FRAUNHOFER
75 YEARS OF INNOVATION

Executive board's report

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The executive board

Prof. Holger Hanselka
President, Executive Vice President for Corporate Strategy, Research and Communications, Acting Executive Vice President for Innovation, Transfer and IP Management

Elisabeth Ewen
Executive Vice President for Human Resources, Corporate Culture and Legal Affairs

Holger Hanselka has been the 11th president of the Fraunhofer-Gesellschaft since 2023. Before that, he was president of the Karlsruhe Institute of Technology (KIT) for ten years and vice-president of the Helmholtz Association for the energy research field. A mechanical engineer by training, Hanselka was the head of the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt from 2001 until 2013 and was a member of the Fraunhofer presidential council for a time. He is active on various committees that advise the German chancellor on matters of science and research policy.

_____"Transferring scientific findings into applications, solutions, and products for and with German and European industry, especially medium-sized businesses, is what makes Fraunhofer essential. Through its strategic realignment, Fraunhofer is positioning itself for the future and creating guidelines for our future research activities."

Elisabeth Ewen is a fully qualified lawyer with an additional qualification in administrative and labor law. After graduating, she worked as a lawyer in the HR department of the German Aerospace Center (DLR) before she became director of human resources at GMD — Forschungszentrum Informationstechnik GmbH. She came to the Fraunhofer-Gesellschaft with the integration of GMD — Forschungszentrum Informationstechnik GmbH. She has held several management positions in human resources at the Fraunhofer-Gesellschaft, most recently as director of human resources. Ewen has been on the executive board of the Fraunhofer-Gesellschaft since August 2022.

_____"The development of our culture takes place through a participatory, forward-looking, and ongoing, lasting process. Fraunhofer is an attractive employer, and we need to communicate that to the applicant market credibly and authentically and ensure that it is something employees experience for themselves as well."

Prof. Axel Müller-Groeling
Executive Vice President for Research Infrastructures and Digital Transformation

Axel Müller-Groeling is a professor at Kiel University. The physicist and manager has conducted research at several renowned institutes and research organizations in Germany, France and Canada. He worked as a management consultant and was also a co-founder and executive vice president of an international, publicly listed photovoltaic group before becoming head of the Fraunhofer Institute for Silicon Technology ISIT in Itzehoe in 2016. He then also became director of the Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Duisburg. He has been on the executive board of the Fraunhofer-Gesellschaft since August 2022.

_____"Efficiency and performance are the common thread running through all the tasks we need to address together. Optimizing our business processes, advancing the digital transformation and AI, and the goal of achieving climate neutrality at Fraunhofer by 2030 remain some of our key challenges."

Dr. Sandra Krey
Executive Vice President for Finances and Controlling

Sandra Krey studied business administration and earned her doctorate at Friedrich-Alexander-Universität Erlangen-Nürnberg. She worked as an auditor at KPMG for several years before joining the MAN Group. She held various leadership positions in accounting and controlling there over a 20-year period. Most recently, she served starting in 2013 as Senior Vice President for Accounting & Finance Processes at MAN Truck & Bus SE and, at the same time, managing director of the MAN Shared Services Center in Poland. Krey has been on the executive board at the Fraunhofer-Gesellschaft since August 2022.

_____"Research is our founding objective. We ensure that our financial resources are spent where innovations emerge from ideas. Ensuring that the Fraunhofer budget is balanced — even with today's subdued economic environment, with costs on the rise and public funding in short supply — is my department's most important task right now."

Photos: Fraunhofer / Stefan Obermeier

2023 management report

Fraunhofer-Gesellschaft — key data for 2023 (in € million)

	2022	2023		Change
Total business volume	**3,049**	**3,404**	**+355**	**+12%**
Contract research	2,615	2,991	+376	+14%
Additional research funding	245	249	+4	+2%
Major infrastructure capital expenditure	189	164	–25	–13 %
Business volume by budget	**3,049**	**3,404**	**+355**	**+12%**
Operating budget	2,567	2,823	+256	+10%
Capital expenditure[1]	482	581	+99	+21%
Project revenue	**2,083**	**2,327**	**+244**	**+12%**
Contract research	1,907	2,167	+260	+14%
of which industrial revenue	787	836	+49	+6%
of which public-sector revenue[2]	1,120	1,331	+211	+19%
Additional research funding	145	139	–6	–4 %
Major infrastructure capital expenditure	31	21	–10	–32%

1 Capital expenditure for contract research, additional research funding and major infrastructure capital expenditure.

2 Comprises German federal and state government, EU and other revenue.

Transformation and operating environment

Profile of the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is one of the world's leading applied research organizations: Since its foundation in 1949, Fraunhofer institutes have been strengthening the competitiveness of business and innovation in Germany and Europe. Fraunhofer's comprehensive range of solutions for industry and policymakers has an impact across industries. The Fraunhofer-Gesellschaft is also a **key player in making Germany a center of innovation**: Its activities **increase the effects of investments in the economy** and **create jobs, while skilled workers earn qualifications** and **modern technology becomes more socially acceptable**.

In 2023, nearly 32,000 people, predominantly scientists and engineers, were employed across 76 institutes with an annual research budget of around €3.4 billion, €3.0 billion of which was designated as contract research. Fraunhofer generated around a third of this from industry contracts and license-fee revenue, totaling €836 million. Another third came from publicly funded research projects. The final share is base funding that is supplied by the German federal and state governments, enabling the Fraunhofer institutes to develop solutions now to problems that will drastically impact industry and society in the near future. Contract research is the most important business focus. Fraunhofer is a particularly important supplier of innovative know-how for small and medium-sized enterprises. The Fraunhofer-Gesellschaft also contributes to the success of key technology missions for society as a whole. For public-private partnerships, Fraunhofer is an attractive and established player. At an organization-wide level, Fraunhofer identifies innovative business units and trending technologies with major market potential and significant relevance to society and advances them through in-house research programs.

Each individual Fraunhofer institute and research institution develops its own business units and core areas of expertise on the basis of its immediate market environment and its links with the wider scientific community. Although the institutes operate as separate profit centers, they are not autonomous legal entities. The institutes also collaborate in research fabs and alliances to capitalize jointly on certain business units or sectors. Fraunhofer is currently finalizing a **portfolio coordination process** involving all organizational units within and between the Fraunhofer Groups.

Transformation process to strengthen the Fraunhofer mission

2023 marked the start of a **deep-seated process of transformation** as a **new presidency** got under way. The senate unanimously elected **Prof. Holger Hanselka** to serve as the new president in May 2023, and he took office in mid-August. He was previously the president of the Karlsruhe Institute of Technology (KIT), and up until 2013 had headed the Fraunhofer Institute for Structural Durability and System Reliability LBF.

As one of the world's leading applied research organizations, the Fraunhofer-Gesellschaft **plays a central role in research and transfer activity in Germany and Europe as a whole**. Fraunhofer's knowledge transfer activities mainly revolve around contract research with industry (largest share), exploitation of intellectual property (IP), spin-offs, and transfer via individuals.

The goal is for Fraunhofer to earn one-third of its budget directly with income from the industrial sector. **Its high proportion of industrial revenue makes Fraunhofer unique in the German research landscape**. Direct cooperation with business and industry takes on critical importance as a result, providing ongoing innovative drive and bolstering German and European competitiveness. Base funding reinforces Fraunhofer's scientific expertise, mitigates development risks and shortens time to market, thereby opening up new technological opportunities for companies. **All of Fraunhofer's activities are measured by their stable long-term operation within the Fraunhofer model**. Alongside strong industrial revenue and income from public funding programs, financial security on the part of grant authorities in the form of reliable inflation-adjusted base funding through the Pact for Research and Innovation is a crucial element of this. Going forward, a course of consolidation will be typical of the paradigm shift following a long growth phase. At the same time, Fraunhofer institutes should still have the opportunity to tap into new areas of need across industry and society with topics that fit Fraunhofer and build capability for these activities.

To enable the Fraunhofer-Gesellschaft to effectively fulfill its **business and market-driven mission** for the German innovation system both now and into the future, it is to continue to evolve based on the unique characteristics that already set it apart. Plans call for a rigorous focus on Fraunhofer's core competencies — applied research and the acceleration of transfers, especially in direct cooperation with industry — and building synergistic partnerships within the research landscape.

The process toward a Fraunhofer umbrella strategy for 2030 was launched at the start of 2024. The goal is to use participatory processes to identify the long-term plans and alignment of the Fraunhofer-Gesellschaft at the overarching organizational level. The aim of the umbrella strategy is to set out how the Fraunhofer-Gesellschaft uses its resources to achieve competitive advantages and ensure long-term success within the Fraunhofer model.

Other elements of the **transformation process** include the **further development of modern governance structures and systems** and **transparent compliance** as well as **designing organizational structures for greater efficiency and agility on the basis of a modern, open corporate culture**. These steps are geared toward creating a climate that fosters innovation by top researchers, along with establishing relationships of mutual trust with internal and external stakeholders. A number of different platforms for dialogue between the president and the executive board and various reference groups of employees were launched when Prof. Hanselka took office, in August 2023. The president traveled to multiple locations for **participatory dialogue** with institute directors, staff, and other stakeholders. These activities were accompanied by discussion events held by the executive board at seven institute locations that cut across different fields, institutes, and levels of the hierarchy. Interactive formats (in person and online from September 2023 to March 2024) with different groups of employees form the basis for the development of a **future vision of the Fraunhofer corporate culture**. There are thus multiple interlocking participatory formats pursuing the same goal of picking up on and consolidating ideas and impetus across the organization with the aim of ensuring a forward-looking Fraunhofer culture. In this way, these formats mark a symbolic starting point for the organization's collective evolution.

Science policy framework and positioning

Increased geopolitical and economic conflicts and the challenges posed by climate change influenced developments in 2023. In light of the challenging processes of transformation these trends have brought across business, industry and society, innovations like those Fraunhofer gets off the ground are critical. However, 2023 was also **a year of huge technological breakthroughs in fields such as as generative artificial intelligence (AI), and it brought key advances in digital policy**. Fraunhofer contributes its applied research perspective to the ongoing discourse around research policy to help improve overall conditions and make them more innovation-friendly and to accelerate and streamline the transfer of knowledge and technologies.

2023 marked a change of direction in German federal budget policy, which will also affect the financing of projects falling within the realm of research policy. The German federal budget for 2024 includes a return to **compliance with the debt brake** mechanism after the increased financial outlays made during the crises of the past few years, which will mean cuts in investment. This is especially true of the budgets of the German Federal Ministry of Health (BMG) and the Federal Ministry for Economic Affairs and Climate Action (BMWK). By contrast, the German Federal Ministry of Defence (BMVg) will see its budget increase, including funding for defense research. The budget for the German Federal Ministry of Education and Research (BMBF) is holding steady from last year, but it will involve reductions in external funding for quantum technologies, artificial intelligence, and life sciences in the research sector. **Despite these cuts, the base funding for non-university research organizations will remain stable**. The base funding allocated to the Fraunhofer-Gesellschaft from the German federal budget has been reduced only slightly compared to 2023. In all, Fraunhofer will receive some €940 million in base funding out of the federal budget. The German Federal Constitutional Court's decision on the financing of the Climate and Transformation Fund (CTF) is expected to bring cutbacks in funding for research and technology, including across various hydrogen applications and in the battery segment.

