EVALUATION

Evaluation of the Human Frontier Science Program

2025 Grand Review

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Table of Contents

Executive Summary

The Human Frontier Science Program (HFSP) is a unique international funding organization dedicated to advancing **frontier, basic research in the life sciences** through **high-risk, high-reward**, **interdisciplinary**, and **internationally collaborative** approaches. This evaluation assesses HFSP's performance and and impact across the following core dimensions: the value of HFSP research and its uniqueness, the excellence of HFSP-supported research, the valorization of basic research supported by HFSP, and the value added for member states investing in HFSP. The findings of this review are based on extensive quantitative and qualitative analyses, international benchmarking, surveys of awardees, interviews, case studies, and consultations with reviewers and representatives from member states.

Overall Conclusions

Overall, the evaluation found that HFSP delivers **exceptional scientific and systemic value**, which is clearly complementing national or regional funding schemes, and that at higher level plays a strategically important role in shaping the global life-science research ecosystem.

The Grand Review demonstrates that HFSP is a **high-leverage and strategically important investment** for its members and inter alia for global life-science research. It delivers exceptional scientific excellence and research that extends the frontiers of knowledge, while also providing foundational contributions to groundbreaking innovation, and hence lasting benefits for researchers, society and member states. The value of HFSP's is grounded in its **distinctive mission and bottom-up science driven operating model**.

Bibliometric and related analyses show that the majority of HFSP research is focused on **fundamental biological questions in combination** with adjacent disciplines like physics, chemistry, or mathematics. A unique feature of HFSP is that all the research supported is internationally collaborative in its design. Topic and concept analyses indicate that work supported by HFSP is **prominently represented in conceptually novel research**, frequently involving high risk and new ideas. HFSP funded projects challenge and often reframe established scientific paradigms rather than making incremental gains on prior knowledge. This is one of the most distinguishing features of HFSP compared to other funders.

Preserving and strengthening the current mission of the HFSP is essential to maintain its impact and relevance in an increasingly complex and competitive global research landscape.

Key Topics addressed by the Grand Review

1. Value of HFSP Research

HFSP research is characterized by **scientific ambition, conceptual novelty, and structural risk-taking**. The awards enable research that deliberately challenges established paradigms, integrates multiple disciplines, and brings together international teams that would otherwise be unlikely to collaborate.

One of the central findings is that HFSP funding is often **formative rather than complementary**. Most awardees report that their projects could not have been carried out at all, or only in a substantially reduced or altered form, without HFSP support. This is particularly pronounced for projects involving new interdisciplinary directions or newly formed international teams.

HFSP supported research facilitates the pursuit of **new research trajectories**, allowing for changes in direction, scope, and ambition.

2. Uniqueness of HFSP

HFSP occupies a **distinct niche** in the global funding landscape. Its uniqueness derives from the combination of several features that are rarely found together in other funding schemes:

- A strong and explicit focus on the frontiers of basic life science
- High tolerance for scientific risk and uncertainty
- Bottom-up, investigator-driven system for research support without top-down topical priorities
- A mandatory focus on interdisciplinarity
- Mandatory and substantive international collaboration, justified solely by its scientific value added
- Support for career mobility across geographical and disciplinary borders
- High degree of flexibility for researchers to use HFSP resources

Comparative analyses show that with HFSP funding research outputs shift measurably toward **more basic, interdisciplinary, and novel outputs**. This indicates that HFSP funding actively shapes research direction and scope rather than merely supplementing existing scientific agendas.

The evaluation also highlights the distinctive role of the **Fellowships and Research Grants**, which successfully bring researchers trained outside the life sciences into biological research and sustains their engagement at disciplinary interfaces over time.

In sum, HFSP supports research that **cannot easily be funded at a national nor international levels**, particularly when it involves geographically distant partners, unconventional disciplinary combinations, or high conceptual risk.

3. Excellence in HFSP-Supported Research

Across all major indicators used in this evaluation, HFSP-supported research demonstrates **outstanding scientific excellence**.

Publications citing HFSP support achieve **field-normalized citation impacts well above global averages** and often exceed those of leading national and international funders. Given the small, modest size of the organization compared to other funders, HFSP outputs are disproportionately highly represented among the **top 10% most-cited publications worldwide** and appear frequently in **impactful multidisciplinary journals**, reflecting both quality and breadth.

HFSP also plays an extremely important role in the **emergence and redirection of research areas**, particularly at the interfaces of biology with physics, chemistry, engineering, and technology.

HFSP-funded scientists have been recognized for seminal work that in many instances has engendered important societal benefits. HFSP awardees have gone on winning 31 Nobel Prizes in the last 35 years and are regularly receiving the most important scientific prizes and awards such as the Lasker Award, the Kavli Prize or the Gairdner Award.

In terms of human capital, HFSP functions as a **powerful career accelerator**. Awardees – especially fellows – are significantly more likely than unsuccessful applicants to remain active in frontier basic research over the long term, and they show high success rates in securing prestigious follow-on funding. HFSP thus contributes to the development of future scientific leaders.

4. Valorization of Basic Research

HFSP projects are not required to state expected societal or economic impacts upfront, as HFSP's philosophy is grounded in exploratory research. Nevertheless, the evaluation provides clear evidence that HFSP research has a significant impact beyond academia. **Research funded by HFSP Grants (13.6%) and HFSP Fellowships (LTF 24% and CDF 20.8%) is often cited and acknowledged in patents**, particularly given that HFSP supports exploratory basic research. These citations span thousands of patent families and organizations, across more than 50 countries, indicating broad application in different sectors of technology (incl. biomedicine, materials, biotechnology). In a global benchmark of basic-science-classified publications across major international funders, **HFSP shows the highest rate of patent citation (22.2%)**, exceeding comparable organizations such as the ERC, the Wellcome Trust, Inserm, DFG, CIHR, BBSRC, JSPS and NHMRC, positioning HFSP at the upper end of knowledge diffusion into technological domains.

HFSP-supported projects primarily generate **conceptual advances, theoretical insights, and new methods and tools**. These outputs form the knowledge base for applied research, technological development, and societal applications. Direct commercialization is not the primary outcome, which aligns with HFSP's position early in the innovation pipeline. HFSP strengthens innovation systems, not by delivering immediate products, but by **expanding the pool of high-quality, reusable scientific knowledge** that enables downstream innovation in fields such as health, technology, and industry.

5. Added Value for HFSP Member States

HFSP generates significant value for its members that extends well beyond individual research projects.

By pooling resources across nations, member states collectively support **high-risk frontier research** that would be challenging to fund nationally. In return, member states benefit from access to excellent global research outputs, internationally connected scientific talent, and lasting collaborative networks.

As illustrated previously, HFSP occupies a unique funding niche which is clearly adding value to funding schemes available for its members, both nationally and internationally. In other words, scientists in HFSP member countries conducting HFSP-type research would not receive funding through existing national or international funding schemes, often due to the high-risk character and international collaborative nature of the project. A distinctive feature of the HFSP is that member contributions are pooled in a single budget through which all projects are funded based on a highly competitive selection.

HFSP funding is associated with a **sustained increase in international collaboration**, which often persists long after the end of the funding period. Many collaborations initiated through HFSP develop into long-term scientific partnerships, strengthening institutional and personal links between countries.

HFSP also contributes to **long-term capacity building** within member states. Alumni frequently secure competitive follow-on funding and assume leadership roles in academia and research systems, reinvesting their expertise and networks locally.

Finally, HFSP plays an important role in **science diplomacy**, fostering trust-based collaboration across borders and contributing to the resilience of the international research system in times of geopolitical uncertainty.

6. Items to be considered for the way forward

The review has brought to light several aspects that need to be considered in the future regarding:

- The trade-off between funding duration and the number of awards recommended for funding
- The monetary value that HFSP awards carry in different world regions
- The increased number of submitted applications and the challenges for the existing peer review system and workload on a small scientific secretariat
- Increased demand for engaging HFSP awardees and alumni in community building activities

The review mandate was very broad with a focus on the scientific outcome and value added for the members. Naturally not all aspects could be analyzed in detail and items for further discussion remain, particularly with respect to the stability and vitality of the organization:

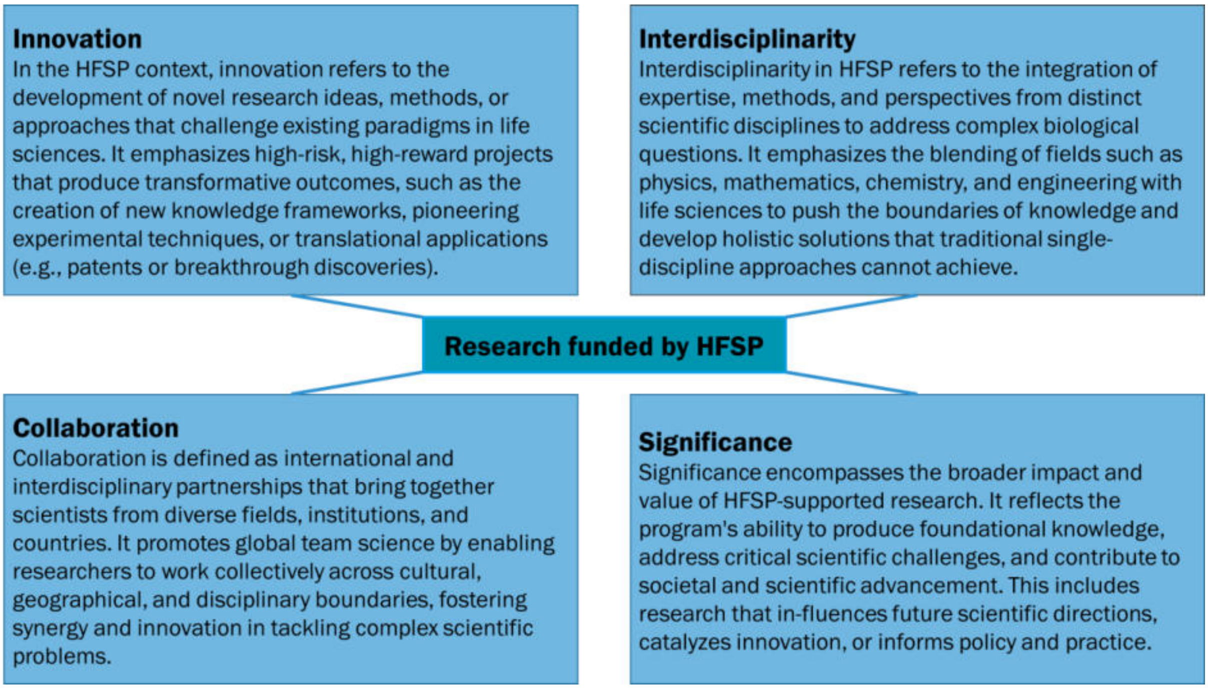
- Interdisciplinary research is now more common than when HFSP started and seen as an important criterion in many other funding programs. HFSP must develop its niche to stay at the forefront of contemporary research that supports projects in emerging fields.
- Is the funding base still sufficient for such an ambitious program to maintain acceptable funding levels in each of the award categories?
- The constituency of HFSP may be widened to include countries with high-quality research infrastructure and a critical mass of scientists.
- HFSP needs to remain robust and diversified as an organization to be able to cope with potential and abrupt changes in the current geopolitical situation.

1 Introduction

The International Human Frontier Science Program Organization (HFSPO) was established to promote cross-border research in the life sciences. This includes new research ideas that bring together researchers from various countries and different disciplines. The novelty and excellence of the research is explicitly associated with high risks. This is seen as the foundation for ground-breaking discoveries and innovations. In this regard the program (HFSP) is one of the few existing truly multilateral support programs currently encompassing Australia, Canada, France, Germany, India, Israel, Italy, Japan, New Zealand, the Republic of Korea, Singapore, Switzerland, the United Kingdom, the United States and the European Commission.

HFSP focuses on advancing frontier research in the life sciences by supporting high-risk, high-reward, and transformative projects. It emphasizes interdisciplinary and transdisciplinary collaborations, enabling researchers from diverse fields to address complex biological research questions. International collaboration lies at the core of HFSP, promoting science without borders by supporting research teams composed of scientists from different countries. The program actively encourages young scientists to broaden their expertise, move into new research fields, and build the skills necessary to become future leaders in science. Additionally, HFSP prioritizes inclusivity and diversity, engaging researchers from a wide range of disciplines and nationalities. Underpinning its efforts is a commitment to team science, recognizing the critical role of collaborative efforts in tackling sophisticated scientific challenges.

Figure 1: Principles of HFSP research



Source: own graphic.

