improve their understanding of technology and boost their interest in STEM in the long term.

[roberta-home.de/](https://roberta-home.de/)



### Supporting Ukrainian refugees

As an internationally active research organization, we feel we have a responsibility to promote the acquisition of knowledge through open exchanging of ideas across national borders. A liberal democratic basic order is a non-negotiable requirement for this. Together with the Alliance of Science Organisations in Germany, we strongly support the German federal government's consistent action against Russia's military attack on Ukraine, which is contrary to international law. Fraunhofer therefore feels it has a responsibility to contribute toward this support. As far as possible, Fraunhofer is offering support on an individual basis to people seeking refuge. In collaboration with the Alexander von Humboldt Foundation, refugees are receiving access to employment opportunities at Fraunhofer.

[s.fhg.de/russia-ukraine-conflict](https://s.fhg.de/russia-ukraine-conflict)

### Fraunhofer Summer Camp

Every year, the Fraunhofer Science, Art and Design network holds a week-long summer camp. The camp is aimed at creative students that would like to work together with researchers from Fraunhofer institutes on topics of common interest. In an inspirational environment, the participants can engage in brainstorming and creative debates to open themselves up to other points of view and ways of thinking and ultimately create something totally new – something never seen before. The workshop structure not only promotes dialogue and brings science and art together, but also supports interdisciplinary

networking within the Fraunhofer-Gesellschaft and creates a breeding ground for developing new research questions and ideas.

The first summer camp in 2019 focused on housing development strategies for the Lusatia region that are viable for the future. The interdisciplinary teams worked together on site to tackle social, industrial and biological transformation processes in the former mining region, and created designs aimed at increasing the locals' quality of life and the area's attractiveness.

In 2022, students and Fraunhofer researchers engaged in creative debate in Kaiserslautern. The overarching theme was Future Living: High-Tech Meets Tradition. At the end of the week-long think tank, the participants presented their innovative use cases and prototypes. Two teams focused on the natural resource sandstone. They came up with a design for a minimally invasive water reservoir to reduce the increasingly common problem of soil aridity, and also created an architectural design for a sustainable, climate-friendly building, making use of the qualities of sandstone. The third team presented a flexible, interactive community building format for a former industrial site belonging to the company Pfaff. Their design used mobile containers that could be controlled using an app.

[s.fhg.de/summercamp-wkd](https://s.fhg.de/summercamp-wkd) (German only)

### Social engagement (by employees) at the institutes

Beyond their own work, many Fraunhofer employees are involved with social issues in their respective institute's locality. This includes taking part in fundraising campaigns, blood donation drives at the institute sites and initiatives such as open workshops for young people. The Fraunhofer institutes can support their employees in their social engagement by initiating or backing relevant campaigns and encouraging their employees' social endeavors by sharing information and creating campaigns at the institutes.

The specific regional connections that the institutes have allow them to support local campaigns and events in ways that are relevant to their research topics. For example, some very socially engaged employees at Fraunhofer IWES are involved with local climate meet-ups and industry development initiatives; they also support science communication programs such as the series of Science goes Public events in Bremerhaven, Fraunhofer IWES researchers have spoken at these events on hydrogen as an energy carrier and the sustainability of wind energy, as well as answering questions from the audience.

At Fraunhofer UMSICHT, socially engaged employees also contribute to sustainable development outside of their organization. One employee coordinates the working group Klimaneutrales Oberhausen (climate-neutral Oberhausen), for instance. This group aims to set up and support practical, feasible climate protection measures.

*Left: Students at the Montessori School Herzogenaurach take part in the Kristalle (crystals) project week  
Photo: Amelie Schardt/Fraunhofer IISB*

*Middle: Fraunhofer IAIS has integrated artificial neural networks into its Open Roberta programming platform for the first time.  
Photo: stock.adobe.com/Fraunhofer IAIS*

*Right: A Fraunhofer Summer Camp participant builds an architectural model.  
Photo: Fraunhofer IVI*

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<sup>1</sup> As part of their roles, employees of the Fraunhofer institutes and research units are often members of a variety of specialist associations and interest groups. When a Fraunhofer entity joins or becomes a member of an association, the legal department reviews the underlying documentation (e.g., statutes). If this review does not give rise to any issues, this department will confer authority to act on behalf of the executive board on the individuals that will exercise the Fraunhofer-Gesellschaft's membership rights.

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## Objectives and outlook

Fields of action	Targets/planned measures	Deadlines
<b>Governance</b>		
<b>Integration into the organizational structure</b>	Developing initiatives to promote a common understanding of corporate social responsibility (CSR) across Fraunhofer	2024
<b>CSR agenda</b>	Initiating specific CSR implementation projects and monitoring them for quality-assurance purposes	2025
<b>Cross-organizational dialogue</b>	Continuing peer learning with other research institutions as part of the LeNa process: The participants in the international LeNa Shape project exploring whether and how the principle of socially responsible research affects research processes and projects in terms of quality, impact and researchers' motivation.	2024
<b>Research and development</b>		
<b>Socially responsible research</b>	Introducing a Fraunhofer-wide support tool for project managers to enable independent, straightforward quality assurance in project management with a view to complying with good scientific practice and accounting for ethical implications	2024
<b>Discourse around challenges facing society</b>	Working to make science more open and developing events to allow for participation by members of the public	2025
<b>Transfer to industry</b>	Further expanding the AHEAD incubation program by linking it to sustainability targets and the transfer activities developed during AHEAD	Permanently ongoing
	Increasing the number of collaborative projects with SMEs	Permanently ongoing
<b>Transfer to society</b>	Continuing to increase the proportion of open-access publications in annual output to reach 75 percent	2025