The objective of the German federal government's **Future Strategy** is to strengthen the German innovation ecosystem. The government has stressed the importance of supporting the transfer of innovative research findings into application. The Fraunhofer-Gesellschaft formulates science policy positions on the individual missions of the Future Strategy (circular economy, digital sovereignty, health and more) and incorporates them into the further process of crafting the strategy.

The **digital transformation** offers great competitive potential for Germany as a hub of innovation. Data plays a strategic role in this as a key resource for **data-driven innovation**. This makes simple and secure access to high-quality data without a lot of bureaucratic red tape a key prerequisite for Germany's position as a hub of research. The Fraunhofer-Gesellschaft has taken positions in various policy fields to ease access to data for research purposes. For example, Fraunhofer formulated **science policy positions on the German Mobility Data Act (Mobilitätsdatengesetz), Research Data Act (Forschungsdatengesetz),** and **Health Data Use Act (Gesundheitsdatennutzungsgesetz)** and contributed them as part of the legislative process.

The topic of generative AI moved to the forefront of science policy debate in 2023. Owing to the disruptive potential of generative AI and the fast pace of global developments in this field, rapid and coordinated action across the entire innovation system is needed. There is great potential for value creation in the area of business model development in particular, due to the existing expertise and wealth of industry-specific data on hand in Germany and Europe as a whole. The Fraunhofer-Gesellschaft has both the technological expertise and the long-standing experience in use case development to support this process. On that basis, **the German chancellor's Zukunftsrat (Future Council)** in 2023 gave the Fraunhofer president, together with SAP and the Max Planck Society, a mandate to serve as **sponsors for the topic of generative AI**. Under the auspices of acatech — National Academy of Science and Engineering and in close cooperation with the other topic sponsors, a dossier was created to highlight the challenges and opportunities associated with generative AI in Germany and identify recommended actions for the German federal government. These results were presented to the federal government at the meeting of the Future Council in January 2024. The Fraunhofer-Gesellschaft also participates in the policy debate surrounding generative AI at the state and federal levels and points out strategies that are open to innovation with an eye to empowering German business and industry to harness the potential of this new technology on a broad basis.

Fraunhofer was instrumental in the drafting of a dossier on the **circular economy** as part of the **Alliance for Transformation (German federal government's central dialogue platform)** in 2023, with a large number of institutes involved. The dossier focused on circular concepts for the construction and battery sectors, which are both key industries for the mobility and energy transition. Together, the drafters crafted suggestions for actions to take through cooperation between business and industry, the research sector, government, social partners, and civil society. The recommendations highlight ways that Germany could accelerate the establishment of a circular economy while at the same time reducing its dependence on imports of key raw materials. They were discussed with the federal government at the final meeting, which was held in January 2024.

The Alliance of Science Organizations in Germany worked in 2023 on relevant topics in innovation and research policy that reflect current issues of importance across the whole of society. Examples include the **German Academic Fixed-Term Contract Act (Wissenschaftszeitvertragsgesetz), Bureaucracy Relief Act (Bürokratieentlastungsgesetz), Energy Efficiency Act (Energieeffizienzgesetz), KRITIS Umbrella Act (KRITIS-Dachgesetz)** and **Lobbying Register Act (Lobbyregistergesetz)**. Within the Alliance of Science Organizations in Germany, the Fraunhofer-Gesellschaft actively contributed to drafting position statements and to association hearings and positioning on challenges in science policy.

International activities

The Fraunhofer-Gesellschaft's internationalization strategy aims to create scientific value within its own organization and to generate profitable effects for Germany and Europe as well as the respective partner country. Fraunhofer has developed various formats for generating excellent scientific content and collaborating with attractive international partners. The eight legally independent international Fraunhofer affiliates represent the most institutionalized form of such partnerships:

- Fraunhofer USA, Inc.
- Fraunhofer Austria Research GmbH
- Fraunhofer Italia Research Konsortial-GmbH
- Fraunhofer UK Research Ltd
- Fundación Fraunhofer Chile Research
- Associação Fraunhofer Portugal Research
- Stiftelsen Fraunhofer Chalmers Centrum för Industrimatematik (in Sweden)
- Fraunhofer Singapore Research Ltd.

The international affiliates act as legal entities for 11 research centers outside of Germany. These institutionalized Fraunhofer collaborations with local universities facilitate long-term research activities abroad. As their work is not profit-oriented, the international affiliates generally qualify for base funding from their country of domicile, and they are financed in a manner similar to the Fraunhofer funding model.

There has been a changing of the guard at **Fraunhofer Austria**, as Prof. Sebastian Schlund was appointed to succeed Prof. Wilfried Sihn as managing director. The Fraunhofer Austria Center für Data Driven Design (DDD), which has locations in Graz and Klagenfurt, also successfully passed an evaluation and audit in July. The audit is a prerequisite for the three-year continuation of the start-up financing provided by the Austrian state of Carinthia for the DDD office in Klagenfurt.

Prof. Raoul Klingner was appointed to serve as the new chairman of the board of directors of Fraunhofer USA.

An **application** to create a Spanish Fraunhofer foundation as a legal umbrella organization **for a Fraunhofer center in Barcelona** was filed in 2023. The official process of registering with the Spanish authorities is currently under way. The partner institute for the planned new center is the Fraunhofer Institute for Biomedical Engineering IBMT, which plans to begin working with the Institute for Bioengineering of Catalonia (IBEC) on an institutional basis in the area of applied theragnostics. Plans call for the necessary development and base funding for the new center to come 100 percent from Spanish sources.

Both **Fraunhofer Portugal** centers, the Center for Assistive Information and Communication Solutions AICOS and the Center for Advanced Water, Energy and Resource Management AWAM, underwent a **strategy audit** in October 2023. Results for both were positive, and a **continuation recommendation** for the coming funding period was issued to the grant authorities (Fundação para a Ciência e a Tecnologia FCT and the Fraunhofer-Gesellschaft).

As part of the **Fraunhofer Innovation Platforms (FIPs)**, Fraunhofer institutes cooperate with a foreign university or a non-university research institution on a certain area. The longer-term cooperation pursues joint applied research, joint projects for customers from industry, and participation in publicly funded projects. After two several-stage calls for tenders in 2023, there are now four FIPs in preparation, with plans to establish two in South Korea and one each in Taiwan and China in 2024.

The internal program **ICON (International Cooperation and Networking)** enables cooperation with excellent foreign scientific universities and non-university research institutions in

projects that typically last three years. Four new ICON projects were launched in 2023:

The Fraunhofer Institute for Solar Energy Systems ISE began collaborating in March 2023 with the University of Strathclyde, in the UK, on an ICON project titled **GreenCom — Green Optical Wireless Communications Facilitated by Photonic Power Harvesting**. The project aims to complement LiFi (Light Fidelity) optical wireless communication with photonic energy harvesting. The goal is to improve energy efficiency in communication networks to enable connectivity that is both ecofriendly and blazing fast.

The Fraunhofer Institute for Wind Energy Systems IWES is cooperating with France Energies Marines in a project titled **NEMO — New methods for turbulence measurements and models in offshore wind**. A new measurement and modelling methodology for the characterization of wind turbulence should enable a better evaluation of locations for offshore wind energy use.

Another ICON project, **Simplified Safety Assessment of Cobots with a Fast Contact Model (SafeCoM)**, was launched with Kyung Hee University (KHU), in South Korea, in October 2023. Its goal is to digitalize safety assessments (collision measurements) of collaborative robots (cobots) for applications in production and in the fields of machinery and healthcare. For model development purposes, AI is used to reproduce complex human biomechanics in detail to craft simulations as a quick and cost-effective (80 percent cost reduction) way to assess the risks of collisions involving cobots.

Tailored Powder Blends with Low Environmental Footprint for Sustainable Metal Additive Manufacturing — SUSMET, an ICON project of the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM and the University of Waterloo, in Canada, started in November 2023. The collaboration focuses on validation of water-atomized powder for industrially relevant additive manufacturing technologies. SUSMET addresses sustainability (availability of raw materials and carbon footprint) and cost efficiency (approximately one-tenth of present-day powder costs) as well as the digital transformation through sintering simulations.

The **Fraunhofer International Mobility Program (FIM)** promotes international mobility and networking by arranging stays abroad for Fraunhofer employees from all areas of the institute. These stays, which can last several months, encourage the exchange of knowledge. A new call for applications for the program was issued in the spring of 2023. Eleven grants for stays starting from the fourth quarter of 2023 were approved. Innovative countries in northern Europe (France, Sweden, Norway), the United States, and Australia saw the highest demand. Another round of applications ran until the end of October 2023, this time for stays starting from mid-2024.

International Fraunhofer representative offices in China, Brazil, India, Japan and Korea function as hubs for networking and marketing. They provide local support for all Fraunhofer institutes in initiating and setting up cooperations with research partners from their respective countries. The representative offices provide the Fraunhofer research portfolio with crucial impetus thanks to their knowledge of the respective regional and local research landscape.

The objective of **PACT — Program for Affiliate Cooperation and Knowledge Transfer** and the associated R&D projects, commercialization measures, and initiatives is to create added value for the entire Fraunhofer network by increasing collaboration between the foreign Fraunhofer affiliates and Fraunhofer institutes. In all, 20 PACT projects were launched in 2023, involving 6 foreign Fraunhofer affiliates, 9 centers, and 18 Fraunhofer institutes.

In the **Cultured Meat** PACT project, the Fraunhofer Institute for Molecular Biology and Applied Ecology IME is working with the Fraunhofer USA Center for Manufacturing Innovation CMI over 18 months to transform meat production from an agricultural practice to biotechnological methods using cell cultures. The objective is to produce cultured meat by adjusting existing techniques for cultured animal cells for large-scale use in the food industry.

The **KI4Med — Künstliche Intelligenz in der Medizinischen Bildgebung** (AI4Med — Artificial Intelligence in Medical Imaging) PACT project, which involves the Fraunhofer Austria Center for Data Driven Design (DDD) and the Fraunhofer Institute for Production Technology IPT, aims to develop a medical diagnostic solution based on AI. The objective of the new system is to generate high-resolution contactless and non-invasive tomographic images of tissue and identify changes in the layers of tissue.

The Fraunhofer Institute for Industrial Mathematics ITWM and the Fraunhofer-Chalmers Centre for Industrial Mathematics FCC are working together on a PACT project titled **Efficient Particle Simulation — EFF-PART-SIM** with the aim of simulating the work of agricultural machines on rough and discrete surfaces. The main application lies in the commercial vehicle segment, particularly involving agricultural and construction vehicles.