The above figure is an attempt to summarize and define the principles of research supported by HFSP (from here on HFSP research). These principles and definitions, along with others, will be used in the study as objectives against which the success of HFSP research will be measured.

To meet its objectives, HFSPO employs a range of innovative funding mechanisms tailored to support frontier research. Its Postdoctoral Fellowship programs include Long-Term Fellowships (LTF) for life scientists to gain experience in a different field of biology and Cross-Disciplinary Fellowships (CDF) for non-biological scientists applying their expertise to biological research. HFSP also offers Early Career Research Grants to interdisciplinary teams within the first five years of their independent careers and Program Grants for collaborative teams at any career stage. Additionally, the recently introduced Accelerator Grants integrate researchers from specific member countries into ongoing HFSP-supported projects. These funding mechanisms support high-risk, paradigm-challenging proposals that do not require preliminary data or prior publications, offering a unique opportunity for innovative and bold research that complements traditional funding schemes.

Since its inception, HFSPO has awarded more than 1,200 research grants involving more than 4,600 scientists working in more than 50 different countries, and more than 3,500 fellowships. HFSP support has been granted to scientists working at more than 1,000 research institutions and universities worldwide. Young scientists from more than 70 nationalities have received HFSP fellowship support so far.[1]

[1] HFSPO. (2025). Our mission, Human Frontier Science Program.

2 Objectives, Scope and Methods of the Evaluation

2.1 Objectives and Scope

The current HFSPO Strategic Plan spanning the period from 2024 to 2032 sets three strategic goals: expanding grant making to support frontier science (Goal 1), strengthening relationships with the scientific community and HFSPO members through reinforced engagement (Goal 2), and becoming a more globally inclusive organization (Goal 3). In line with these goals, the focus of this review is to assess

1. its uniqueness and the quality of the research HFSP supports,
2. the added value it provides to the Members,
3. the value that basic research supported by HFSP contributes to the innovation economy, and
4. to provide a perspective on change and improvement regarding the organization's the overall strategic planning.

The central aim of the evaluation is to determine and highlight the unique value of HFSP for long-term scientific progress in the life sciences. This includes the analysis of outcomes and impacts of HFSP-supported research, as well as the impact of HFSP on the careers of researchers and collaboration patterns. Based on this, the value of HFSP for its members will be investigated. It will also be examined to what extent HFSP meets the current needs of its members. Finally, perspectives and recommendations will be developed on how HFSP can fulfil these needs and achieve its goals even better. To specify the direction of inquiry and ensure that all stated requirements will be met, the following topics will be addressed in the study:

Table 1: Review questions

Topic	Evaluation questions
Uniqueness of HFSP	• Is HFSP support still in a unique position throughout the member countries or internationally in general that justifies the member's investments? • Is the mission of HFSPO as formulated in the new strategy and the current operational modus reflecting the needs and requirements of the members? • If truly unique, is HFSP support the only means for teams of applicants to collaborate across disciplinary and country boundaries? Would young scientists be able to carry out their research without HFSP support? • Is there evidence that HFSP supported research is seeding novel research that attracts significant follow-up funding? • Does HFSP stimulate awardees to continue international collaborative high-risk research after their HFSP Research Grant has come to an end?
Excellence of HFSP research	• Is HFSP supporting truly frontier-extending research, that is internationally collaborative, and of a type not normally fundable through national schemes? • For the Long-term (LTF) and Cross-Disciplinary Fellows (CDF), does their postdoctoral experience lead to further frontier life sciences research?

	• Is there a special value in the (CDF) program for both the young scientist but also the field of research, also in comparison to the LTF? • What is the scientific impact of HFSP funded research as evident through peer reviewed scientific publications? Do HFSP funded scientists publish more articles with a higher impact? • Is there a different degree of interdisciplinarity in research funded by HFSP in comparison to other funding organizations? Is this visible in publications by HFSP awardees?
Valorization of basic research	• Are there parameters that would allow to measure the innovation potential of HFSP supported research? • Biology has taken a central position in the 21st century research and innovation landscape. Is HFSP's contribution recognizable and significant? • Fundamental research in the life sciences is a driver of innovation. How much does HFSP supported research contribute to this innovation pipeline?
Value added of HFSP for its members	• Does HFSPO succeed in seeding truly international collaborations, and if so, how is that valued by HFSPO Member countries? • How do rates of international collaboration compare to other organizations? Have lasting collaborations emerged from HFSP funded research? • Is there a difference in the collaboration patterns between teams of young investigators vs teams of senior investigators • Does HFSPO supported research collaborations have a specific impact as indicated by collaborative papers compared to non-collaborative publications? • What is the best way to articulate the overall value-added of the HFSPO to its Members (beyond academic and financial benefits)?
The way forward	• Are the resources available conducive to continue as a lead program for research support. Does HFSP dispose over the financial foundations and operational resources for the implementation of the new strategic plan? • Do member countries see a need for additional, novel program activities (incl. engagement) or changes to existing programs • Does the membership of HFSP present the critical mass of the leading science countries or should there be an even broader membership base with more countries as part of the organization? What would be the best suited future governance strategy in light of the ambitious new strategic plan 2024-2032?

Source: Tender specifications.

These five dimensions are the basis for the table of contents. Each chapter will outline various aspects of the questions provided in the table above. At the same time, it needs to be noted that the questions are very complex and require contextualization, as they also concern other dimensions. For example, aspects of excellence concern the dimension of value added, which, in turn, also concerns the way forward.

The review assesses the achievements and impact of the HFSP over the past funding period. It seeks to evaluate to what extent the program delivers on its objectives of supporting high-risk, interdisciplinary, and internationally collaborative research while addressing its alignment with evolving scientific and funding landscapes. To this end, the study will analyze different aspects of HFSP activity and its impacts, among them career trajectories of HFSP researchers within the framework of a cohort study.

The review was initiated to ensure that HFSP continues to meet its mission of promoting frontier research and addressing global scientific challenges effectively. HFSP enters its fifth decade with a new strategic plan guiding its path from 2024 to 2032.

In this context, the review is crucial for assessing the program's historical performance and guiding its future direction. The study will extensively evaluate the research programs using qualitative and quantitative methods.

2.2 The Underlying Logic Model & the Payback Framework

To provide a comprehensive assessment of the HFSPs' activities and impact, the review employs a mixed-methods approach, combining both quantitative and qualitative methods. Qualitative instruments are helpful for obtaining a more in-depth look into impact dynamics, while quantitative instruments allow for the analysis of large datasets to support the gained insights. By combining the approaches, the limitations and weaknesses of the individual methods can be compensated. In the following subchapters, the analytical framework and the underlying methodological toolbox are described.

For this review, we followed a theory-based evaluation approach that develops and tests the cause-and-effect relationships between inputs and activities on the one hand, and outputs and outcomes on the other. In evaluations, these relationships are typically outlined in what are known as Theories of Change (s. Annex 11.1), which is a method used in evaluation to understand the relationship between interventions and observed outcomes.

In addition to this, we make reference to the Payback Framework, which is a conceptual model for evaluating the impacts or "payback" of research beyond traditional academic metrics.[2] In essence, Payback classifies research outcomes into five broad impact categories, ranging from academic outputs and to wider societal benefits. This approach has been widely applied by research funding agencies and organizations around the world to evaluate programs in health, social sciences, and other fields.[3]

Knowledge Production (Academic Output): Knowledge production refers to the creation of new scientific or scholarly outputs. This is the most traditional form of research impact, encompassing the scholarly communications that disseminate findings. The quality of these outputs is also considered, for example, their citations or influence on patents.

Engagement and Capacity Building: This category covers two closely related aspects: building research capacity in terms of human capital and infrastructure, and influencing the direction of future research.

Development of Novel Applications: This category reflects the applications of research in the form of new or improved policies, products, interventions, or practices. It captures instances

[2] It should be noted that the Payback Framework was initially developed to evaluate health services research. It relies on quantitative and qualitative methods and has its strengths when using case studies to trace the whole process. For international and multi-disciplinary research which has various funding schemes (such as fellowships and grants) the Payback Framework will have to be complemented with additional metrics.
[3] Rollins, L., Llewellyn, N., Ngaiza, M., Nehl, E., Carter, D. R., & Sands, J. M. (2021). Using the payback framework to evaluate the outcomes of pilot projects supported by the Georgia Clinical and Translational Science Alliance. *Journal of Clinical and Translational Science*, *5*(1), e48.

where research findings have been taken up by decision-makers or innovators to create something new or to change the way things are done.

Benefits for the Research Field (Outcome and Progress in the Field): This category represents the direct benefits or improvements within the specific domain of research. It denotes progress in addressing a problem or advancing a field, attributable at least in part to the research.

Wider Societal or Economic Benefits: The fifth category covers the broad, overarching benefits to society or the economy that result from the research, beyond the particular field or issue it addressed. These are often indirect or long-term impacts.

2.3 Methodology

2.3.1 Quantitative analysis

The quantitative analyses were conducted using Digital Science's Dimensions database. Dimensions is a large-scale, integrated research information platform that aggregates and links data across the global research ecosystem. It combines publications, grants, patents, clinical trials, policy documents, datasets, and researcher profiles in a single, connected database. Each research object is enriched with persistent identifiers, standardized metadata, and citation and subject classifications, enabling robust cross-sector and longitudinal analyses.

For this evaluation, Dimensions was used to identify and analyze HFSP-supported outputs, compare them to relevant benchmarks, and track their influence beyond academia. Key functionalities applied in this report include:

- **Reliable funder identification**, allowing HFSP-supported publications, grants, and outputs to be accurately isolated as a corpus.
- **Linked research objects**, enabling measurement of downstream uptake through citations in patents, clinical trials, and policy documents.
- **Field- and year-normalized bibliometric indicators** (e.g., Field Citation Ratio (FCR), Top 10% citation performance) to contextualize HFSP outcomes against global baselines.
- **Subject classification via Fields of Research (FoR)**, used to map the disciplinary composition of HFSP-supported research.
- **Researcher-level analytics**, supporting comparisons between successful and unsuccessful applicants and pre/post-award trajectories.

In summary, Dimensions provides the structured, linked, and internationally comprehensive data necessary to evaluate HFSP's contribution to scientific excellence, interdisciplinarity, and cross-sector impact.

Data curation

Data on publications and awardees (fellows and research teams) are curated and matched against the Digital Science Dimensions database. Relevant publications extracted from Dimensions based on acknowledgements were compared to the data provided by HFSP, and relevant missing outputs were added for the final corpus for the quantitative analysis (for more information, s. 11 – Annex).

HFSP publication corpus construction

The publication corpus used for the quantitative analyses was constructed through a structured curation and triangulation process that combined data provided by HFSP with publication records identified in the Dimensions database. HFSP-delivered publication lists were cleaned, de-duplicated, and standardized, then matched to Dimensions using persistent identifiers and normalized bibliographic metadata. To ensure comprehensive coverage, this corpus was complemented by publications independently identified through funding acknowledgements in Dimensions, capturing outputs not consistently recorded in HFSP's internal records. The final dataset represents a consolidated, award-linked HFSP publication corpus suitable for robust bibliometric and longitudinal analysis (see Annex for full methodological detail).

Readers may note variations in the total number of publications (n) across different sections of this report. These differences are due to specific inclusion criteria applied to fit the objective of each individual analysis:

- Time-Window Restrictions: Analyses focusing on citation impact (e.g., Field Citation Ratio) are restricted to specific publication years (e.g., 2008–2023). This exclusion of the most recent years is necessary to allow a minimum two-year window for citation accumulation and the calculation of stable metric values.
- Linkage Specificity: While overall trends may utilize the entire corpus, granular analyses are often a subset to focus on specific award types (e.g., Fellowships vs. Grants) or verified researcher linkages.
- Benchmarking Comparability: For comparative benchmarking against other funding organizations, the dataset is restricted exclusively to Dimensions-sourced records. This ensures a standardized baseline for comparison, as internal administrative data is not available for external portfolios.

Consequently, the sample sizes presented in figures and text are tailored to the specific parameters and use cases of each analysis rather than representing a fixed total across the entire report.

Publication profiles for researchers pre and post HFSP award rested on curation of researcher profiles, likewise the matching of unsuccessful applicants for analysis based on the provision of HFSP data.

Data selection

Depending on the focus of each analysis, one or more programs were selected:

- Analyses related to research outputs (publications, citations, interdisciplinarity) were based on Research Grants and Fellowships.
- Analyses related to career development, mobility, and longevity are more relevant to fellowship programs (Long-Term and Cross-Disciplinary Fellowships) but also touch Early Career Grants.
- Analyses related to international collaboration and inclusivity will apply across all programs.