Fields of action	Targets/planned measures	Deadlines
<b>employees</b>		
<b>Diversity</b>	Increasing the employment rate for employees with severe disabilities to 3.1 percent	2025
	Increasing the proportion of female scientists, particularly at the upper management levels (level 1: 20 percent; level 2: 25 percent)	2025
	Yearly proportion of at least 30 percent female scientists in Vintage Class internal program	Permanently ongoing
	Proportion of women on advisory boards at the institutes of 33 percent	2025
<b>HR management/ leadership</b>	Advancement of the HR development model for recruiting next-generation scientists through tailored training for careers at the Fraunhofer-Gesellschaft or otherwise (science, industry, self-employment) through to networking with alumni	Permanently ongoing
<b>Resources and procurement</b>		
<b>Energy procurement/ Energy management</b>	Commencement of organization-wide implementation of energy management systems in line with ISO 50001	2024
	Investments in internal photovoltaic systems for self-generated electricity amounting to at least 25 million euros	2024
	Implementation of renovation roadmaps	From 2023 Permanently ongoing
<b>Mobility</b>	Approval of Climate-Friendly Business Travel guidelines for the entire Fraunhofer-Gesellschaft	2023
	Further support for environmentally friendly commuting	Permanently ongoing
	Expansion of charging infrastructure to all institutes	Permanently ongoing
<b>Sustainable procurement</b>	Expansion of sustainable procurement management through implementation of the Sustainable Procurement guidelines, building expertise among all procurement personnel and providing technical support solutions.	Permanently ongoing

## Business development in 2021

With tremendous effort from everybody involved and the support of grant authorities, the Fraunhofer-Gesellschaft once again succeeded in overcoming the effects of the pandemic in 2021. The results for 2021 show subdued growth of 3 per cent, with a total business volume of around 2.9 billion euros. Contract research accounted for 86 percent of this sum (around 2.5 billion euros) and represents Fraunhofer's core activity. Around one third of the business volume stemmed from base funding provided by the German federal and state governments. Long-term research activities that fall outside of the scope of this regular base funding is allocated to the item Additional research funding, which amounted to 163 million euros. Major infrastructure capital expenditure amounted to 234 million euros.

### Shareholdings

At the reporting date, the Fraunhofer-Gesellschaft held equity investments in 84 companies across a broad range of sectors. Technology transfer to industry formed the focus of activities at 60 of the companies in the shareholding portfolio, while a

further 18 equity investments were of a strategic nature. Equity investments also include six affiliated companies. In 2021, the Fraunhofer-Gesellschaft invested a total of 2.5 million euros in the acquisition of equity interests in shareholdings. The Fraunhofer-Gesellschaft added three companies to its investment portfolio and divested its shares in five others.

### Spin-offs

The Fraunhofer Venture department typically provides support to researchers looking to found spin-offs as they prepare to launch their new business. In certain cases, Fraunhofer takes on a minority share in the spin-off under company law as part of its technology transfer activities. In 2021, Fraunhofer Venture provided support to 52 new spin-off projects; a total of 30 new spin-offs were established.

You can find further details on Fraunhofer's financial situation in our Annual Report for 2021.

[s.fhg.de/fraunhofer-jahresbericht-2021](https://s.fhg.de/fraunhofer-jahresbericht-2021)

### Key data: key data for 2021 (in € million)

	2020	2021		
<b>Total funding</b>	<b>2832</b>	<b>2915</b>	<b>+ 83</b>	<b>+ 3%</b>
Contract research	2398	2518	+ 120	+ 5%
Additional research funding	164	163	- 1	- 1%
Major infrastructure capital expenditure	270	234	- 36	- 13%
<b>Business volume by budget</b>	<b>2832</b>	<b>2915</b>	<b>+ 83</b>	<b>+ 3%</b>
Operating budget	2357	2445	+ 88	+ 4%
Capital expenditure <sup>1</sup>	475	470	- 5	- 1%
<b>Project revenue</b>	<b>1716</b>	<b>1858</b>	<b>+ 142</b>	<b>+ 8%</b>
Contract research	1553	1738	+ 185	+ 12%
of which industrial revenue	658	723	+ 65	+ 10%
of which public-sector revenue <sup>2</sup>	895	1015	+ 120	+ 13%
Additional research funding	76	73	- 3	- 4%
Major infrastructure capital expenditure	87	47	- 40	- 46%
<b>International project volume<sup>3</sup></b>	<b>276</b>	<b>287</b>	<b>+ 11</b>	<b>+ 4%</b>

<sup>1</sup> Current capital expenditure for contract research, additional research funding and major infrastructure projects.

<sup>2</sup> Comprises German federal and state government, EU and other revenue.

<sup>3</sup> Excludes license-fee revenue and revenue generated by independent international affiliates through business with third parties (2021: 27 million euros).

## Publishing notes

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