Fraunhofer international

Business report

Total business volume

In business terms, 2023 was a successful year for Fraunhofer. The total business volume amounted to €3.4 billion, having increased by a substantial 12 percent compared with the previous year. Contract research accounted for 88 percent of this sum (€3.0 billion) and represents the organization's core activity. Around one-third of contract research funding is provided by base funding from the German federal and state governments. Research with long-term funding that falls outside the scope of this regular base funding is allocated to a new item, additional research funding, which amounted to €249 million in the reporting period. Major infrastructure capital expenditure amounted to €164 million. These three segments will be discussed in greater detail in the following sections.
See p. 16, chart titled "Fraunhofer total business volume"

Business volume is based on the performance statement, which meets the requirements of the grant authorities. In the operating budget, personnel and non-personnel expenses are recognized according to general accounting practice along with the change in the extraordinary item "License-fee revenue reserve for statutory purposes." As capital expenditure is recognized at the amount incurred at the time of purchase, depreciation, amortization and impairment losses are not included in the performance statement. In 2023, Fraunhofer's capital expenditure amounted to €581 million overall, a 17 percent share of the total business volume. Personnel expenses increased by 9 percent to €1,920 million. This is due primarily to a 5 percent increase in permanent staff and to one-time payments to compensate for inflation as part of the collective agreement reached in 2023. At €921 million, non-personnel expenses were 13 percent higher than in the previous year, owing to factors including higher energy and material prices and an increase in externally financed project volume. The reserve was used during 2023 to cover liquidity requirements. €18 million net was released to provide funds to establish high-performance centers, to equip Fraunhofer institutes with solar photovoltaic systems and to fund strategically important formats aimed to promote the acquisition of shareholdings.
See p. 16, chart titled "2023: Total business volume by budget"

Contract research

Contract research is the mainstay of Fraunhofer's business activities and, in line with the Fraunhofer funding model, consists of three core areas, each contributing equal amounts to the organization's finances:

- Research directly contracted by industry
- Publicly funded research projects
- Pre-competitive research financed through base funding

In 2023, the base funding requirement increased by 16 percent to €824 million. Base funding is provided by the German Federal Ministry of Education and Research (BMBF) and the state governments at a ratio of 90:10. **Industrial revenue** rose by 6 percent to a new high of €836 million. While revenue from contracts with industry increased by 8 percent to €679 million, license-fee revenue from industry stood at €157 million, slightly below the high level seen in the previous year.
See p. 16, chart titled "Revenue from contract research"

Revenue from publicly funded projects increased significantly again in 2023. Project funding from the German federal government, in particular, jumped by 21 percent to €802 million. Within this, the revenue of the BMBF increased by 18 percent to €406 million, the funding of the Federal Ministry for Economic Affairs and Climate Action (BMWK) by 15 percent to €267 million and the revenue of the other federal ministries by 54 percent to €129 million. Project funding provided by the German state governments decreased by 5 percent to €232 million after a sharp increase in preceding years. There was a significant rise in EU revenue, which was up 28 percent to stand at €114 million. Other revenue increased by 46 percent to €183 million and includes funding granted by foundations, universities and other research-funding institutions. In 2023, this figure also includes €19 million in reimbursements under the German Energy Price Brake Act (Energiepreisbremsengesetze) and an extraordinary insurance claim payment of €13 million for the Fraunhofer Institute for Technological Trend Analysis INT based on the flooding in 2021.
See p. 16, chart titled "2023: Revenue from publicly funded projects"

In addition to being one of the Fraunhofer institutes' criteria for success, the high **share of funding coming from external project revenue** is a unique selling point for the Fraunhofer-Gesellschaft. The project funding share therefore serves both as a key performance indicator and as a barometer for establishing an optimal funding mix in contract research. It is calculated as the share of project revenue in the operating budget, including imputed depreciation of capital assets (excluding project groups and special effects on the balance sheet regarding reserves and provisions). Due to the significant increase in revenue from publicly funded projects, the project

funding share rose again to 76.4 percent in 2023. The share of funding provided by the German federal and state governments increased to 36.3 percent. At 29.7 percent, the share of industrial revenue was at the same level year over year.
See p. 17, chart titled "Funding share"

Additional research funding

Additional research funding covers research activities with long-term funding outside the scope of regular base funding.

In addition to defense-related research, the National Research Center for Applied Cybersecurity ATHENE and the Fraunhofer Research Institution for Battery Cell Production FFB fall under additional research funding.

ATHENE is operated jointly by the Fraunhofer Institutes for Secure Information Technology SIT and Computer Graphics Research IGD in collaboration with Technical University of Darmstadt and Darmstadt University of Applied Sciences. Its research focuses on the protection of critical infrastructures such as power and transportation and the safeguarding of IT systems. The center applies an interdisciplinary approach, combining IT and engineering with legal and economic issues, psychology and ethics. ATHENE is funded by the BMBF and the federal state of Hesse in a ratio of 70:30 and recorded a budget of €24 million in 2023.

With expenses of €84 million, the development of the **FFB** continued to gain momentum in 2023. The BMBF is providing a total of €500 million in funding for this large-scale initiative through project finance. The state of North Rhine-Westphalia is providing an additional €200 million for the construction of a building to house the new facility in Münster. The FFB is to become the center for developing modern and scalable battery cell production for Germany and Europe.

In the field of **defense research**, Fraunhofer has pooled the research and development (R&D) activities of seven institutes that receive base funding and ongoing project funding from the German Federal Ministry of Defence (BMVg). The objective of these R&D activities is to provide people, infrastructures and the environment with the best possible protection against potential security threats resulting from natural disasters or military, technological, terrorist or criminal activity. Defense research expenses remained at the previous year's level of €141 million in 2023. A small increase of €4 million in the base funding provided by the BMVg brought the total to €87 million, while project funding from the same ministry decreased by €5 million to €54 million.
See p. 17, chart titled "Additional research funding"

Major infrastructure capital expenditure

Major infrastructure capital expenditure comprises building projects and the purchase of scientific instruments and furniture to equip new facilities. At €164 million, investments in **construction and equipping of new facilities** were 13 percent lower than in the previous year, as external influences continued to have a delaying effect on the outflow of spending for construction activities. This includes, in particular, fixed periods from the European Regional Development Fund (ERDF) and increased requirements for funded construction. The amount spent on building projects decreased by €19 million to €133 million, of which €98 million related to major and €35 million to minor building projects. Investments in equipping of new facilities decreased by €6 million to €31 million.

Special funding for major building projects and the equipping of new facilities is provided by the federal and state governments in a ratio of 50:50. The state governments often provide additional funding from the European Regional Development Fund (ERDF), which reduces the funding required from federal and state governments by an equivalent amount. Minor building projects are financed from joint base funding in a ratio of 90:10. The funding required from the German federal and state governments totaled €143 million. ERDF funds from the German state governments and other revenue accounted for €21 million of project revenue.
See p. 17, chart titled "Major infrastructure capital expenditure"

Financial and net asset position

At December 31, 2023, the Fraunhofer-Gesellschaft had total assets of €4,855 million, up €239 million or 5 percent when compared to the previous year. Assets presented in the ordinary accounts comprised 99.7 percent of total assets, with non-profit organization capital accounting for the remaining 0.3 percent.

Noncurrent assets accounted for 62 percent of assets and were €216 million higher at €2,997 million. This increase was chiefly attributable to the fact that capital expenditure on property, plant and equipment exceeded depreciation of those assets. Property, plant and equipment grew by €195 million to €2,919 million. In addition, shareholdings financed out of reserves were reclassified from current assets to noncurrent assets at the residual carrying amount of €14.5 million at January 1, 2023.

Current assets accounted for 37 percent of assets and were €3 million lower at €1,802 million. Receivables from the German federal and state governments relating to base funding increased by €346 million to €374 million, including

receivables for funding approved during this financial year. Their over-year nature is ensured by the budgetary instrument of Selbstbewirtschaftungsmittel (SBM – resources managed independently). As a result, SBM in the amount of €345,000,000 from the German Federal Ministry of Education and Research (BMBF) and €13,503,000 from the German Federal Ministry of Defence (BMVg) are included (SBM were recognized in cash and cash equivalents the previous year). Receivables from the German federal government and the German state governments from project billing (including contracts) increased by €20 million to €355 million. Receivables from affiliated companies decreased by €7 million to €0.4 million. Cash and cash equivalents (including bank account balances) decreased by €275 million to €18 million. The value of the securities portfolio was €53 million lower, at €459 million. Of this, €372 million stemmed from license-fee revenue reserve, €17 million corresponded to the extraordinary item "For financing restructuring measures" and €70 million was from a patent sale.

Equity — which comprises the non-profit organization capital that is not financed by government grants (€15.6 million) and the reserve for statutory purposes (€11,225) — increased by a marginal amount. Economic equity also includes four kinds of extraordinary items recognized in the balance sheet: The extraordinary item "Grants relating to noncurrent assets" was €216 million higher at €2,986 million. The extraordinary item "License-fee revenue reserve for statutory purposes" decreased by €32 million to €372 million. The "Extraordinary item for payments from patent sales" was €103 million. This item is matched by other receivables and securities of an equivalent amount on the assets side of the balance sheet.

An extraordinary item of €17 million was entered for the necessary restructuring of cleanroom infrastructure. This item is matched by securities of an equivalent amount on the assets side of the balance sheet. Use of these funds is tied to a restructuring plan and contributes to the development of the main sites of Fraunhofer institutes and their secondary locations. The aim is to reduce fixed costs while also enhancing collaboration and the quality of services. €4.3 million was used for this purpose during this financial year.

The extraordinary item "Grants used to finance current assets" is not included in financial equity and is used to account for income not yet received, less expenses not yet paid, by the reporting date. This essentially corresponds to advance project funding and amounted to €320 million at the reporting date.

Provisions increased by €34 million to €277 million, €40 million of which was accounted for by provisions with maturities of more than one year. In the case of pension and compensated leave provisions, a corresponding amount of receivables from the German federal and state governments totaling

€109 million was entered on the assets side of the balance sheet.

Liabilities rose by €106 million to €756 million. In addition to an increase of €77 million in unappropriated grants from federal and state governments from base funding and project billing, trade payables, liabilities from affiliated companies and other liabilities also rose by a total of €29 million.

As a beneficiary of public funds, the Fraunhofer-Gesellschaft is subject to budgetary constraints that prohibit it from making use of the capital markets or of lines of credit with banks. Nevertheless, the organization's liquidity is guaranteed at all times, as it can regularly call on cash payments from its grant authorities under base funding arrangements and can use its reserves as needed. The Fraunhofer funding model stood up to the test in times of crisis and is built on a solid foundation.

The **Fraunhofer-Zukunftsstiftung (Fraunhofer Future Foundation)**, established in 2008, is a legally independent institution that supports technology-oriented research projects at the Fraunhofer institutes as per the Statutes. The foundation added €3.7 million in all to the spending capital in 2023. These additions result from donation income, proportionate returns from successful foundation projects, repayable grants, and revenue from asset management. The Fraunhofer Future Foundation provided €6.8 million in funding for projects at Fraunhofer institutes in 2023. This reduced the spending capital from €91.5 million to €88.4 million.

Shareholdings and spin-offs

At the reporting date, the Fraunhofer-Gesellschaft held equity investments in a total of **83 companies** operating in a diverse range of sectors. The **transfer of technology** to industry formed the focus of activities at 53 of the companies in the investment portfolio, while a further 24 equity investments were of a strategic nature. Equity investments also include 6 affiliated companies. In 2023, the Fraunhofer-Gesellschaft invested a total of €7.1 million in the acquisition of equity interests in shareholdings and divested its shares in 6 companies. The Fraunhofer-Gesellschaft added one company to its investment portfolio. Furthermore, 6 others that had previously been held as current marketable securities were reclassified to noncurrent assets. The total carrying amount of shareholdings (including shares in affiliated companies) increased to €31.5 million (previous year: €9.2 million). The significant increase in the carrying amount was driven primarily by the reclassification of the 6 companies from current assets, as their carrying amount at the end of 2023 was €21.8 million. Income from the divestiture of shareholdings came to €7.1 million.