Program-level comparisons

The analyses distinguished between HFSP's core program categories, namely Long-Term Fellowships (LTF), Cross-Disciplinary Fellowships (CDF), and Research Grants (Program Grants and Early Career Grants). This differentiation allowed the identification of patterns specific to post-doctoral versus investigator-led research, and the assessment of whether different mechanisms foster distinct research outputs, collaboration patterns, or career outcomes. Comparisons between the Fellowships also shed light on the effects of disciplinary origin and on post-award trajectories.

In addition to comparing program types, we examined changes over time across the HFSP portfolio. By segmenting outputs and researcher data by award year, we identified longitudinal trends, for instance, whether HFSP-supported research has become more interdisciplinary or more collaborative. These temporal patterns will support assessments of strategic evolution within HFSP's funding model.

Comparative benchmarks

Where relevant, HFSP-supported publications and researchers were compared against appropriate benchmarks to contextualize performance and trajectories. These benchmarks include field- and year-specific baselines (for citation rates, interdisciplinarity, international collaboration, etc.), selected peer funders or funding programs, and global field-wide averages. In addition, benchmarking was conducted along several complementary axes to reflect HFSP's international, basic science mission. Global benchmarks, representing worldwide biological and biomedical research, include:

- National research funders, such as CNRS, DFG, BBSRC, NSERC, ARC and JSPS that provide context for how HFSP performance compares with leading national science portfolios.
- Medical and disease-focused funders (NIH, CIHR, MRC, NHMRC, NCI, and Inserm), which highlight the distinctions between HFSP's frontier, discovery-driven research and clinically targeted programs.
- Completing the benchmark group is Wellcome Trust, a charitable organization, whose mission overlaps with HFSP in supporting high-risk, curiosity-led inquiry in a biomedical space.

Within this broader benchmarking landscape, EMBO Fellowships are considered the primary and most meaningful comparator for HFSP Fellowships. Both schemes operate in basic biological and biomedical sciences, prioritize novelty and excellence over national or disease mandates, and support both early-career researchers and investigator/team-science initiatives. EMBO's inherently international network makes collaboration, interdisciplinarity, and mobility metrics genuinely comparable to HFSP's global model. Importantly, both funders are reliably acknowledged in publications, allowing accurate funder-tagged corpora in Dimensions and enabling fair, field- and year-normalized analyses (e.g., FCR, Top-10% indicators).

NOTE

Limitations of Benchmarking for HFSP

Different funders will never be perfectly comparable, because differences in scope, target groups, strategic orientation, funding conditions, and scheme-specific features inevitably introduce ambiguity. Benchmarking HFSP is particularly challenging because the program is very unique, as discussed in particular in chapters 4 and 6. Another highly relevant factor is that HFSP is more selective than all other programs examined, i.e. it has lower application success rates (s. Annex 11.8). This allows HFSP more than other programs to concentrate funding on excellence at the very top end. Accordingly, excellent scientific results are to be expected, although the degree of excellence remains of strong interest. Among other things, it reflects how well HFSP succeeds in identifying outstanding scientists and proposals, and to what extent HFSP's approach, thematic orientation, and the concrete implementation of its funding process generate excellent outcomes.

Where available and suitable, HFSP grant programs are singled out and juxtaposed. Where possible, trajectories of unsuccessful HFSP applicants were also analyzed, providing an internal counterfactual. By comparing the subsequent publication performance, collaboration patterns, and career progression of unsuccessful applicants to those of successful HFSP awardees, the added value and catalytic effects of HFSP funding relative to applicants with similar backgrounds, research fields, and career stages can be assessed. This comparison offers a nuanced assessment of HFSP's impact at the researcher and portfolio level.

Topic modeling: Mapping research structure

Table 2: Topic modelling and semantic analysis

To capture both the breadth of the portfolio and the depth of innovation, this evaluation employs a dual-lens framework that distinguishes between the structural mapping of research fields and the semantic extraction of novel emerging concepts.

Dimension	Publication Clusters (Structural)	Concept Analysis (Semantic)
Unit of analysis	***Publications*** Analyzes the publication title and abstract as a whole entity,	***Concepts*** Isolates and analyzes specific scientific terms, variables, and key phrases extracted from within the text of title and abstract
Core method	***Topic / cluster modelling*** Uses algorithmic grouping to organize large volumes of papers into distinct thematic families based on shared vocabulary.	***Semantic concept extraction*** Employs natural language processing to identify the relationships and distances between specific scientific ideas or terms.
Main output	***Stable research areas*** Maps out the established "landscapes" of research, showing major, well-defined fields of study.	***Conceptual frontiers*** Detects the shifting edges of science, highlighting where distinct concepts are merging or diverging.
Indicative of	***Portfolio structure, balance, coherence***	***Novelty, differentiation, frontier signals*** Signals unique contributions, separating truly novel framing from standard approaches.

	Reflects how well the funding is distributed across different disciplines and whether the portfolio holds together logically.	
Risk profile	***Shows diversification & stability*** Demonstrates a safe, diversified investment across recognized and reliable scientific domains.	***Shows high-risk, exploratory ideas*** Reveals investment in unproven, experimental, or highly complex conceptual combinations.

Source: Own representation.

Topic modeling was implemented using an embedding-based clustering approach applied to the publication titles and abstracts. Publications were encoded into high-dimensional representations and grouped into thematic clusters using algorithmic criteria designed to maximize internal coherence and separation between clusters. The number of clusters was set to a maximum of 10, supporting stable, reproducible identification of research areas rather than relying on predefined disciplinary taxonomies. Each cluster was subsequently characterized using aggregate linguistic features of its constituent publications, enabling transparent interpretation of clusters as substantive research areas. This approach supports a robust, scalable, and field-agnostic mapping of research structure, reducing dependence on journal-based classifications and enabling consistent comparison across funders, programs, and time periods.

Measuring conceptual novelty

Conceptual novelty was assessed using concept-level semantic embeddings derived from publication text. For each publication, novelty was quantified as semantic distance from a global reference corpus (2020–2024) of funded basic science in biology and chemistry, ensuring that comparisons reflect differences in conceptual framing rather than historical change. High-novelty publications were defined as those falling within the top decile of novelty scores across the combined HFSP and non-HFSP corpus.

Within the context of this evaluation, conceptual novelty is treated as an empirical signal of frontier science activity. Rather than equating frontier science with the emergence of entirely new topics or fields, this analysis also focuses on shifts in how scientific problems are framed, explained, and conceptually organized within established domains. Research operating at the frontier is thus characterized by its distance from prevailing explanatory frameworks, even when it addresses long-standing biological questions.

This approach builds on recent work demonstrating that scientific novelty can be robustly quantified as semantic distance in embedding space, capturing differences in conceptual framing rather than the mere appearance of new topics or terminology. Word-embedding–based novelty measures have been shown to distinguish genuinely novel scientific contributions within established fields and to correlate with expert assessments of novelty, particularly when compared to a reference corpus.[4]

[4] Shibayama, S., Yin, D., & Matsumoto, K. (2021). Measuring novelty in science with word embedding. *PLOS ONE*, *16*(7), e0254034.; Yin, D., Wu, Z., Yokota, K., Matsumoto, K., & Shibayama, S. (2023). Identify novel elements of knowledge with word embedding. *PLOS ONE*, *18*(6), e0284567.
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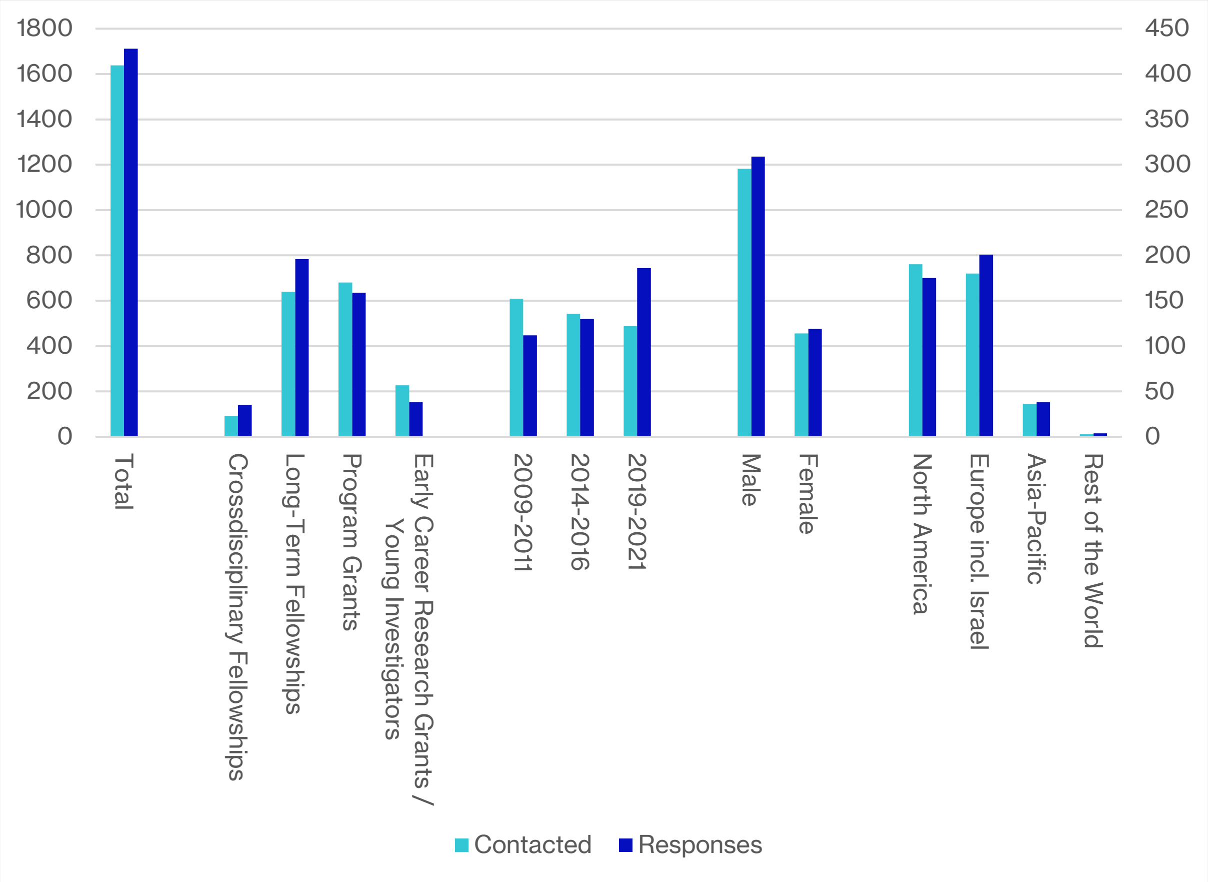
2.3.2 Qualitative analysis

Survey

A survey of HFSP awardees was conducted to create a broad evidence base reflecting their perceptions. Three three-year cohorts were included: 2009–2011, 2014–2016, and 2019–2021. Awardees from all program lines (Cross-Disciplinary Fellowships, Long-Term Fellowships, and Research Grants, including Early Career Grants and Young Investigator Grants) were invited to participate in the survey

Figure 2: Overview of survey target group (invitations and responses)

Left Axis: Total invitations; Right Axis: Number of responses.



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021.

We contacted 1,638 awardees. 272 email addresses were no longer valid. We received 428 responses, 379 complete. That is a total response rate of nearly one third (31.3 %,excluding the no longer valid addresses).[5] The figure above shows the distribution of the invited participants and the corresponding response rates for each group.

[5] In some cases, secondary email addresses were used to increase the response rate. The exact response rate may therefore deviate slightly.

As expected, the response rate decreases for the older cohorts. Nevertheless, even for the earliest cohort, enough awardees (112) responded to allow for robust conclusions.[6] The number of respondents from the category "Rest of the World" was too low to draw any robust conclusions. They are therefore usually not included in regional differentiation. The number of responses from the Early Career Research Grants/Young Investigators and Cross-Disciplinary Fellowships is low (38 and 35, respectively), but not too low to make the drawing of conclusions impossible.[7] These conclusions are tentative and will be triangulated with other evidence. Research Grants include the Early Career Research Grants/Young Investigators and Program Grants. The Cross-Disciplinary Fellows and the Long-Term Fellowships are summarized under Fellowships. The specific program is singled out when there is an interesting deviation.

With the answers received, there is a certain sample bias in favor of awardees who remained in academia. Many of the email addresses were linked to academic institutions, and academics are generally more likely to respond to surveys. The quantitative analysis showed that HFSP awardees remain at exceptionally high rates in academia, but not as often as the survey results suggest. This bias needs to be taken into account when interpreting the results. The survey is well-suited for exploring the academic dimension of HFSP's impact, but somewhat less so for representing non-academic career trajectories and impacts outside of academia.

The bias will be less relevant for the youngest cohort, since their response rate is higher overall and they had little time to transition out of academia, as their HFSP funding only ended very recently. Accordingly, each analysis examined whether the younger cohorts differed significantly from the older cohorts.

Interviews

To contextualize the survey and the quantitative analyses, an interview program was conducted with Fellows and recipients of Early Career Research Grants. Research Grants were excluded because they were covered by a separate interview program conducted as part of the case studies. In total, eight interviews were carried out. The selection followed a semi-random procedure designed to ensure a certain degree of diversity in terms of origin, field of research, gender, and year of funding. The interviews were conducted in a semi-structured format to ensure comparability while allowing participants the opportunity to share their experiences and perspectives.

Case Studies

The case studies form a key qualitative component of the HFSP evaluation and aim to generate detailed insights into the characteristics and outcomes of selected HFSP-supported projects. Building on the quantitative analyses, survey findings, and interview results, they provide a deeper understanding of how HFSP funding supports frontier science, fosters interdisciplinary collaboration, and promotes the development of international research teams.

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[6] The margin of error is approximately ±9 percentage points (95 % confidence level). This is considered sufficient for approximate statements. If these results are used in the evaluation, care is taken to ensure appropriate contextualization.
[7] The margin of error is approximately ±16 and ±17 percentage points (95 % confidence level) respectively.

The case studies were selected in consultation with HFSP. To date, nine interviews have been conducted across six case studies, two of which are currently available in final draft form and three in first draft form. To better capture the perspectives of commercialization and valorization, two additional case studies are planned that will focus specifically on these aspects.

Focus groups

Focus groups are an integral part of the qualitative data collection strategy, offering a structured setting for dialogue with key HFSP stakeholders. In contrast to interviews and case studies, which focus on individual research experiences, focus groups explore broader strategic and institutional perspectives. They support collective reflection on HFSP's role in national and international research systems, perceptions of program effectiveness, and ideas for future development.

The focus group with the HFSP Review Committee and Council of Scientists members took place on November 18th, 2025. The focus group was used to validate findings from the quantitative and qualitative analyses and to reflect possible improvements of the HFSP selection process. Through a structured discussion of the review procedures and selection criteria, the insights contributed to refining the analysis. A second focus group with representatives of HFSPO members took place on December 2nd, 2025, and centered on the perception of HFSP among members as well as possible needs for change. The second focus group contributed to the evaluation topics on the value added for members and the way forward. Additional interviews were conducted with members from the HFSP Review Committee, the Council of Scientists and the Board of Trustees who could not attend due to scheduling or time zone conflicts.

A Note on Small-N Studies

Small-*N* studies play an important role in the social sciences, especially in fields such as public policy and evaluation. The approaches generally trade breadth for depth, allowing researchers to gain rich, contextual insights that large-N statistical analyses might miss. In this review, two common methods of enquiry were used (interviews and case studies), which typically result in a small N. The third method, the online survey, was targeted at a sample of 1,366 fellows (excluding the invalid email addresses) and grantees yielding 428 answers. This typically does not count as a small N study. Since we opted to survey three different cohorts (to check for differences in answering behavior) instead of all fellows and grantees, there are fewer responses than there would have been if all fellows and grantees had been targeted.

In social science, a study's validity refers to how well it measures what it claims to measure and how credible its findings are. Classic methodological works[8] affirm that qualitative and quantitative studies ultimately share the same logical standards of inference, meaning that small-N studies can be just as valid and informative as large-N studies. The central mechanism for validating the results is using multiple methods or data sources to cross-check findings. In this review, the findings of the bibliometric analysis and those from the more qualitative approaches have been combined in a way to complement each other (triangulation). To synthesize the discussion, Table

[8] For example, King, G., Keohane, R. O., & Verba, S. (1994). Designing social inquiry: Scientific inference in qualitative research. Princeton University Press.

3 provides a brief comparison of the strengths and limitations of interviews, case studies, and online surveys in small-N research, particularly with respect to validity criteria.

Table 3: Strengths and Limitations of Small-N Methods

Method	Strengths in Small-N Context	Challenges / Limitations
Interviews	• Rich, detailed qualitative data and context-specific insights. • Can probe causal mechanisms directly through participants' perspectives. • Flexible interaction can clarify meanings (improving validity of responses).	• Responses may be biased or selective; credibility must be cross-checked. • Difficult to standardize or replicate exactly (potential reliability issues). • Typically not representative of a broad population (limited generalizability).
Case Studies	• Deep process-tracing yields high internal validity (causal depth). • Multiple evidence sources (documents, interviews, etc.) enhance construct validity via triangulation. • Nuanced understanding of context; can refine or generate theory (analytic generalization).	• Few cases examined -> low external validity in statistical terms (findings may not apply universally). • Researcher bias or subjective interpretation can affect conclusions (mitigated by transparency and peer review). • Case selection must be handled carefully to avoid selection bias (e.g., "cherry-picking" cases).
Online Surveys	• Efficient way to collect structured data from targeted samples (e.g., policy experts in two countries). • Standardized questions ensure consistency across respondents (reliability of measurement). • Anonymity and computerized delivery can reduce social desirability bias in answers.	• Small sample size reduces ability to generalize findings beyond the sample; not statistically representative of larger populations. • Potential nonresponse or self-selection bias (those who respond might differ from those who don't). • Survey questions need careful design and pre-testing; misinterpretation by respondents can threaten validity, especially without an interviewer to clarify.

Source: King, Gm Keohane, R. & Verba, S (1994): Designing Social Inquiry: Scientific Inference in Qualitative Research; Princeton University Press, Princeton.

As the table suggests, each method has particular strengths: interviews and case studies are valuable in delivering internal validity and conceptual depth, whereas online surveys (even with small N) offer structured data and consistency. Their limitations are the flip side of those strengths: what is gained in depth or focus is often paid in breadth or uniformity. Crucially, none of these limitations is fatal to validity.

2.3.3 Definitions of Core Concepts regarding the Classification of Research

The following section defines several terms as they are understood and used in this report. These definitions do not claim to represent an objective truth; rather, they provide the basis for a shared understanding.

Basic Science:
Research driven by curiosity to uncover fundamental principles of nature, without immediate application in mind.

Frontier Science:

Research that makes novel contributions to its field or beyond, facilitating breakthroughs which push its boundaries. Frontier science operates at the boundaries of established fields, pushes into newly emerging and interdisciplinary areas, and actively helps to shape them.

Novelty:
In this report, novelty is defined by how scientific problems are framed and conceptualized, rather than simply by the introduction of new topics or techniques. Novel research reshapes the explanatory framework and challenges prevailing assumptions.

High risk:
The chances of achieving the predefined objectives are low, but this does not mean that the research cannot generate other benefits. High risk is necessarily associated with innovative, boundary-pushing research and thus with frontier science.

High reward:
The research has a major impact in or beyond its field. This may be confined to the scientific domain, but it can also extend beyond it. It is closely associated with excellence.

Excellence:
Excellent research is characterized by its wide reception, primarily within the scientific community but also in societal, political, and economic domains. This can be reflected in publications, citations, press articles, policy documents, and patents.

Interdisciplinarity:
Individual researchers work across multiple fields (or subfields) or collaborate with others working in different fields. This is reflected, among other things, in interdisciplinary publications and in the mobility of researchers between fields.

International Collaboration:
Researchers from more than one country or region are participating in grant applications, projects and related publications.

3 HFSPs Mission and Structure

The overarching mission of HFSP is "supporting scientific excellence at the frontier of life science", i. e., promoting innovative basic research. For almost four decades, HFSP has maintained its position in the global research ecosystem by supporting high-risk, high-reward projects and facilitating international collaboration across disciplines and regions. The programs are aimed at scientists in all career stages, as well as fostering the scientific ecosystem around values such as diversity & inclusion, open science and freedom of research, and science for society.

The organization's strategic direction is set out in the Strategic Plan 2024–2032. Based on the principles of Vitality, Connectivity, Diversity and Foresight, HFSPO "commits to a world where frontier, breakthrough science pioneers new knowledge and solutions for humanity's future"[9]. For the 2024 – 2032 period, HFSPO has defined the following goals:

1. Expand Frontier Science: Closing the "frontier gap" and reinvigorating HFSPO's leadership and niche in supporting truly frontier life science.
2. Strengthen HFSPO through Engagement: Create opportunities for discussion and exchange that foster breakthrough leaps in frontier life science and connect all HFSPO Members, stakeholders, and the community as a whole.
3. Become a globally inclusive organization: Welcome and engage a diverse array of people's ideas, perspectives, and research institutions across HFSPO and extend our shared values.

HFSP has a range of funding schemes that differ in structure and target groups but are all designed to support the type of research at the core of HFSP's mission: high-risk/high-reward, interdisciplinary, internationally collaborative frontier science. To this end, the various funding schemes impose specific requirements on applicants. For example, fellows may not conduct their project in a country where they have already been active for an extended period, and Research Grants require establishing new international, and preferably intercontinental, collaborations. The following table provides an overview of key facts for the different funding schemes.

Table 4: Overview HFSP funding schemes

Activity	Funding Scheme	Target Group	Duration
Research Grants (RG)	Program Grants (RGP)	Scientists at any career stage	3-year support
	Early Career Research Grants (RGEC)	Scientists within 5 years of their first independent position and 10 years after their PhD	3-year support

[9] HFSPO. (2024). HFSPO strategic plan 2024–2032: Frontier life science in a time of change.

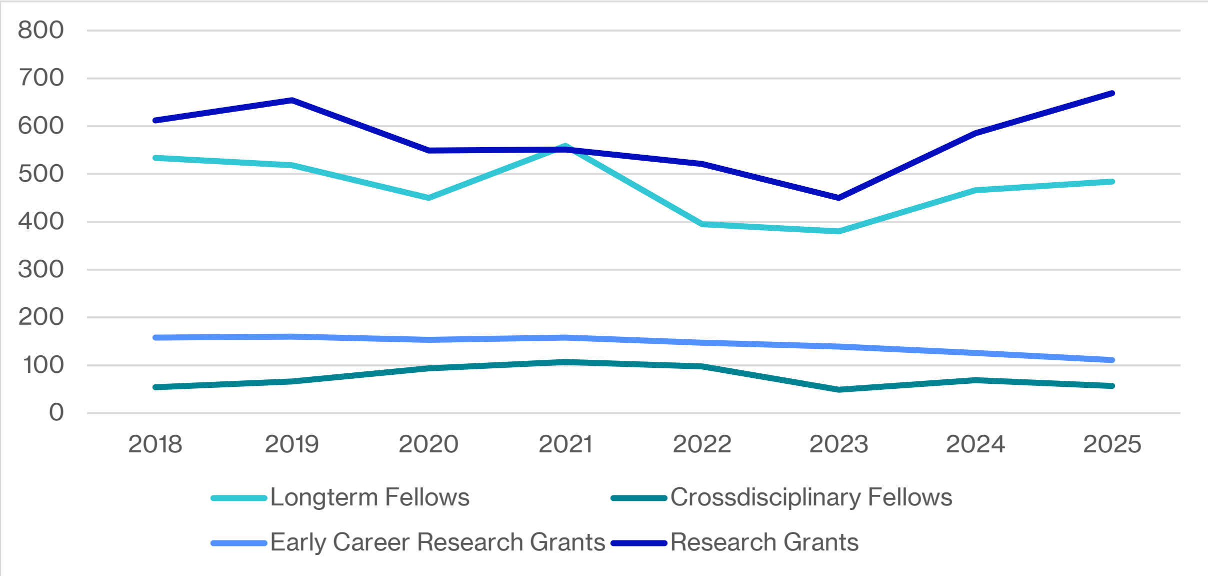
	Accelerator Grant	Scientists working at a re-search institution in India, Japan, New Zealand, Norway, Republic of Korea, Singapore or South Africa	2-year support
	Scientist4Scientist Initiative	HFSP awardees with the intent to help and host scientists affected by the current conflict in Ukraine	Until the end of current HFSP project
Fellowships	Long-Term Fellowships (LTF)	Scientists within 3 years of their PhD on a biological topic	3-year support
	Cross-Disciplinary Fellowships (CDF)	Scientists within 3 years of their PhD outside of the life sciences	3-year support

Source: Own representation of HFSP Program Structure.