Spin-offs are an integral part of Fraunhofer's strategy for exploiting its industrial property rights. The Fraunhofer Venture department generally supports spin-off founders as they prepare to launch their new business. In individual cases, Fraunhofer takes a minority share in the spin-off under company law as part of its technology transfer activities. In 2023, Fraunhofer Venture provided support to 71 new spin-off projects; 23 new spin-offs were established. Fraunhofer has set itself the goal of increasing not only the number of spin-offs but also their proportional contribution to overall industrial revenue. Fraunhofer's innovation hub AHEAD offers a package of targeted measures and programs to help achieve this.

Exploitation of intellectual property rights

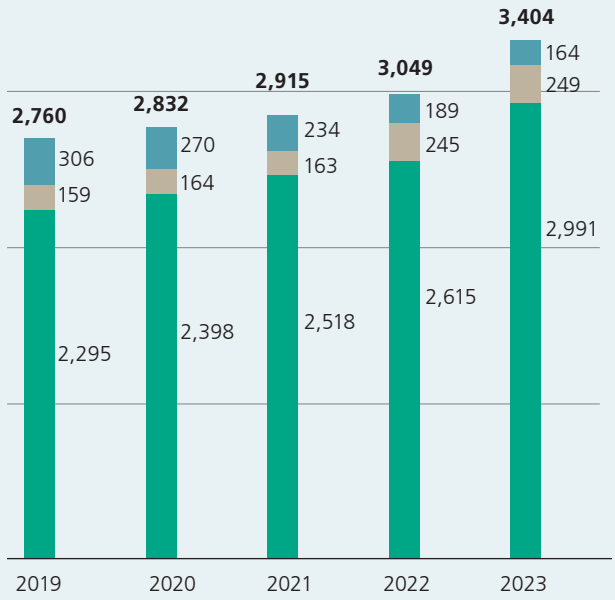
The Fraunhofer-Gesellschaft remains the leader among German research institutions in terms of its annual number of invention disclosures and new patent applications. After the decrease seen in the previous two years, the number of invention disclosures rose again in 2023 to stand at **506 inventions**. The number of **patent applications claiming rights of priority** was also up year over year, at **406**. The lower number of new applications in 2021 and 2022 is having a delayed effect on IP inventory. The Fraunhofer portfolio of active patent families, each of which comprises all intellectual property rights in different countries, decreased year on year to stand at 7,068. General price increases have also caused the institutes to focus even more on the cost aspect of intellectual property rights, so they are clearing their portfolios of older IP rights in some cases. The general strategy of the Fraunhofer institutes remains to secure only valuable inventions permanently under patent law. To guarantee ongoing exploitation of intellectual property rights, Fraunhofer is continuing its efforts to group patents into portfolios that are then offered to selected companies, licensed or, in some cases, sold.

See p. 17, chart titled "Patent applications claiming rights of priority"

As a rule, Fraunhofer generates revenue from the **commercial exploitation of intellectual property (IP) rights** by way of license fees. In addition, IP can also be contributed to patent pools or exploited through the sale of IP. The most successful of these pools consist of patents for audio and video encoding. In conjunction with other parties from different countries that hold patents that are relevant to standards, Fraunhofer uses various patent pools to issue licenses on a worldwide basis. The income from these pools is reinvested in pre-competitive research, thus helping strengthen Germany's position as a research hub for the long term. In 2023, Fraunhofer concluded 212 new IP licensing or sale agreements, bringing the total number of active agreements at the end of 2023 to 2,989. Revenue from the licensing and sale of IP amounted to approximately €158 million.

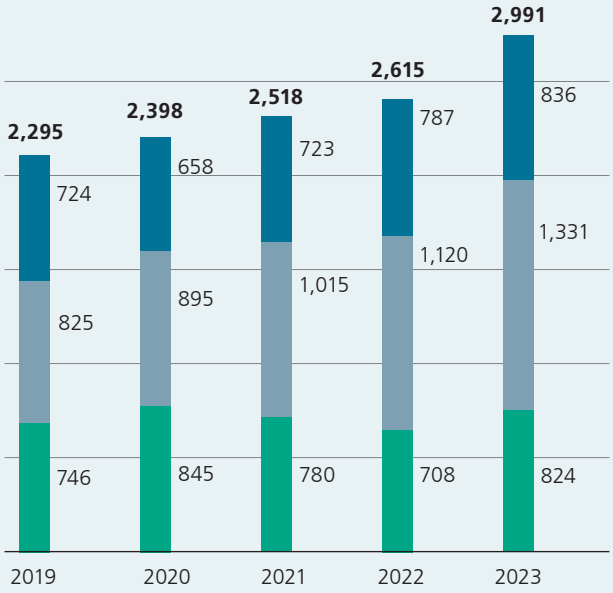
Facts and figures

Fraunhofer total business volume in € million



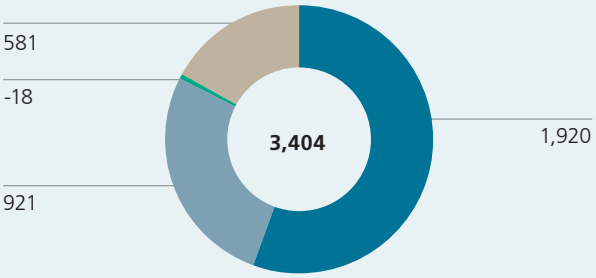
- Major infrastructure capital expenditure
- Additional research funding
- Contract research

Revenue from contract research in € million



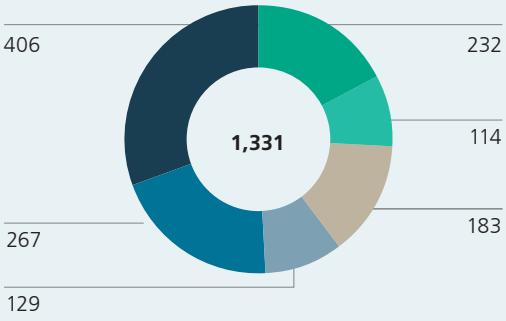
- Industrial revenue
- Revenue from publicly-funded projects
- Base funding

2023: Total business volume by budget in € million



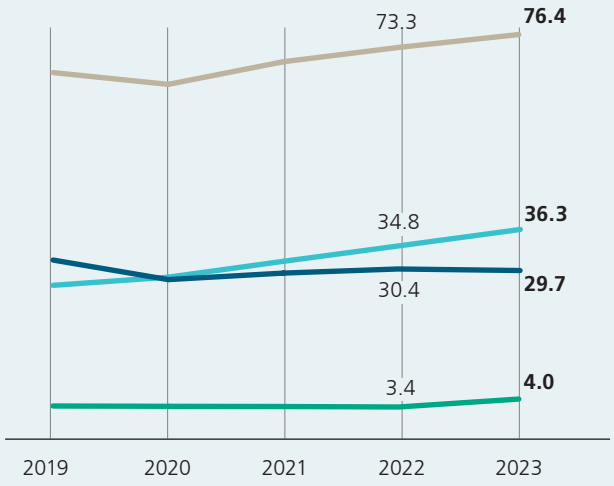
- Personnel expenses
- Non-personnel expenses
- Change in reserves
- Capital expenditure

2023: Revenue from publicly funded projects in € million



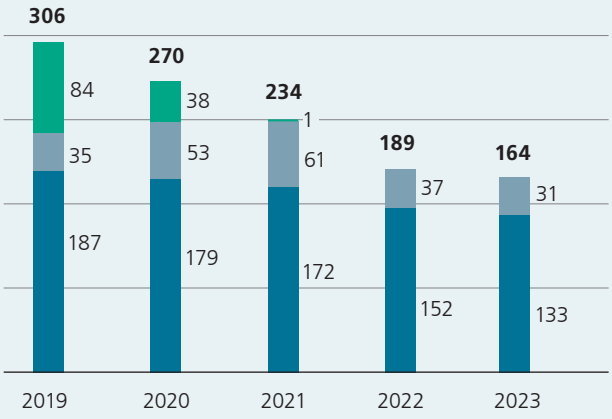
- BMBF
- BMWK
- Other federal ministries
- Federal states
- EU
- Other

Funding share in %



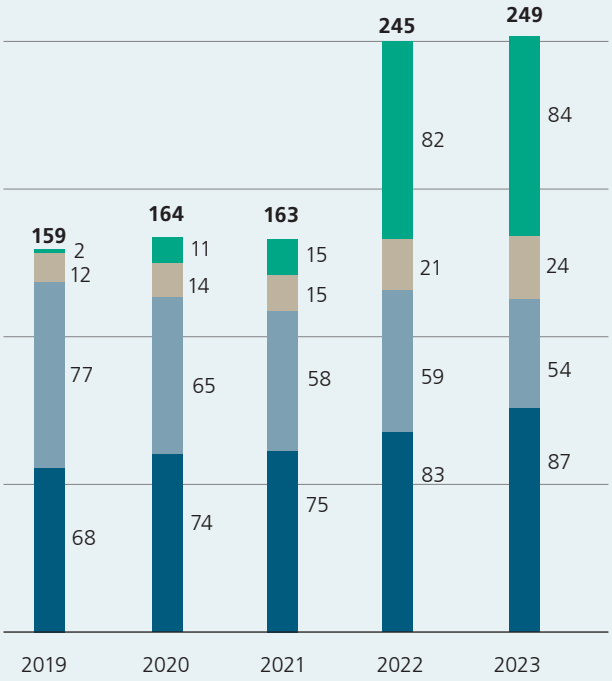
- Total project revenue (including other revenue, 2023: 6.4%)
- Industry
- Federal and state governments
- EU

Major infrastructure capital expenditure in € million



- Research Fab Microelectronics Germany (FMD)
- Equipping of new facilities
- Building projects (major and minor)

Additional research funding in € million



- FFB project funding (BMBF)
- ATHENE base funding (BMBF and federal state of Hesse)
- BMVg project funding
- BMVg base funding

Patent applications claiming rights of priority

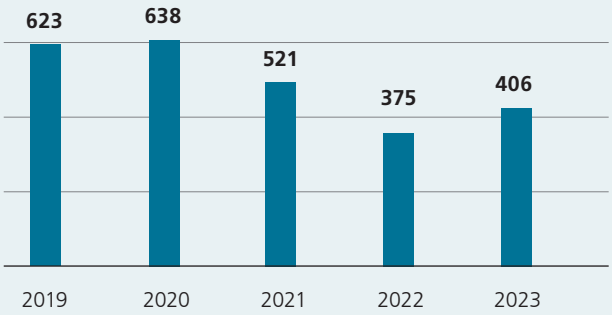


Photo: iStock

Sustainability aspects

Responsibilities of the Fraunhofer-Gesellschaft

For Fraunhofer, sustainability means taking full responsibility for a future worth living in. In addition to research, this encompasses responsible corporate governance as it relates to the dimensions of the environment, the economy, and social matters. Responsibility is also manifested in the ways we give back, including a wide array of development opportunities for employees, efforts to include our communities in research processes, and programs for students at the secondary school and university levels.

Fraunhofer published a detailed corporate social responsibility (CSR) report in 2023. A cross-departmental management structure was established in late 2022 to handle all aspects of sustainability and corporate social responsibility. The focus in 2023 was on compliance requirements and on governance in the area of sustainability. Initial action fields and measures for the strategy that is to be established were defined in the 2023 sustainability report and are being tracked with an eye to quality assurance. For example, efforts to transfer research findings to industry and society are being ramped up through initiatives such as strategic partnerships with industry customers, and cross-organizational dialogue is being established through jointly defined research processes, including those focusing on socially responsible research. Beyond that, efforts to increase women's representation among scientific staff and on institute advisory boards are also under way. Fraunhofer is preparing to provide information **according to the detailed specifications of the Corporate Sustainability Reporting Directive (CSRD)** in the management report **starting in the 2025 financial year**. The CSRD ensures transparent communication and comparability across the sustainability activities of companies and organizations. Fraunhofer is acting early in establishing the necessary processes for collecting data across all units, which is a key prerequisite for accurate, credible, and effective reporting. A central working group appointed by the executive board is hard at work creating the conditions for detailed CSRD reporting that is geared toward material aspects. The double materiality analysis initiated in 2023 will serve as a basis for this. Sustainability-related aspects are considered "material" if they are relevant from either the inside-out perspective (impact of Fraunhofer's business activities on the environment and society) or the outside-in perspective (relevant opportunities and risks that sustainability topics entail with an eye to the future viability of the Fraunhofer business model). A survey of stakeholders on these topics is planned for the first half of 2024.

Realignment of the compliance management system

The Fraunhofer-Gesellschaft believes that good corporate governance means not only complying with legal requirements as a matter of course, but also ensuring values such as trust, respect and fairness are maintained, both internally and externally. Fraunhofer has been operating a compliance management system (CMS) since 2010. It has been continually developed since then in order to comply with increased regulations in the field of research.

At Fraunhofer, compliance is seen as a business enabler, whereby the employees of the central compliance department are reliable points of contact who know the business processes and can generate added value. Acting in compliance means weighing up coherent measures in the spirit of fair cooperation within jointly defined guidelines for responsible and successful research. The compliance framework ensures, among other things, that control processes are coordinated by having various participants with autonomous responsibilities and functions interact within the CMS. All employees taking part in the defined processes carry out permanent checks (e.g., dual control principle). As part of the compliance control concept, topic owners in the specialist departments regularly review regulatory and procedural requirements (e.g., compliance with inspections).

In addition, the innovative and flexible business model of modern science and applied research with social responsibility requires compliance to be integrated into the corporate culture. The rules, roles and values must be communicated to all employees and exemplified by their managers. This requires orchestrated interplay between cross-divisional competencies from HR, communications, legal affairs and compliance, among others. By combining personal responsibility with knowledge of the guiding principles and the rules and regulations, we can ensure that our employees and managers act in a responsible and compliant manner on behalf of Fraunhofer. This is the only way to ensure that Fraunhofer can continue to be successful in the long term, leaving enough room for the important tasks: research and the transfer of innovation.

Implementing the German Supply Chain Act (Lieferkettensorgfaltspflichtengesetz, LkSG)

The German Act on Corporate Due Diligence Obligations in Supply Chains (Lieferkettensorgfaltspflichtengesetz, LkSG) entered into force on January 1, 2023. This German federal law governs the economic activities of companies based in Germany with 3,000 or more employees working there (1,000 or more starting next year) by imposing due diligence obligations intended to minimize human rights and environmental risks in the supply chains of these enterprises. The Fraunhofer-Gesellschaft meets the requirements of the LkSG and has taken steps to fulfill its due diligence obligations.

The role of human rights officer falls within a newly created department tasked with monitoring the risks related to human rights and the environment within Fraunhofer's own value chain and supply chain. The **existing risk management system** of the Fraunhofer-Gesellschaft **has been expanded to include the LkSG** and will continue to grow in order to permit identification of risks related to human rights and the environment.

The first regular risk analysis aimed at identifying risks related to human rights and the environment in Fraunhofer's sphere of business and among direct suppliers was performed this year. An external provider that specializes in these matters was brought in to analyze the risks relating to direct suppliers. As the first step, the specifications of the LkSG and the guidelines from the German Federal Office for Economic Affairs and Export Control (BAFA) were used to perform an abstract risk analysis. The results were then subjected to a manual plausibility check. This process identified risks but no violations, and appropriate preventive measures were initiated. Corrective processes that will apply in the event that any violations are identified in the future were also defined.

The Fraunhofer-Gesellschaft human rights strategy was adopted in late 2022. It was set out in a declaration of principles by the executive board and made accessible on the Fraunhofer website as of January 1, 2023.

An LkSG channel was added to the Fraunhofer whistleblowing system to ensure that incoming reports of potential violations can be processed systematically and anonymously.

In relation to indirect suppliers, a process of as-needed risk analysis was defined to allow for immediate action if any violations in the supply chain come to light. The documentation and public reporting pursuant to the specifications of the BAFA will be presented on time as of April 30, 2024.

Sustainability research

Some 32,000 Fraunhofer employees work with partners from industry and the research sector to translate ideas into innovative solutions. These activities are aimed at addressing the urgent challenges facing society today. Fraunhofer's research currently focuses on five overall societal objectives: digitalized value creation, a fully circular economy, completing the energy transition, affordable healthcare, and security and a resilient society. Transferring research findings into application can be a significant help to companies in achieving their sustainability goals and developing more sustainable products and services.

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. One example is Fraunhofer's **Electrocaloric heat pumps ElKaWe** flagship project, in which teams of researchers are developing electrocaloric heat pumps as an alternative to the currently prevailing compressor technology, which is not cost-effective. These innovative heat pumps promise higher efficiency, plus they operate without any coolant. 2023 saw a milestone in the gallium nitride-based power electronics needed to this end: Fraunhofer researchers finalized an ultra-efficient **circuit topology for voltage converters with 99.74 percent electrical efficiency**. This result is setting standards worldwide and represents an important advance toward zero-emissions solutions for heating and cooling.

The **ReSoURCE** EU project (Horizon Europe) is also making a crucial contribution to cutting carbon emissions. Fraunhofer researchers are participating in the industry-led consortium, where they are working with others on sustainable solutions for recycling refractory materials. The Fraunhofer Institute for Laser Technology ILT and its spin-off Laser Analytical Systems & Automation GmbH (LSA) are involved in these efforts. In particular, they are contributing their laser expertise toward measurement equipment for automated sorting facilities. Worldwide, some 32 million metric tons of used refractory materials are generated each year. Thus far, only a fraction of that amount has been recycled. Producing refractory materials from primary raw materials generates significant volumes of CO_2, so the project's goal is to recycle these materials instead. The researchers' findings will lay the groundwork for increasing the share of these materials that is recycled, which currently stands at 7 to 30 percent, to 90 percent, thereby reducing European CO_2 emissions by as much as 800,000 metric tons per year.

Global water use has nearly sextupled in the past 100 years and is rising by about 1 percent a year. Increasing consumption and pollution of water resources, a growing global population, and longer periods of drought have combined to make

usable water an increasingly scarce commodity. On top of that, approximately 70 percent of potable water is currently used in agriculture, and 60 percent of that is wasted due to over-irrigation. The Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI and the Fraunhofer Institute for Applied Optics and Precision Engineering IOF, in tandem with spin-offs constellr GmbH and SPACEOPTIX GmbH, developed an innovative infrared camera called LisR, short for **"Long-wave infrared sensing demonstratoR,"** to enable greater sustainability in irrigation. LisR measures real-time land surface temperatures from orbit, making it significantly more accurate for irrigation strategies than previously existing models. The technology demonstrator was successfully tested on the ISS International Space Station in 2022. Starting in 2026, this kind of targeted irrigation could save some 180 billion metric tons of water and cut CO_2 emissions by 94 million metric tons — while also boosting global harvests by as much as 4 percent (see 2022 annual report).

One example of sustainability in transferring research findings directly to industry is the **strategic cooperation between Fraunhofer and Procter & Gamble (P&G)**. A new integrated approach was added in July 2023 in the form of the **Joint Innovation Platform**. The platform's objective is to intensify the connections between interdisciplinary Fraunhofer expertise and P&G in order to focus efforts toward sustainability in the supply chain. The long-term strategic partnership is founded on clearly defined goals within P&G's sustainability agenda. Specific P&G pledges include achieving net zero GHG (greenhouse gases) at its more than 200 production sites, distribution centers, and technical centers and in its over 100,000 inbound and outbound transportation routes. The company's goals also include protecting the affected watersheds at all its production sites and reducing use of fresh water by more than 111 billion liters per year. P&G is also working to build sustainability data systems for the supply chain and to provide verifiable, granular, and accessible data for internal and external reporting purposes. The new form of cooperation via the Joint Innovation Platform is intended to lead to efficient, significantly accelerated access to Fraunhofer expertise across four strategic fields: transportation; scope 1 and scope 2 emissions; water; and environmental, social, and governance (ESG) data.

The Fraunhofer-Zukunftsstiftung (Fraunhofer Future Foundation) runs a funding program aligned with the UN's Sustainable Development Goals (SDGs). With an annual funding volume of €5 million, it enables researchers from the Fraunhofer-Gesellschaft to develop products, services, and business models that help to make the world more environmentally friendly, socially equitable and financially viable. In 2023, for example, the foundation provided funding for **NexusHub,** a water-saving system to grow plants in arid regions, and **Phosphatfänger ("phosphate catcher"),** a technological solution developed to reclaim phosphate from wastewater. In implementing its projects, the foundation is increasingly utilizing participatory elements to incorporate stakeholder needs into product development and technology transfer at an early stage.

Transfers of knowledge and technology contribute to Germany's sustainability as a hub of economic activity and help to make society more sustainable through spin-off and licensing projects. In the AHEAD funding program, which supports technology transfers involving innovative ideas, a new line called the **AHEAD SDG Track** was created specifically for spin-off and licensing projects that are important to achieving the SDGs. Participating teams are coached by experts on topics such as impact calculation, the circular economy, and preparing for financing opportunities. The teams' business model is geared toward achieving positive social or ecological impact through their innovative solutions. Since the program was first launched in 2019, 64 teams have completed the SDG Track of the AHEAD program.

The Fraunhofer experts contribute their system expertise relating to future technologies to political decision-making processes. These contributions are in demand in forums such as the **German chancellor's Alliance for Transformation**. In this dialogue format, the German federal government consults with entities representing business and industry, social partners, and the research sector on how to make the social and ecological transformation of Germany a success. Prof. Holger Hanselka attended various meetings in 2023. The federal chancellery appointed Prof. Manfred Renner to the **circular economy task force** within the alliance. Renner is one of the heads of the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT, a role in which he coordinates numerous consortia and activities relating to the circular economy.

He contributed significant expertise on circular value creation in batteries and circular management in relation to construction, building materials, and buildings to a position paper published by the task force.