3.1 Overview of selected Key Figures

The most significant funding schemes, and those examined in the present evaluation, are the two Fellowship schemes, the Research Grants, and the Early Career Research Grants. The Early Career Research Grants and Cross-Disciplinary Fellowships can be regarded as variants of the Research Grants and Long-Term Fellowships, respectively. The differences relate to the target groups: unlike Long-Term Fellows, Cross-Disciplinary Fellows must come from a field outside the life sciences. Early Career Research Grants, in turn, are directed exclusively at researchers who are at a relatively early stage of their careers. 2025 HFSP funded 47 Long-Term Fellowships, 3 Cross-Disciplinary Fellowships, 25 Research Grants and 5 Early Career Research Grants. It should be noted that the Research Grants and Early Career Research Grants each fund up to four researchers per project. Research Grants and Long-Term Fellowships are by far the largest funding schemes. The other two funding schemes complement the bigger ones by targeting specific groups of scientists. The relative sizes are reflected in the number of applicants (s. Figure 3).

Figure 3: Total Application Numbers (LoIs) for different funding schemes 2018-2025



Source: HFSP-Data.

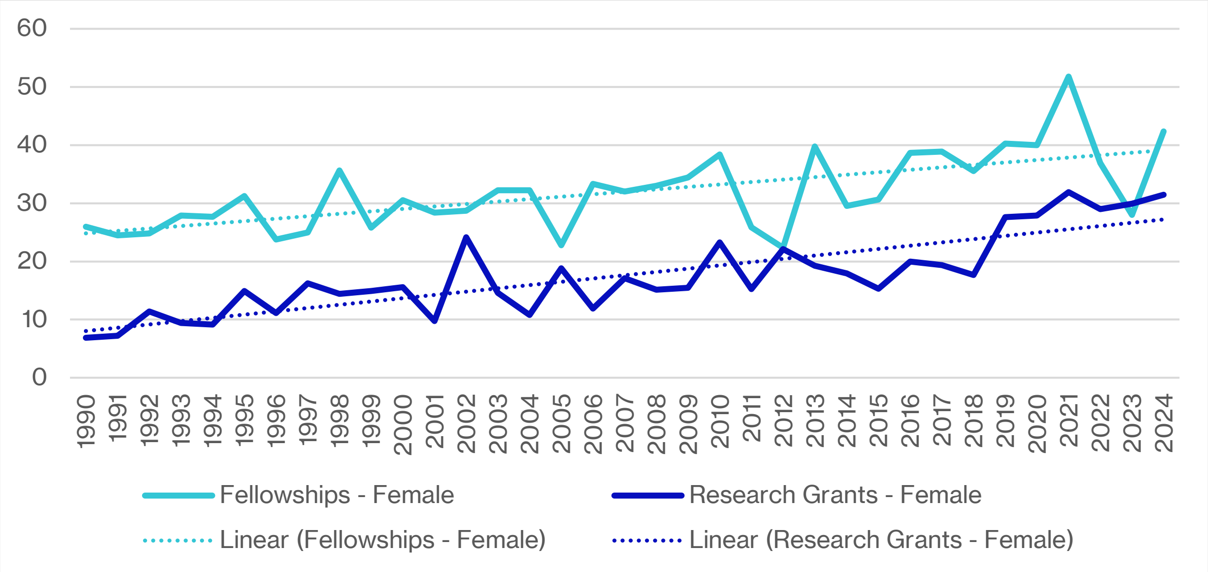
The number of applicants for the Cross-Disciplinary Fellowships and the Early Career Research Grants is stable, with a slight downward trend for the latter. In contrast, the Long-Term Fellowships and the Research Grants exhibit greater fluctuations, with a marked increase over the past two years.

A two-stage application procedure was introduced for the Fellowships from 2022 onwards, mirroring the process that has long been in place for the Research Grants (including Early Career). However, this change is unlikely to have contributed substantially to the increase in Long-Term Fellowship applications over the last two years, as the timing does not fully align with the increase, and the Research Grants show a similar increase. The latter suggests that shifts in the broader funding landscape are a more likely explanation.

The success rates correlate strongly with the number of applicants, as HFSP's financial resources are limited, and thus the number of projects and researchers that can be funded have remained relatively constant. The Research Grants (including Early Career) have a relatively stable success rate of around 5%, whereas the Fellowships have a slightly higher more erratic success rate of between ~5 % and ~15 % in the last five years.

The success rates of HFSP, particularly for the Research Grants, are significantly lower than those of comparable programs, which typically range between 10 % and 30 % (s. Annex 11.8). HFSP grants are therefore much more competitive than others, reflecting the high demand for the specific type of support that HFSP offers (s. section 5.1). The low success rate results in a relatively large application burden on both sides, making it more important to keep the process as streamlined as possible (s. section 3.2). On the other hand, it also means that HFSP can be highly selective in choosing awardees and projects, which is reflected in the high quality of HFSP-supported research. This has consequences for the benchmarking as noted in the relevant chapter (s. **Comparative benchmarks**).

Figure 4: Percentage of Female Awardees in the Fellowships and Research Grants (incl. Early Career Research Grant, Young Investigators)



Source: HFSP-Data.
Gender was self-reported. For a small number of awardees, no gender information was available, or they were nonbinary; these cases were excluded from the analysis.

The figure above shows the percentage of awardees in a given year who were women, distinguishing between Fellowships and Research Grants. The latter category includes Early Career Research Grants. As shown, the proportion of female awardees started at a low level in 1990 but has increased substantially since then. Notably, the share of female awardees has been consistently and markedly higher in the Fellowships than in the Research Grants. However, this discrepancy between funding schemes has also diminished over the years. Overall, the proportion of women among those receiving funding is still well below 50%. This is most likely not due to fewer women than men obtaining doctoral degrees in the life sciences. Exact global figures are hard to pin down, but various sources indicate that the proportion of female researchers in this field is around 50% or higher.[10] It is therefore worth examining the success rates for men and women in HFSP funding schemes.

The success rates for men and women in the Research Grants have converged, and there is no longer a systematic difference. The fact that women nonetheless account for only around 30% of Research Grant awardees is entirely attributable to the lower number of female applicants. One

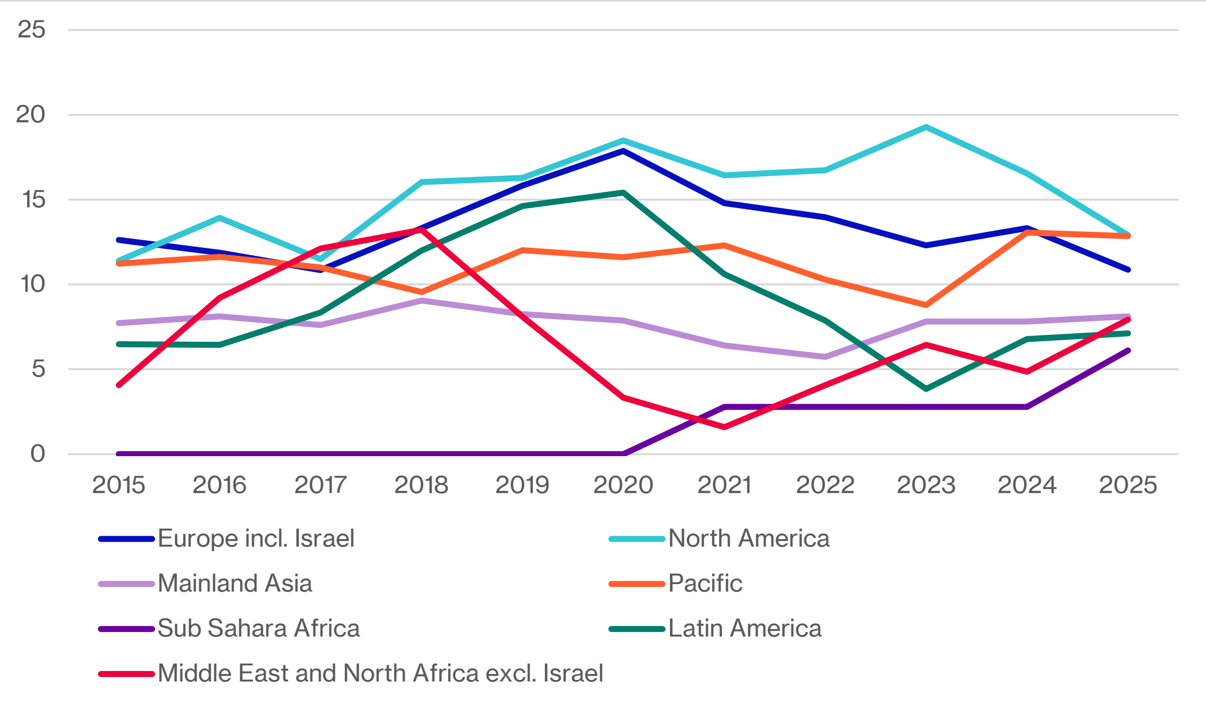
[10] The 2021 UNESCO Science Report already noted that women in the life sciences have achieved parity in most countries and are even disproportionately represented in some (UNESCO. (2021). UNESCO Science Report 2021. Women and the digital revolution [Chapter 3]. https://www.unesco.org/reports/science/2021/en/women-digital-revolution). Eurostat shows that for years women account for ~ 60 % of doctoral degrees in biological and related sciences in the EU. A more detailed analysis of Eurostat data for 2021 shows that women in the life sciences account for approximately two-thirds of all degrees (Botey, M. (2025). February 11: International Day of Women and Girls in STEM. https://www.ofce.sciences-po.fr/blog2024/en/2025/20250227_MB/). In the US women earned about 55 % of life science doctorates 2020 (Maryland Smith Research. (2024). Study Examines Gender Disparity in Science Research Funding. https://www.rhsmith.umd.edu/research/study-examines-gender-disparity-science-research-funding).

possible contributing factor is that networks among researchers remain predominantly male.[11] However, interviews and case studies do not provide any evidence for this.

The data for the Fellowships are more erratic and harder to interpret. In contrast to the Research Grants, a slight advantage for men over the past five years can still be observed, which partly explains the disparity between men and women in the number of awardees in the same period. However, the composition of the applicant pool plays a bigger role than the success rate here as well. Also, in 2025, the success rate for female applicants was markedly higher than for male applicants (10 % vs. 7 %).

The proportion of Europeans among the Fellows has declined markedly over the past decade from 46 % in 2015 to 21 % in 2025. Nevertheless, they still constitute the largest group by far. When the analysis is broadened to include success rates, a more complex picture emerges.

Figure 5: Success rates for Fellows differentiated by Region in % (Average over three last years)



Source: HFSP Data.
Data inconsistencies and missing data may skew the results, but not by a significant degree.

The figure above shows success rates by region for the fellowships, calculated as three-year averages to improve the readability of trends. The success rates exhibit a clear convergence trend and, thereby increasing diversity among the Fellows. Nevertheless, it is evident that the three regions, North America, Pacific, and Europe (including Israel) continue to stand out with significantly

[11] See for example: Kwiek, M., & Roszka, W. (2021). Gender-based homophily in research: A large-scale study of man-woman collaboration. *Journal of Informetrics*, *15*(3), 101171.; Whittington, K. B. et al. (2024). Structure, status, and span: gender differences in co-authorship networks across 16 region-subject pairs (2009–2013). *Scientometrics* 129, 147–179.

higher success rates than the other regions. The Research Grants show a similar picture overall with Europe (including Israel), North America and Pacific having the highest success rates and among the most applicants, with Europe leading the latter category by a significant margin.

Overall, the results show that HFSP's center of gravity remains in Europe and North America, with several Pacific countries also playing a significant role. Over time, however, HFSP has increased its geographical diversity. Due to the small numbers involved and the resulting volatility, only a broad trend can be inferred from the quantitative data. However, this trend is supported by the findings from focus groups and interviews. HFSP also undertakes targeted outreach efforts, for example, through masterclasses, to mobilize suitable applicants from previously underrepresented parts of the world.

3.2 Assessment of current Program Design and Administration

Various aspects of HFSP's program design, administration and outreach are assessed very positively by the researchers surveyed and interviewed. Overall, supported researchers perceive HFSP as a flexible program. With the flexibility offered, HFSP sets itself apart from other programs by giving researchers a higher degree of freedom, as visible in Figure 27. Interviewed researchers characterize the program as exceptionally flexible, with HFSP supporting changes to the topic and methodology.