Socially responsible research

The initiative for socially responsible research describes researchers' holistic responsibility for the various aspects of their activities. At the corporate level, this includes questions on the choice of research topics (What should we research? What do we not want to research?), and at the level of individual R&D projects, it involves carrying out projects with quality assurance and transferring the results with a focus on benefits. Based on an established framework for reflection (LeNa joint research project of the German Federal Ministry of Education and Research together with the Leibniz Association

and the Helmholtz Association), internal and external areas of responsibility for Fraunhofer project teams were defined as part of a further Fraunhofer project in 2023. These areas can now be discussed based on new guidelines. The internal area of responsibility addresses the design of the research process, and especially good scientific practice, quality assurance for project management, and — where necessary — adherence to codes of ethics during project implementation. External responsibility toward stakeholders includes grappling with the potential ramifications of project results, both through the necessary transfer of results to deliver benefits across industry and society and through a capably performed impact assessment to minimize the risks of misuse and abuse of research findings. The guidelines are intended to assure Fraunhofer project teams that all of the relevant aspects relating to responsibility have been taken into account through open internal discussion as a group before a project starts. In particular, scientists are invited to contribute their own individual moral views, and raising awareness of ethical issues, especially new ones, is a focus of the process. The guidelines were introduced on an optional basis for all Fraunhofer project teams, along with a module for Fraunhofer's central continuing education activities titled **Introduction to the Ethics of Technology and Technology Impact Assessments** (launching in 2024). Both measures — the guidelines and the module — serve to strengthen excellence in Fraunhofer research and foster people's greater satisfaction with their own work.

Community participation in the research and innovation process makes an important contribution to shaping innovation for maximum benefit. In an EU project titled **FRANCIS — Frugal Innovation by Citizens for Citizens** (funding period: 2021–2024), the Fraunhofer Institute for Industrial Engineering IAO and the Fraunhofer Information Center for Planning and Building IRB joined with further partners to kick off a series of so-called open innovation challenges open innovation challenges. The challenges invite people all over the world to develop ideas for simple, sustainable solutions. The project puts special effort into motivating and empowering marginalized groups, such as older people, to participate. The first idea competition, which covered the topic of the culinary world and home care and was aimed primarily at three countries — Germany, Turkey, and India — was concluded in August 2023. The top three placements went to a personalized furniture concept, a bed-making device, and a clever recycling system.

Sustainability management at non-university research organizations (PDF only available in German)

Employees

At year-end 2023, Fraunhofer had 31,942 employees, 23,543 of whom were research, technical or administrative staff (RTA staff), 7,887 were students and 512 were trainees.

The goal of **knowledge transfer via individuals** is for excellently trained Fraunhofer employees to take on positions of responsibility in industry or the research sector or to start their own businesses after a few years.

Fraunhofer added 1,113 people in scientific, technical and administrative roles in 2023. In fact, 3,300 people were newly brought on board, while 2,200 left the organization. This turnover is intentional, and especially amid today's shortage of skilled workers, it requires professional recruitment and onboarding, structured career support, and high levels of leadership and management skills.

Since autumn 2022, the **Fraunhofer Corporate Culture Vision of the Future** project has been working on an analysis of current framework conditions and on levers to develop the Fraunhofer culture even further. This is to establish processes and structures that promote ongoing cultural dialogue. Two closely coordinated participatory dialogue formats were implemented starting in late August 2023:

- Meet the Executive Board
  This open discussion format centering on current overall conditions and future prospects is based on personal discussion between employees and at least two executive board members. It is a way for the executive board to address internal and external dynamics at the Fraunhofer-Gesellschaft by meeting people where they are, taking note of their needs, and giving employees as a broad group an opportunity to share their personal experiences and wishes with the board. A total of 7 workshops were held, one each at 7 different Fraunhofer locations.

- Cultural Dialogue
  Fraunhofer employees met for 16 target group-specific workshops where they mapped out positive changes they would like to see in Fraunhofer's culture going forward. Representatives from each Cultural Dialogue will discuss their findings with the executive board afterward and synthesize them into a vision of the Fraunhofer corporate culture of the future.

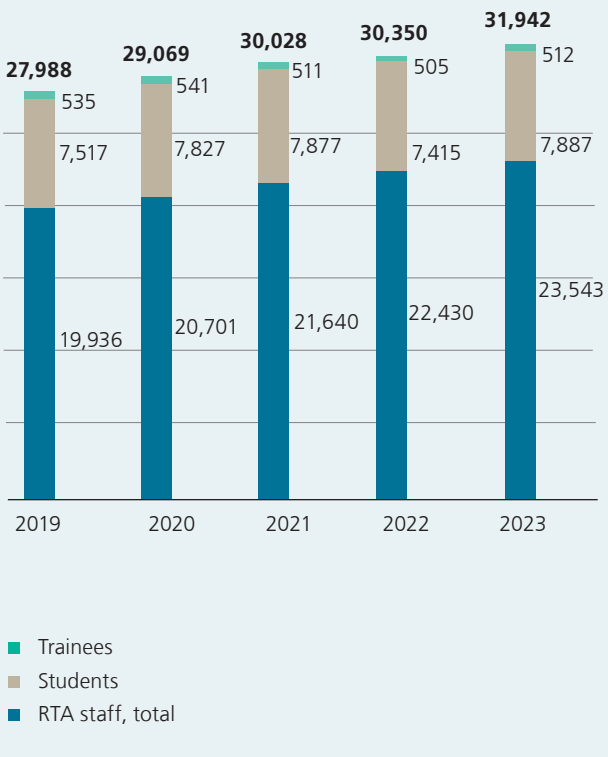
With the dialogue events concluded, the final phase of the project involves developing and establishing tools and formats to support the continuation of cultural dialogue and feedback and consequently the evolution and further development of the culture.

One major area of focus in 2023 was the **introduction of a new employer brand** with a new slogan, **"Change starts with us,"** which replaced the previous "YES" campaign. The new brand provides the overarching structure for all of the institutes' communications aimed at a broad range of different target groups, shows team spirit and diversity, and offers authentic insight into Fraunhofer by spotlighting real employees in their own work environments.

Further development of overall working conditions

One of the main ways that knowledge transfer via individuals, a key mission for Fraunhofer, is implemented is the **careers with Fraunhofer** approach, which is based on a holistic personnel development concept geared toward supporting employees' individual career planning. Mandatory **employee development meetings** constitute the key element of individual development planning. Individual career 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 spin-offs), which are consolidated through defined qualification fields, topics and measures. Now that the **SuccessFactors Talent** SAP tool has been introduced Fraunhofer-wide as a standardized platform providing digital support for development planning and the SAP learning management system is in place as a uniform learning platform, extensive efforts have gone into expanding the range of e-learning courses available. There are now about 50 free e-learning courses on topics such as leadership, business management, and work and self-organization that all employees can access for self-paced continuing education purposes. In addition, **target group-specific career programs** continue to assist employees in networking across institute boundaries: the **Vintage Class** and **Advanced Management Class** for top-level and upper management staff, **TALENTA** for female scientists and scientific managers, and the **Step forward** program for young professionals. A new **business management program** has also been added to optimize exploitation, business development, and cooperation with industry customers at the institutes.

Employees (number at year-end)



The **"A Doctorate at Fraunhofer" Code of Conduct, which was adopted in 2020,** sets binding quality standards for the overall conditions of doctoral supervision at Fraunhofer. A detailed survey was conducted in May 2023 to evaluate the degree to which the quality standards outlined in the code of conduct are currently being implemented at the institutes. Institute directors, supervisors at the institutes, and doctoral candidates employed by Fraunhofer were all asked for their opinions and evaluations. This descriptive snapshot of the situation at Fraunhofer shows the various strengths and weaknesses on the subject of doctorates with Fraunhofer. A correlation analysis was also performed, identifying a range of correlations between contextual factors, aspects of doctoral supervision, and performance indicators (job satisfaction, progress toward the doctorate, duration of doctorate, non-completion rate, attractiveness as an employer). There were two key takeaways from the survey. First, the quality standards set down in the code of conduct make a crucial contribution to the performance indicators, and second, there are important areas of leverage that have now been identified and can be used in crafting specific plans of action.

The systematic **exit survey** of employees leaving Fraunhofer is an important instrument for identifying the effectiveness of the measures within the overall HR development strategy. There was a positive shift in 2023 on the key question of whether departing employees would recommend Fraunhofer as an employer. The approval ratings are currently at 63 percent (up from 60 percent in 2021 and 59 percent in 2020). A consolidated development status is apparent in the voluntary quit rate, which stands at 75 percent in 2023 (up from 74 percent in 2021 and 73 percent in 2020) In keeping with the Fraunhofer approach, "knowledge transfer via individuals" was the most frequent reason cited by those leaving the

organization at their own request, at 26 percent (compared to 49 percent in 2021 and 27 percent in 2020). Positive ratings for support with development planning among departing employees stood at 51 percent in 2023. That represents a significant increase from previous years (40 percent in both 2021 and 2020). This positive trend was apparent across all groups of employees during this reporting year.

These working conditions are one of the reasons that Fraunhofer is ranked in the **top employers** list every year. In 2023, the Fraunhofer-Gesellschaft was also one of the most popular employers in the Trendence and Universum employer rankings. Fraunhofer placed first in the Trendence barometer of graduates in the research category and second, also in the research category, in the professional rankings.

Diversity

Achieving innovative strength through scientific excellence is a core part of the mission of the Fraunhofer-Gesellschaft. With that in mind, Fraunhofer's objective is to foster a research and working environment in which all employees experience equal opportunity as a result of the support provided for diversity and the creation of overall conditions of inclusivity. A comprehensive approach to diversity management supports a cultural shift toward equal career opportunities for women and men, appreciation for the diversity of all employees, and development of inclusive overall conditions. In this regard, grant initiatives at Fraunhofer are congruent with the objectives of the Pact for Research and Innovation and with the **Gender Equality Plan** implemented by the European Commission in 2022.

Equal opportunities in the workplace are central to the overall approach to diversity. A holistic concept strengthens the ambitious goals of gender equality. To bring about **equal opportunity and family-friendly structures and processes**, Fraunhofer has embraced an overall plan that systematically combines six fields of action: recruitment, career progression, communication, cultural transformation, monitoring and general conditions. The **equal opportunities support program** was continued in 2023 as a centerpiece of these efforts. The program supports the institutes in developing a strategy, analyzing the status quo, and identifying actions to take to promote equal opportunity.

TALENTA, launched in 2013, is a key component of equal opportunity in research and leadership positions. The support and development program transitioned from project start-up financing to a permanent funding model in 2023. In this time, 812 female researchers at Fraunhofer have been able to take advantage of the program, which includes support for career and research time alongside qualification and networking formats to achieve their career goals, such as completing their doctorate, further developing their leadership skills or strengthening their scientific visibility.

Fair career opportunities are heavily influenced by unconscious bias. The **Unconscious Bias pilot initiative** was launched in 2023 to help institutes introduce measures to counter bias. Nine institutes utilized the analysis, training, and communication package developed toward this end in 2023.

For the past 12 years, the **Diversity funding program** has been assisting institutes in implementing new measures to promote equal opportunity and diversity. Since then, a total of 240 applications from institutes have been funded at a total cost of €2.3 million. The institute-specific initiatives funded in 2023 include strategies for raising awareness about diversity, predominantly focusing on unconscious bias, innovative accessibility measures for people with disabilities and workshops to promote intercultural collaboration.

In October 2023, the Fraunhofer-wide framework agreement with **pme Familienservice** (emergency childcare, home care and eldercare, and life coaching) was extended for two years. Since then, the use of the pme Akademie, which includes webinars, e-learning programs and suggestions for living mindfully, has also been included. In 2023, in addition to 9 cases where childcare was used and 70 requests for home care and eldercare, life coaching was used most frequently, with 130 requests.

The **FamilienLOGO** certification process, which Fraunhofer supports, serves to review the status of work-life balance within an institute through dialogue between the institute management or administration and the equal opportunities officer. The certification process focuses on the following aspects: information and communication, flexible working arrangements, institute-specific care options, parental leave and returning to work, Fraunhofer support options, and budget for work-life balance. In 2023, 6 institutes took advantage of the opportunity to obtain the certification for the first time. Of those institutes, 4 were granted the Familien-LOGO for their outstanding family-friendly conditions. In all, 24 units have received the FamilienLOGO since 2019.

Fraunhofer is committed to equal opportunity and inclusive conditions for all employees. At Fraunhofer, inclusion means that people with and without disabilities can work together and conduct research naturally and on equal terms. Our primary goal is to design working conditions, structures and processes that fulfill the needs of all employees, with or without disabilities, while also promoting diversity awareness within the organizational culture in the long term. An analysis of the current situation and any gaps was performed in 2023 with an eye to crafting an **overall plan to promote inclusion**. Particular room for improvement was identified in the areas of accessibility, raising awareness and skill building, and fighting bias. An initial package of strategic measures was put together on this basis. To raise awareness of equal rights for people with disabilities in science and the research sector and foster inclusion, the Fraunhofer-Gesellschaft and Max Planck Society teamed up to launch the Inclusion Initiative. It is supported by all 10 members of the German Alliance of Science Organisations. The initiative mainly comprises:

- **Strategy workshop in November 2023**
  Approaches for encouraging inclusion in science and research were devised, and a roadmap of actions for 2024 was drawn up.

- **Career event in December 2023**
  More than 100 external candidates with disabilities learned about career paths at research organizations.

- **Social media campaign from November 2023 to January 2024**
  The campaign showcased snapshots of the strategy workshop, the career event, innovative research projects and inspiring career paths pursued by people with disabilities.

Sustainability in scientific research

Climate-friendly research processes and infrastructures are a key sustainability goal for Fraunhofer, which is why Fraunhofer takes concrete action to reduce greenhouse gas emissions as part of its **own climate strategy**. Increasing energy efficiency is a crucial element of these efforts. **Energy management systems** have been introduced at multiple institutes, and there are plans to implement an ISO 50001-certified energy management system across the entire organization. Cross-institute energy efficiency and climate action networks have also been initiated. In 4 regional networks, which were each set up for a 3-year period, 50 institutes are supporting the monitoring of specific targets for reducing environmental impact. The networks also connect members with support from moderators, presenters and external energy consultants. An **internal funding program** was created in mid-2023 with €20 million in initial funding for necessary investments in energy efficiency and climate action measures. Applications for the program reached some €2.1 million in the first 6 months.

Purchases of **green electricity starting in 2023** allowed Fraunhofer to lower emissions across the organization by an estimated nearly 35,000 metric tons of CO_2 equivalents (CO_2e) compared to the previous year. This value was extrapolated based on the available figures for total electricity use for 2021. In the heat sector, use of **geothermal systems** is one way to help reduce CO_2 emissions. In 2023, 2 climate action projects on near-surface and medium-deep geothermal systems were launched to assess selected Fraunhofer locations in order to determine feasibility and options for usage as well as support them during the implementation phase.

Efforts to expand self-sufficiency in energy sourcing are also advancing through **solar arrays**. Of these arrays, 64 were approved across Fraunhofer as of the end of 2023, when the internal photovoltaic (PV) program concluded. The average application volume came to approximately €0.4 million each. In total, €25.0 million was approved, and the planned capacity amounts to 12.03 MWp. The amount of electricity generated would be sufficient to supply approximately 2,600 four-person households with electricity. About five percent of Fraunhofer's total electricity consumption can thus be covered by these PV systems.

Number of solar arrays	64
Average application	€ 0.4 million
Funding volume	€ 25.0 million
Installed power	12.03 MWp
Expected power generation	12,181 MWh

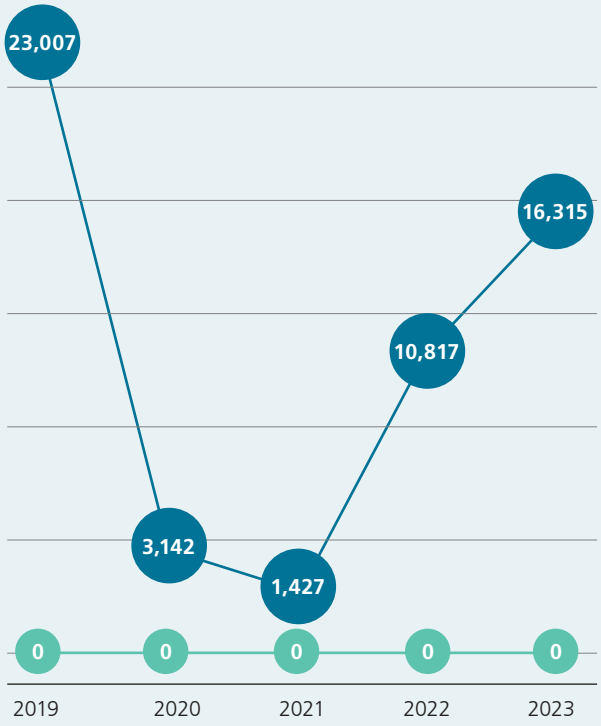
The funds for developing these solar arrays were provided to the institutes through an interest-free internal program aimed at swiftly ramping up in-house power generation through solar solutions. The institutes benefit from energy savings, as a full return on the cost of purchasing the photovoltaic system typically materializes within the space of 10 years. While PV systems do not release any CO_2 during operation, a holistic view must also take into account production (upstream chains) and disposal of the system. The German Environment Agency (UBA) puts the greenhouse gas potential for solar power at 56 g CO_2e/kWh when the system is operated in Germany. The emission factor for the electricity mix in Germany, with upstream chains taken into account, is approximately 485 g CO_2e/kWh in 2021. In addition to the beneficial economic component, solar expansion is also highly important to the Fraunhofer climate strategy.

2023 brought another significant **increase in business travel**. Business travelers logged 9.3 million more passenger kilometers traveled by train than in 2022, for a total of 27.5 million passenger kilometers. That is approximately 75 percent of the figure for 2019, before the coronavirus pandemic. By using the framework agreement between the German federal government and Deutsche Bahn, train journeys for Fraunhofer continue to be regarded as carbon-neutral. Air travel also noticeably increased, rising 50 percent year over year. That brought the CO_2e total for 2023 to exactly 16.315 metric tons (data and calculation by AirPlus/atmosfair).* This represents 71 percent of the emissions for 2019. Emissions from flights taken in 2022 were neutralized in 2023 via a biogas project in Nepal conducted with atmosfair. Plans also call for emissions from flights taken in 2023 to be offset.

Total waste figures are available with one year's delay, so they are currently only available for 2022. According to these figures, the Fraunhofer institutes generated 5,349 metric tons of non-hazardous waste and just under 579 metric tons of hazardous waste in 2022. Fraunhofer distinguishes between hazardous and non-hazardous waste in keeping with the German Waste Classification Ordinance (Abfallverzeichnisverordnung, AVV). This works out to another slight decrease in non-hazardous waste and a decrease of more than 100 metric tons in hazardous waste compared to 2021. Many institutes maintain leasing arrangements in which traditional non-hazardous municipal waste (paper, residual waste, plastics, etc.) is disposed of in part by the landlord or, in the case of collaborations, by higher education institution partners. Rough estimates are prepared for these cases. The data transmitted do not cover all Fraunhofer research units and institutes. The reduction in non-hazardous waste is a result of the efforts made at the individual institutes. The fluctuations in hazardous waste can largely be explained by research project parameters. Most waste generated by projects cannot be controlled directly.

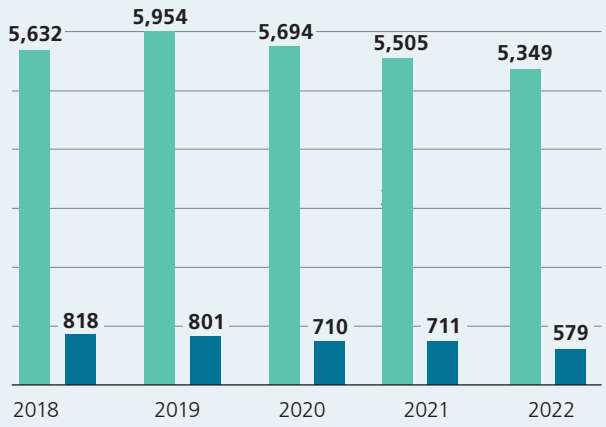
* Since the decision to offset air travel in 2019, flight-related emissions have been calculated using the VDR standard with a Radiative Forcing Index (RFI) of 2.7 in order to take into account the total climate impact of flights taken by Fraunhofer employees. In the interests of transparency, these are reported accordingly.

CO_2 emissions from business trips by Fraunhofer employees, in metric tons



- 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 Deutsche Bahn, according to the information given by Deutsche Bahn

Volume of waste produced by Fraunhofer institutes, in metric tons



- Non-hazardous waste
- Hazardous waste

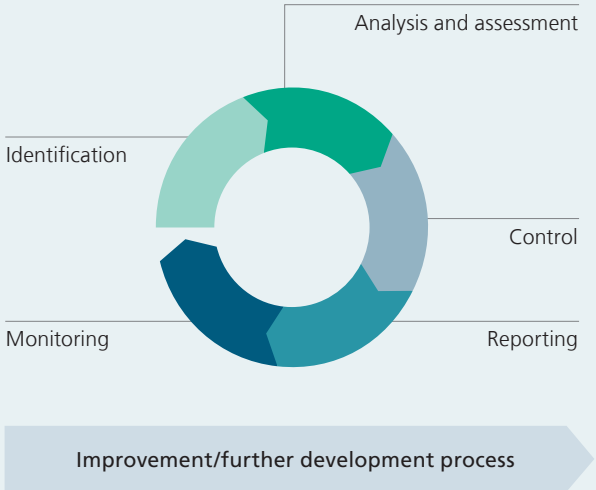
Risks and outlook

Risk management and risks

An overall assessment of the risk situation at the Fraunhofer-Gesellschaft continues to show potential risks similar to those faced by many other institutions and companies. These risks stem mainly from the ongoing and multifaceted crisis situation, which includes geopolitical tensions, price increases, and a dim economic outlook. One additional factor affecting Fraunhofer specifically is that trust remains to be rebuilt among stakeholders, cooperation partners, and the public in the wake of the reports issued by the German Court of Audit (BRH) and amid the ongoing audits. Steps to address these factors through adjustments in governance and to increase efficiency in business processes were initiated at the end of 2023. At present, however, there is no sustained risk to the Fraunhofer-Gesellschaft in the next year.

Fraunhofer takes risk to mean all internal and external events and developments that might jeopardize the organization's success. These include both risks where the monetary value can be directly ascertained and qualitative risks. Fraunhofer's risk management system is designed to identify existing and potential risks at an early stage and to manage them by means of appropriate measures in such way that they either do not materialize at all or do not have consequences that could endanger Fraunhofer's business success or jeopardize its ability to fulfill its mission in accordance with its statutes. To achieve this objective, the Fraunhofer-Gesellschaft has set up a risk management system that takes into account its requirements and structure and undergoes continuous improvement. In the cyclic risk management process, risk experts in the specialist departments carry out systematic, standardized risk assessments on a yearly basis. Overarching high-level risk surveys of upper management are also conducted to supplement these efforts. In these surveys, managers identify what they believe to be the biggest risks to the Fraunhofer-Gesellschaft, regardless of the specific topics for which they are responsible, and propose actions to take to mitigate those risks. This information is used along with external risk assessments to review whether the information is complete and perform plausibility checks. The individual risks identified through the standardized risk inventory process and the associated countermeasures are then summarized and evaluated collectively under the appropriate risk categories in an annual risk report that is presented to the executive board. Additionally, the specialist departments inform the executive board of relevant risk-related developments — both routinely and on an ad-hoc basis — via the established reporting channels.