EXAMPLE

From unconfirmed hypothesis to lasting impact: the value of flexibility

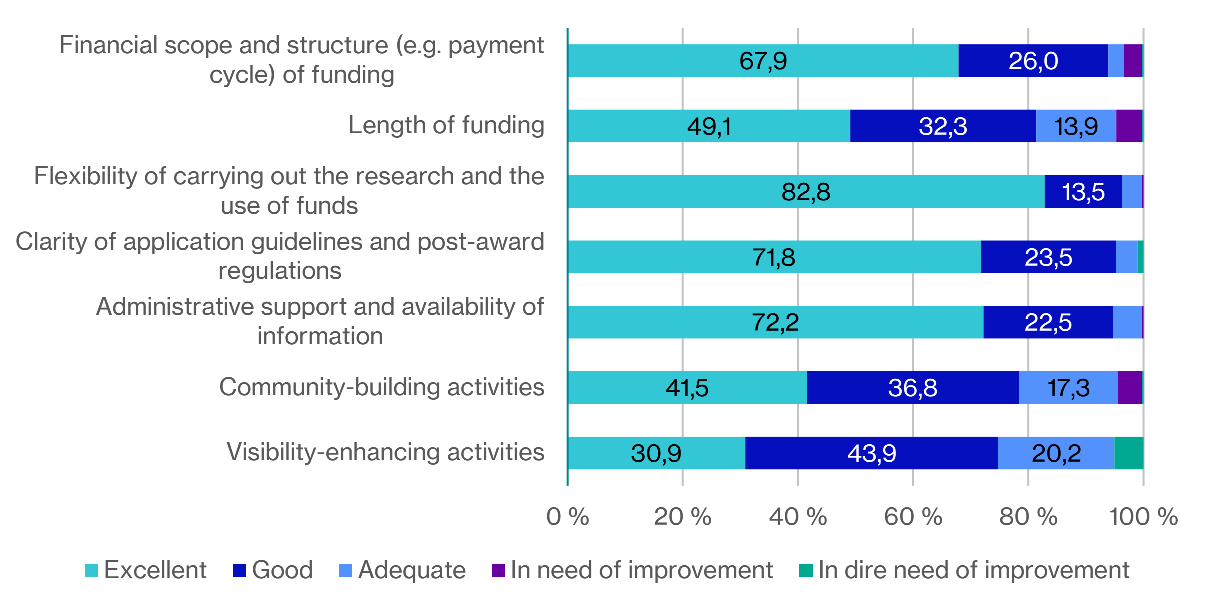
The HFSP-supported project started with a high-risk hypothesis on adaptive antiviral immunity in mosquitoes. When early results showed that the original hypothesis could not be confirmed, HFSP's flexible funding framework allowed the team to pivot both research focus and methodology without major bureaucratic hurdles. The project shifted towards a more comparative and evolutionary genomics approach, expanding whole-genome mapping across mosquito populations and integrating new analytical pipelines and methods. This flexibility was essential to ultimately generating robust, globally relevant insights into mosquito evolution and human specialization that would not have emerged under a rigid funding scheme. It pioneered an approach to mapping genes and populations that was subsequently adopted by others for different species.

Source: Case study interview, Literature: Lozada-Chávez, I. et al. (2025). Adaptive genomic signatures of globally invasive populations of the yellow fever mosquito Aedes aegypti. Nature Ecology & Evolution.

According to the survey respondents, HFSPO offers clear application guidelines and provides sufficient information and administrative support (s. Figure 6). Length of funding is largely assessed positively, with only around 5 % of the respondents seeing a need for improvement. Awardees highly value the community-building and outreach activities offered by HFSP, with the annual HFSP meetings being described as "mind-bending" and a crucial networking component across disciplines and projects. Interviewed researchers and reviewers underline a high demand for more visibility-enhancing activities, for example, through the engagement of HFSP awardees. This must, however, be balanced against highly limited human and financial resources of HFSP.

Figure 6: Assessment of program design, administration and outreach in % aggregated for all funding schemes

How do you rate HFSP in the following categories?



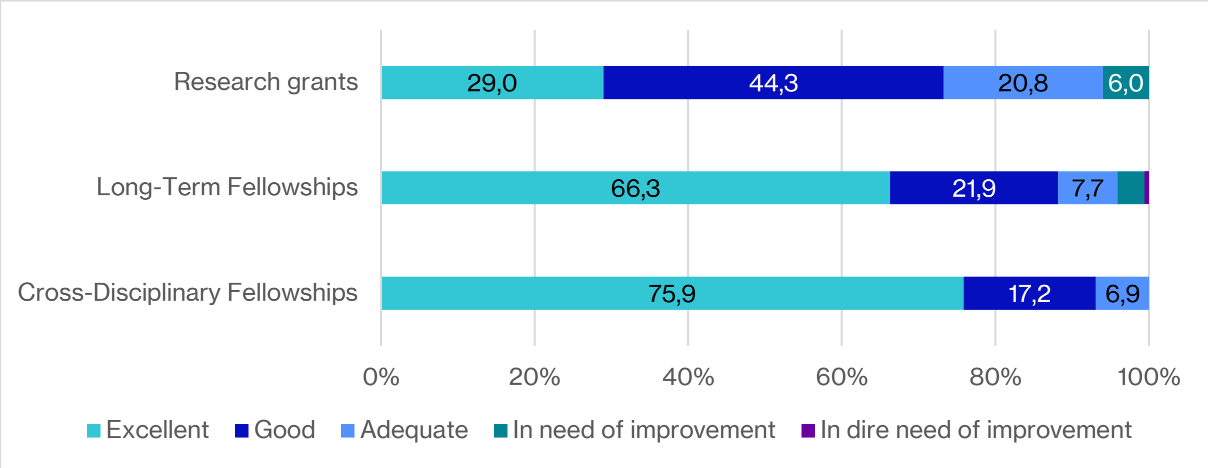
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 381.

Distinguishing the assessment of the funding period by funding scheme allows for a differentiated perspective. Figure 7 shows that 75 % of the surveyed grantees rate the current funding duration as good or excellent. About a quarter of the surveyed research grantees view the length of funding as adequate or in need of improvement while the share of fellows with this view is below 10 %. Given the highly ambitious, interdisciplinary and collaborative character of the HFSP projects, respondents and interviewees argue that it can be challenging to complete the project within the three-year funding period. In comparison, the ERC Synergy Grants cover up to six years[12] and the NIH awards for high-risk, high-reward research span five years.[13] Nevertheless, the interviewees recognize the trade-off between funding fewer projects for longer vs funding more projects overall. The length of funding is assessed more positively by fellows. With their three-year duration, the Long-Term and Cross-Disciplinary Fellowships cover a similar, if not a longer, period than comparable postdoctoral fellowships. The EMBO fellowship, for example, generally covers two years.[14] The Fellowships offered through the Marie Skłodowska-Curie Actions range from one to three years.[15]

[12] EMBO. (2025). Postdoctoral fellowships – Benefits. ERC Synergy Grant: Collaborative Research Funding Opportunities.
[13] National Institutes of Health. (2026). High-risk, high-reward research (HRHR). NIH Common Fund. High-Risk, High-Reward Research (HRHR) | NIH Common Fund.
[14] EMBO. (2025). Postdoctoral fellowships – Benefits. Postdoctoral Fellowships – Benefits – EMBO.
[15] European Commission. (2025). Postdoctoral fellowships. Marie Skłodowska-Curie Actions. Postdoctoral Fellowships - Marie Skłodowska-Curie Actions.

Figure 7: Assessment of length of funding by funding scheme in %

How do you rate HFSP in the following categories?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 381.

Looking at the response behavior by region, the very positive assessment of the financial scope can be further differentiated. It should be noted that the n is comparably low for Africa, Latin America and the Middle East, but participants from these regions have rated the financial scope overwhelmingly positively. Interviewees from these regions, e. g. Argentina, confirm this assessment. The share of researchers assessing the financial scope and funding structure as adequate or in need of improvement is higher, though still quite low, in Europe, North America and Asia. Interviewees argue the overall funding rates are higher in these regions, as well as the costs of living.

In 2022, HFSPO initiated a thorough organizational and process review of the program that investigated the appropriateness of HFSP instruments and the selection process. Overall, the review assesses the HFSPO procedures very positively, deeming them well-suited to identify “the most innovative, ‘frontier’ research ideas and recommend them for funding” [16]. The review further identifies two core challenges for HFSP: handling the high demand for HFSP funding and diversity, two topics also addressed in the current 2025 review, particularly in the focus group with members of the Review Committee and the Council of Scientists.

As evident in section 3.1, the number of applications has increased across the past years, especially for the Long-Term Fellowships and the Research Grants. Reviewers largely attribute this increase to developments in the global funding landscape. The increase in applications is reflected in an increased workload for the HFSPO office and the affiliated reviewers, mainly in the first application stage. Additional reviewers were brought in to keep the procedures streamlined. The additional reviewers were primarily researchers that have worked as HFSP reviewers before.

[16] See Kolarz, P., Davé, A., Bryan, B., Urquhart, I., Rigby, J., & Sutinen, L. (2022). Organisational and process review of the Human Frontier Science Program (Final report). Technopolis Group.

Through this step, the burden for the reviewers by the time of the selection process was perceived as manageable underlining the flexibility and agility of HFSPO.

In 2002, HFSPO introduced the Letter of Intents (LoIs) as a first stage of the application procedure for research grants. Since 2022, LoIs have also been part of the fellowship application process. In contrast to the introduction of LoIs for the grant program,[17] the introduction of LoI has not led to a significant surge in application numbers. From the point of view of the reviewers, the use of LoIs has improved the application process for fellowships, allowing the reviewers to focus on full-length proposals that already fulfill HFSP requirements. Through the introduction of LoIs, the full-length proposals are perceived to be of a higher quality.

The focus group discussions revealed, that the reviewers highly value the panel assessment in the full application stage and feel well prepared to be able to identify high-risk and frontier projects. The interviewed reviewers acknowledge that the panel assessment is not free from biases, for example, country- or discipline-specific, but underline that these usually become visible in the discussion and can be accounted for. Nevertheless, the interviewed reviewers agree that to ensure this, the Review Committee must maintain a sufficiently high level of diversity in different dimensions: the range of HFSPO member states, scientific subfields and emerging research fields.

[17] Kolarz, P., Davé, A., Bryan, B., Urquhart, I., Rigby, J., & Sutinen, L. (2022). Organisational and process review of the Human Frontier Science Program (Final report). Technopolis Group.

4 Characteristics of HFSP Research

HFSP positions itself as a funder of frontier science in the life sciences: research that is more ambitious, interdisciplinary, and internationally collaborative than that supported by other funding organizations. The following chapter examines the extent to which HFSP fulfills these ambitions and the degree to which this confers a unique position within the global life-sciences funding landscape. The various strands will be brought together in a later section (s. section 6) in a summary on the theme of uniqueness.

EXAMPLE

Addressing one of reproductive biology's fundamental open questions

With the fellowship project "Molecular and physical mechanisms of gamete binding and fusion in zebrafish" (Victoria Deneke), HFSP supported research investigating the question of what binds sperm and egg together. The project was based on a multi-disciplinary approach and leveraged Nobel Prize-honored artificial intelligence technology (AlphaFold) to predict protein structures as early adopters. The project results fed into a 2024-published study in which researchers identified an interlocked bundle of three proteins crucial to ensuring fertilization. Beyond the basic discovery, the findings open pathways for clinically relevant advances in research on infertility and contraception in the long run.

Source: Case study interview, Literature and articles: Deneke, Victoria E. et al. (2024). A conserved fertilization complex bridges sperm and egg in vertebrates. Cell, 187(25), 7066–7078.; Preston, E. (2024, October 17). Sperm can't unlock an egg without this ancient molecular key. The New York Times. https://www.nytimes.com/2024/10/17/science/sperm-egg-proteins-key.html?ogrp=ctr&unlocked_article_code=1.S04.9mTG.IdADO2wrruFk&smid=url-share.

4.1 Frontier Science

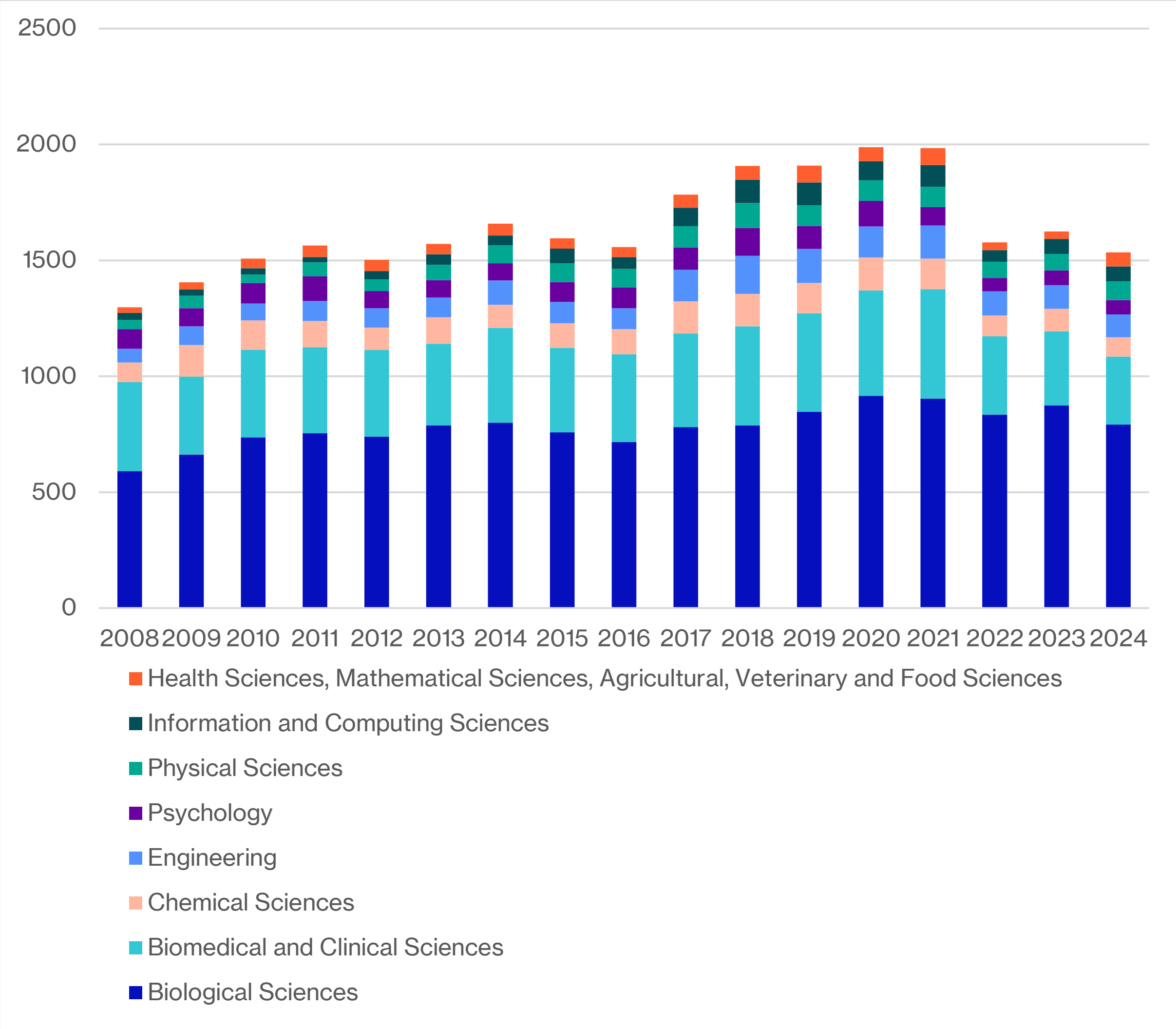
4.1.1 Disciplinary Mix Over Time: Life Science Core with Adjacent Disciplines

HFSP's mission is to support basic frontier research in biology, while deliberately integrating perspectives from adjacent disciplines such as physics, chemistry, mathematics, engineering, and the cognitive sciences. This mandate is reflected in the disciplinary profile of HFSP-acknowledged publications over time. Using the Fields of Research (FoR) classification at the top level, Figure 8 shows the distribution of HFSP publications across the ten dominant disciplines between 2008 and 2024.

Across the full period, Biological Sciences remain the core domain of HFSP research, consistently accounting for the largest share of publications and showing sustained growth through 2024 (s. Figure 8). This reflects HFSP's origins and enduring strength in fundamental life-science discovery. Biomedical and Clinical Sciences form the second-largest discipline, remaining substantially smaller than Biological Sciences throughout the period but showing moderate growth from the late 2000s to a peak around 2020–2021. This pattern indicates an increasing integration of biomedical questions and clinically relevant frameworks into HFSP-supported basic research, without displacing the program's primary focus on fundamental biology.

Figure 8: Unique HFSP Publications in different disciplines (FoR) over time

Publications of disciplines of HFSP-supported publications across the ten top-level Fields of Research (FoR) in this dataset. Biological Sciences dominate throughout the period, with steady contributions from Biomedical and Clinical Sciences.



Source: HFSP Data and Dimensions Database.

Beyond these core areas, the most dynamic relative growth occurs in adjacent fields, notably Engineering, Information and Computing Sciences, and Psychology. Although smaller in absolute volume, these disciplines increase steadily over time, highlighting a gradual shift toward more interdisciplinary and integrative research modes. The growing presence of computational, quantitative, and cognitive approaches reflects HFSP's role in enabling research that bridges biological mechanisms with modelling, technology development, and systems-level analysis.

Recent declines observed across several disciplines should be interpreted cautiously. From 2022 onward, total HFSP-attributed publication counts decrease across most Fields of Research, reflecting shorter publication windows for recently funded projects and broader post-COVID disruptions to research activity and dissemination. Except for Biological Sciences, which remain comparatively resilient, all major disciplines show reduced absolute publication numbers in the last three years, mirroring global publication trends rather than indicating a substantive shift in HFSP's disciplinary priorities.

Taken together, the disciplinary profile reveals a portfolio that is biologically anchored yet connected to adjacent scientific domains, consistent with HFSP's strategic emphasis on boundary-crossing frontier research.

4.1.2 Publication Clusters

Beyond disciplinary labels, HFSP-supported publications organize into coherent research clusters rather than dispersing into isolated topics. A clustering analysis of HFSP-acknowledged publications between 2008 and 2024 reveals a stable set of major research areas with sustained publication activity over time (Figure 9). This structure indicates an intellectually coherent portfolio built around enduring scientific problems, rather than a collection of disconnected outputs.

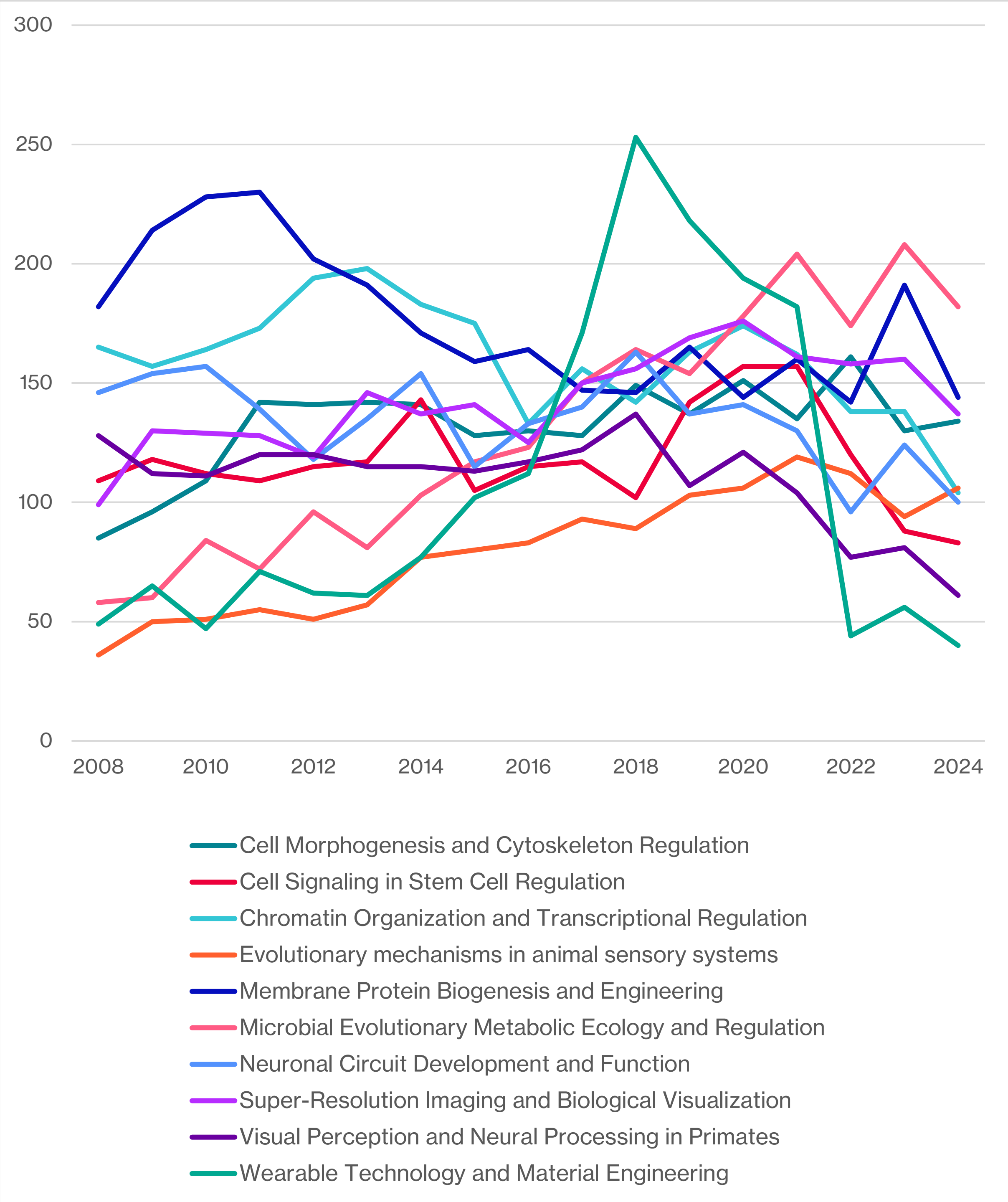
The overall publication volume grows steadily from 2008 through the late 2010s, with most clusters maintaining strong activity into the early 2020s. As in the disciplinary analysis, a modest dip in publication counts appears in the most recent years, consistent with post-COVID dynamics and indexing delays rather than a structural decline.

The dominant clusters reflect HFSP's long-standing strengths in molecular and cellular biology, neuroscience, and imaging, while also capturing emerging interdisciplinary frontiers. Core clusters such as chromatin organization, cell signaling, and cytoskeletal regulation anchor the portfolio in fundamental biological mechanisms. At the same time, clusters focused on neuronal circuits, sensory processing, microbial ecology, and advanced imaging illustrate HFSP's sustained investment in systems-level, computational, and methodological innovation. More recent clusters, including wearable technology and material engineering, point to exploratory interdisciplinary directions that integrate engineering, sensing, and biological experimentation.

Overall, the cluster structure demonstrates a portfolio that is broad in scope yet internally coherent, combining depth in foundational biology with openness to new scientific frontiers.