Cyclic risk management process



The Fraunhofer-specific risk classification model provides a framework for the annual risk assessment, which in turn serves as a basis for the risk report presented to the executive board. The first layer of the model consists of four main areas of risk: business model, financing, resources and business operations. The second layer of the model assigns individual Fraunhofer-specific risks (currently 19) to these four main areas.

Business model risk encompasses types of risk that represent a threat to the continuation and further development of the Fraunhofer business model. This relates to both important external conditions and risks regarding the internal design of the business model. Due to the current crises — namely the wars in the Middle East and in Ukraine, supply chain disruptions, high (energy) prices, effects of climate change and shortage of skilled workers — negative effects are still to be expected in certain areas of the research portfolio. In anticipation of this, Fraunhofer continues its ongoing activities in relation to strategic portfolio management.

In the context of **financing risks**, the focus is on containing risks that might compromise Fraunhofer's access to research funding or its solvency. The Fraunhofer funding model is based on three financing pillars (base funding, public-sector revenue and industrial revenue), each of which contribute about a third

of the financing. Due to the current tension with the German federal budget and the **need for budget consolidation**, potential budget cuts by the grant authority or restrictions in budget flexibility may lead to a decrease in public funding. The amount of base funding also creates tension on Fraunhofer's funding, as the **rate of inflation** exceeds the increase in base funding agreed as part of the Pact for Research and Innovation, so there has been a reduction in real terms. In these challenging times, it is essential for the institutes and the research portfolio to be financially sustainable within the Fraunhofer model, including in the long term. The necessary measures are apparent from the consolidation course. The relative share of industrial revenue stands at 29.7 percent, slightly below Fraunhofer's target of about one-third, as revenue from publicly funded projects remained high in 2023. Actions taken to consistently implement Fraunhofer's mission of economic cooperation include optimizing the range of services offered and adjusting the research portfolio. Nevertheless, efforts to increase industrial revenue do depend on the overall economy. The Fraunhofer funding model has proved to be highly resilient in past crisis periods, with the result that the Fraunhofer-Gesellschaft continues to assume it will achieve balance among its sources of funding.

In order to maintain the share of base funding in the funding mix in the long term, Fraunhofer **proactively pursues forward-looking economic management** and promotes **mission-oriented, success-based institutional funding** from the federal and state governments along with **business management conditions appropriate to the research sector**. The current financial statutes enable Fraunhofer to operate in a flexible, efficient and autonomous way. If these options were curtailed, it would limit Fraunhofer's liquidity and safeguards against risks, thereby sharply restricting its flexibility and capacity to respond to new developments.

Projects for **building and equipping new facilities** that are co-financed by the federal and state governments and the EU (ERDF) are subject to restrictions concerning how long the funds are made available. Significant delays in project progress can lead to a delayed outflow of funds or even forfeiture of the funds provided. Fraunhofer has a construction control unit in place to monitor the progress of projects for building and equipping new facilities and to continuously explore possible means of expediting such projects. Strategic measures are also taken with an eye to determining construction volumes and setting priorities. Investments and maintenance of research infrastructures are key factors for Fraunhofer in maintaining its ability to operate successfully in the future.

Resources risk encompasses those types of risk that may affect the availability of tangible and intangible resources needed to successfully carry out research activities. Ongoing macroeconomic and geopolitical uncertainties mean that the Fraunhofer-Gesellschaft has various challenges to contend with. In the energy segment, for example, service interruptions and price increases are risks that cannot be ruled out. The Fraunhofer-Gesellschaft continues to take measures aimed at **enhancing a resilient and sustainable energy supply** and bolstering **general resilience in the face of crisis situations**. Efforts toward efficient design of business processes in research management have been ongoing since 2022. There are still challenges associated with the shift to the SAP S/4HANA system, especially in terms of the throughput times for individual business processes. Measures have been put in place to enhance the efficiency of business processes, such as purchasing processes, and ensure compliance. Work to refine the customized SAP tools used to account for documentation-heavy public projects with highly variable formal requirements is ongoing.

The **reputation** of the Fraunhofer-Gesellschaft and its brand is a valuable asset and forms the basis for long-term collaborations and economic success. Responsible corporate governance is a top priority for Fraunhofer. As a matter of course, this includes compliance with all applicable laws, including the specifications of funding legislation, and with requirements set by customers and cooperation partners. Good scientific practice likewise forms the basis for all research activities undertaken at Fraunhofer. This means the potential for reputational harm resulting from negative media reports and delays in business dealings is a threat that must be taken seriously. Fraunhofer is aware that individual missteps cannot be ruled out entirely and can also tarnish the organization's reputation. To identify risks like these as soon as possible and minimize their impact, Fraunhofer focuses on ongoing **further development of compliance, communication, and brand management** and on **consistent monitoring** (see p. 19, "Sustainability aspects, realignment of the compliance management system").

Business operations risk comprises those types of risk that may arise from research and administration processes, or from conducting specific research projects. Increasingly stringent regulatory requirements pose a challenge for an applied research organization with a very broad industry portfolio. They also tie up capacity needed to shape the future viability of industry and society.

Sustainability is growing more and more important, not only due to the increasing impact of climate change, but also as a result of requirements established by society as a whole, customers, and specific regulations. As a result, efforts toward **holistic coordination of all three dimensions of sustainability** (environmental, social, and governance) undergo further development and integration into the overall strategy and organizational structure. Clear responsibilities, job descriptions, and resources for operational execution of the planned regulatory requirements such as the Corporate Sustainability

Fraunhofer risk classification model

Main risk areas	Specific risk types
Business model	State aid law
	Non-profit status, taxation
	IP exploitation, spin-offs
	Corporate strategy, portfolio management
	International activities
Finances	Base funding
	Public-sector revenue
	Industrial revenue
	Operating expenses / Capital expenditure / Construction
	Liquidity, advance funding, other financial risks
Resources	Human resources
	IP, know-how
	Infrastructure
	Financial assets, reserves
	Reputation, brand
Business operations	Service performance, contractual risks
	Legal risks
	Information security
	Governance, internal control systems

Reporting Directive (CSRD) and Corporate Sustainability Due Diligence Directive (CSDDD) are also defined as part of implementation projects.

Secure handling of information and data is critically important to a knowledge-based research organization. The risk of cyberattacks (ransomware, cyber-espionage) continues to rise in tandem with increasing international conflict. Fraunhofer is addressing this risk in the short term through actions such as **improved data backups** and in the long term by planning for a more secure IT architecture ("zero trust" principles), which is being devised as part of the **executive board project on cybersecurity**. Risks posed by the use of disruptive technologies such as artificial intelligence (AI), especially in its generative forms, and quantum computing are also considerations here.

Outlook

Despite increasing economic challenges, Fraunhofer **remains financially stable** for the 2024 financial year.

Public-sector employees saw a significantly larger pay raise under their collective agreement than in previous years, which will also increase personnel expenses — the single largest block of costs — by a significant margin. The institutes are also planning personnel growth, albeit at a noticeably slower rate than in 2023. Although inflation seems to have peaked, higher procurement costs still need to be financed in the long term. In terms of the **supply of electricity and gas**, Fraunhofer has achieved some certainty on pricing thanks to **framework agreements for 2024**. On the whole, non-personnel expenses are expected to rise only slightly year over year. With investment activity remaining more or less constant, Fraunhofer

expects total business volume to increase by a significantly smaller margin than last year.

On the funding side, Fraunhofer has solid orders for 2024 at this point. The planned revenue increase in publicly funded projects is a near certainty due to a large backlog of orders. The industrial revenue situation remains challenging. Amid growing uncertainty in the overall economic situation, the increase in absolute terms that has been planned by the institutes would be a win. The share of funding from industrial revenue is unlikely to rise significantly given the current situation. It is difficult to foresee at this point how rising geopolitical tensions (the war between Russia and Ukraine, the Middle East conflict) and the risk of a lasting recession in Germany will affect the development of Fraunhofer's business.

At the same time, the **need for transformation in Germany and Europe** is increasing and requires more speed if **international competitiveness and prosperity** are to be maintained in the future. Challenges include the global competition for monopolies on resources and technologies and for skilled workers, a sharp increase in geopolitical conflict, the worsening climate crisis, the destabilization of entire societies through targeted disinformation, cyberattacks, and infrastructure attacks, and last but not least, disruptive changes brought about by generative AI and the platform economies.

With its mission of applied research and accelerated transfer, Fraunhofer has a special role to play in harnessing holistic solutions to help make industry and society more resilient and forging ahead with the digital and sustainable transformation. **Next-generation computers and microchips** hold out special promise for Europe as a whole and Germany specifically. The next big technology cycle will be based on research-intensive technologies such as **quantum and neuromorphic computing (QNC)**. Advances in these fields are being made under the umbrella of the Research Fab Microelectronics Germany (FMD) in tandem with other partners with the goal of ensuring that Germany and Europe not only remain competitive, but also can build access to production sites, for example within the framework of the QNC Space module. A broad technological basis within that module ensures that a wide range of approaches to quantum computing — superconducting, neutral atom, ion traps or quantum dots and other approaches such as memristors for neuromorphic computing — can all be tested. Fraunhofer researchers are involved in a range of activities to develop solutions and methods geared toward making information and communication technology less resource-intensive, such as the **GreenICT@FMD** initiative.

Beyond digital solutions, **sustainability and resource efficiency** are critical considerations for all key technologies right from the start. This includes relying on renewable raw materials, reclaiming and recycling critical materials through a circular economy, and eliminating substances harmful to health and the environment. There is also an increasingly urgent need for strategies and technologies to combat climate change and its effects. Germany in particular and Europe in general have a significant edge in this field, known as **green tech**, thanks in no small measure to Fraunhofer technologies. The task now is to seize the first mover advantage on the international stage and swiftly bring developments and business models to market.

For Fraunhofer's research findings to have an impact as they make their way into industry and society via a diverse range of pathways, it is crucial to establish **overall conditions that are innovation-friendly**. This includes experimental spaces where researchers work shoulder to shoulder with industry under market-driven conditions while EU state aid law, aspects of nonprofit status, and other regulations are also considered — in pursuit of topics such as generative AI solutions to alleviate the shortage of skilled workers.

The "twin transformation" — that is, the simultaneous shift toward digital solutions and sustainability — can only be a success in today's tough environment if it is achieved and implemented faster. The only way to accelerate the pace of change from initial concept to proposed solution will be to ease the burden of bureaucracy and foster greater cooperation between the research sector, business and industry, and government. New business and funding models, such as **the expansion of regulatory sandboxes and new forms of cooperation for shared use of cutting-edge research infrastructure, especially by private-sector companies**, are possible approaches for Fraunhofer.

The executive board would like to thank the members, supporters, friends and, most of all, the employees of the Fraunhofer-Gesellschaft for their support, dedication and hard work in 2023.

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.

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