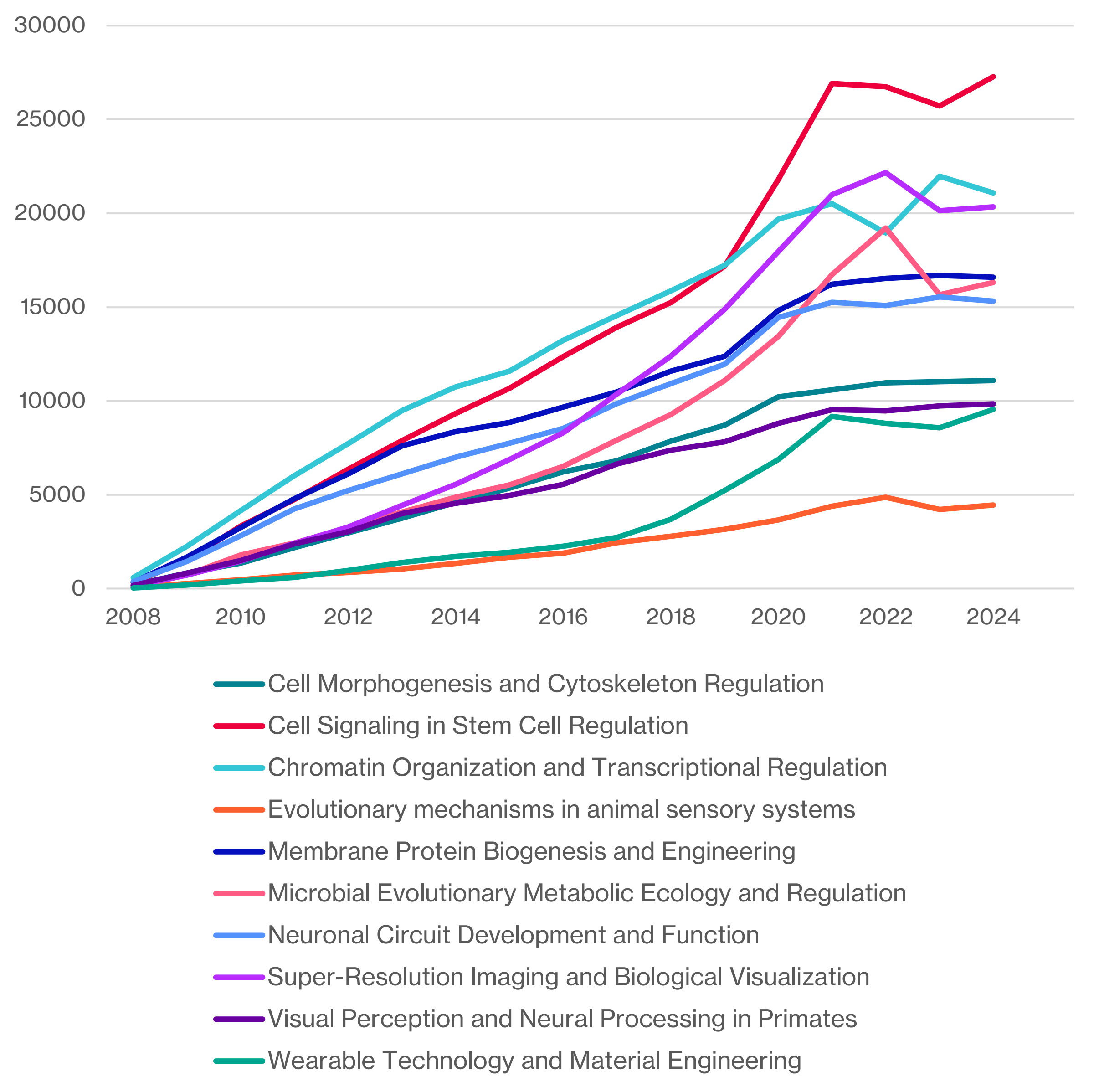
Figure 9: The top ten publication clusters and volume from 2008–2024

The system sorts publications into clusters and determines what distinguishes these clusters.[18]
The y-axis shows number of publications.



Source: Dimensions database, HFSP data.

Figure 10: The top ten publication clusters and citations from 2008–2024.
Using a methodology analogous to that described for the previous figure, citations are presented here on the y-axis.



Source: Dimensions database.

Across all ten clusters, citation trajectories rise steadily and cumulatively from 2008 to 2024, confirming that HFSP-supported research generates durable and broad scientific influence (s.

[18] Methodological note: The system begins by retrieving a numerical "fingerprint" for each publication that reflects its underlying meaning. It then determines how many clusters are appropriate – either using the number provided by the user or testing several options to find the grouping that best separates the documents. With the number set, the algorithm assigns each document to the cluster whose central theme it most closely matches. Finally, it enriches each cluster by gathering titles and abstracts and generating concise, meaningful labels and summaries using an AI model to describe what the documents in each group have in common.

Figure 10). The strongest citation growth appears in clusters such as Cell Signaling in Stem Cell Regulation, Chromatin Organization and Transcriptional Regulation, and Neuronal Circuit Development and Function, while smaller or emerging areas, most notably Wearable Technology and Material Engineering, show impact that is disproportionately high relative to their publication volume. When linked to the publication trends, the analysis shows that HFSP's most influential areas are not always its largest in terms of output: some clusters deliver exceptional impact per publication, underscoring HFSP's high-risk, high-reward model. This is especially true for the clusters: Cell Signaling in Stem Cell Regulation, Chromatin Organization and Transcriptional Regulation, as well as Neuronal Circuit Development and Function. The recent dip in publication counts reflects likely post-COVID dynamics (a global effect) and indexing delays rather than reduced influence. The combination of broad output and deep citation accumulation highlights a portfolio that is both structurally diverse and conceptually powerful.

When interpreted together, the publication-volume and citation-trajectory charts reveal that HFSP's most cited domains are not always its largest in output. Clusters such as Cell Signaling in Stem Cell Regulation and Wearable Technology and Material Engineering demonstrate how HFSP's high-risk, interdisciplinary model produces areas with disproportionately high citation impact, even when publication volumes are modest or fluctuating. (Detailed data and summary of clusters are in Annex 11.9.

4.1.3 Clusters and Disciplines (FoR)

Citation trajectories provide a complementary signal of influence and durability. Across all major publication clusters, citations accumulate steadily and cumulatively from 2008 to 2024 (Figure 10), indicating that HFSP-supported research generates lasting scientific impact rather than short-lived bursts of attention. Importantly, influence is distributed across multiple clusters rather than concentrated in a single domain, reducing portfolio risk and increasing the likelihood of frontier spillovers across fields.

When examining citation impact within publication clusters, a consistent pattern emerges: interdisciplinary contributions frequently outperform the cluster baseline. Field-normalized citation analysis via FCR shows that publications based on HFSP-supported research often achieve higher impact in Psychology, Information and Computing Sciences, Engineering, or Biomedical and Clinical Sciences within the same cluster. This effect is particularly pronounced in method- and technology-intensive clusters, such as super-resolution imaging and membrane protein biogenesis, where computational, physical, and chemical perspectives substantially elevate citation performance (s. Table 5)

These findings indicate that HFSP's high-risk/high-reward profile is not reflected in volatility in publication volume, but rather in the diversity and distribution of scientific influence. Interdisciplinary integration functions as a mechanism that amplifies impact within established biological domains, reinforcing the value of HFSP's funding model.

The following table summarizes FCR values for HFSP's ten major research clusters and its top seven contributing disciplines (FoR) and their FCR, respectively. The greatest impacts occur in conceptually and methodologically integrative domains, indicating that HFSP's interdisciplinary research model not only broadens the scientific landscape but also enhances citation performance.

Table 5: Field citation ratio (FCR) across HFSP's publication clusters

Cluster	Publications	Citations	FCR Total	Biological Sciences	Biomedical and Clinical Sciences	Psychology	Chemical Sciences	Engineering	Physical Sciences	Information and Computing Scien-
Membrane Protein Biogenesis and Engineering	3,030	246,468	4.3	4.4	6.2	20.3	3.2	2.9	3.9	13.6
Chromatin Organization and Transcriptional Regulation	2,764	348,454	5.8	5.6	7.8	19.5	5.8	3.2	3.6	3.8
Super-Resolution Imaging and Biological Visualization	2,476	242,670	4.0	3.2	5.5	26.9	3.5	4.5	4.8	3.5
Neuronal Circuit Development and Function	2,317	257,126	7.9	5.5	8.8	9.0	4.5	2.9	5.5	4.7
Cell Morphogenesis and Cytoskeleton Regulation	2,300	184,184	4.5	4.4	6.1	17.2	2.8	3.6	4.9	5.0
Microbial Evolutionary Metabolic Ecology and Regulation	2,282	192,591	4.3	4.3	4.7	6.8	2.7	2.4	7.9	4.4
Cell Signaling in Stem Cell Regulation	2,046	329,788	8.1	7.2	9.0	6.5	5.3	6.3	1.7	12.3
Visual Perception and Neural Processing in Primates	1,884	158,935	6.3	4.3	7.3	6.3	1.3	4.1	4.4	3.7
Wearable Technology and Material Engineering	1,816	81,704	3.9	3.0	4.9	4.0	3.4	3.8	3.6	3.0
Evolutionary mechanisms in animal sensory systems	1,416	58,713	3.9	3.6	5.5	5.3	4.9	3.6	5.1	4.1

Source: Dimensions database.

4.1.4 Recent Novel Concepts

In this evaluation, conceptual novelty is interpreted as a quantitative signal of frontier science. This analysis captures research that challenges prevailing explanatory frameworks and redefines how established biological problems are understood.

Between 2020 and 2024, HFSP-supported research is markedly overrepresented among the most conceptually novel publications in the life sciences, relative to non-HFSP publications from the same thematic areas in the contemporaneous global literature (for a definition of novelty, s. Section 2.3.3). Using a semantic measure of conceptual novelty (defined as distance from the global reference corpus), HFSP-supported studies are typically around an order of magnitude more likely than the global baseline to fall within the top decile of novelty scores across multiple established domains, including neuroscience, immune regulation, RNA biology, metabolism, and signaling. For a detailed explanation of the semantic analysis methodology and the full comparative data, please refer to section 2.3.1 and Annex 11.11.

Across these domains, HFSP's recent novelty reflects a shared conceptual stance rather than topic selection or the introduction of entirely new mechanisms. HFSP-supported work consistently reframes biological systems as dynamic, state-dependent, and context-sensitive, emphasizing internal state, temporal structure, and cross-scale interactions as central explanatory drivers. Processes that are often treated as modulatory or background in the broader literature (e.g. RNA regulation, metabolic state, or immune activity) are instead positioned as primary determinants of biological function. This consistent re-prioritization of explanatory drivers across multiple domains is a defining feature of frontier science: it reflects movement at the conceptual boundary of established fields rather than incremental extension within them.

This explanatory shift is evident across multiple areas of biology, though its empirical footprint varies by domain. As Table 6 shows neuroscience accounts for the largest absolute number of highly novel HFSP publications (334 publications, 5.8% of HFSP outputs 2020–2024), indicating a particularly strong concentration of conceptual risk-taking in this area. In RNA biology and signaling, HFSP-supported studies elevate regulatory dynamics and spatial–temporal control from intermediary roles to central organizing principles, albeit with smaller absolute volumes (112 and 47 highly novel publications, respectively). In metabolism and immune regulation, biological function is framed less as a response to external stimuli and more as an emergent property of long-lived, system-level regulation, with immune regulation representing a substantial share of HFSP's highly novel outputs (237 publications, 4.1%).

The recurrence of this pattern across domains indicates that HFSP's novelty lies in supporting a common form of conceptual risk, rather than prioritizing particular biological topics. In other words, HFSP defines its portfolio by the boldness of the explanatory approach rather than by subject matter alone.

The effect is especially pronounced in neuroscience, where, within the 2020–2024 period, HFSP-supported publications show both the largest absolute presence among highly novel outputs and the strongest average novelty advantage relative to the global baseline. Rather than centering explanations on static circuit architecture or synaptic connectivity alone, HFSP-supported studies more frequently frame neurons as adaptive biological systems whose intrinsic physiology, metabolic state, subcellular organization, and temporal context actively shape neural activity, memory, and behavior. Although these mechanisms are individually well established, their elevation to first-order explanatory roles represents a clear departure from dominant frameworks in contemporary neuroscience.

HFSP-supported research is thus overrepresented among publications in the top decile of conceptual novelty across multiple domains, relative to non-HFSP publications from the same thematic areas in contemporaneous global literature. Here, conceptual novelty is measured as semantic distance from the global corpus, and “high novelty” refers to publications falling within the top decile of novelty scores across all non-HFSP and HFSP papers in this period.

Table 6: Novel Concepts in HFSP Research

Domain (theme label)	Dominant framing in the broader literature	Distinctive framing in HFSP-supported research	Type of novelty	Nr of HFSP publications with novelty score in the top decile	Share of HFSP publications (2020-2024)
Neuroscience (neurons)	Neural function explained primarily through circuit architecture and synaptic connectivity	Neurons framed as adaptive biological systems whose intrinsic physiology, metabolic state, subcellular organization, and temporal context actively shape activity and behavior	Re-prioritization of explanatory drivers	334	5.8%
RNA biology	RNA treated mainly as an intermediary between DNA and protein	RNA regulation emphasized as a dynamic, integrative control layer involving localization, timing, and structure	Elevation from conduit to control system	112	1.94%
Metabolism	Metabolism viewed largely as background bioenergetics or a readout of cellular state	Metabolic state treated as an active driver of signaling, differentiation, and functional outcomes	Reversal of causal direction	109	1.89%
Immune regulation (immune cells, stress reactivity)	Immune activity framed as acute, stimulus-driven responses	Immune processes framed as long-lived modulators of tissue function and system-wide behavior	Contextual expansion	237	4.12%
Signaling pathways	Pathways treated as modular, isolatable cascades	Signaling framed as context-dependent, spatially constrained, and emergent from system-level interactions	System-level reframing	47	0.82%

HFSP-supported research is overrepresented among publications in the top decile of conceptual novelty, relative to non-HFSP publications from the same thematic areas in the contemporaneous global literature. Here, conceptual novelty is measured as semantic distance from the global corpus, and “high novelty” refers to publications falling within the top decile of novelty scores across all non-HFSP and HFSP papers in this period.

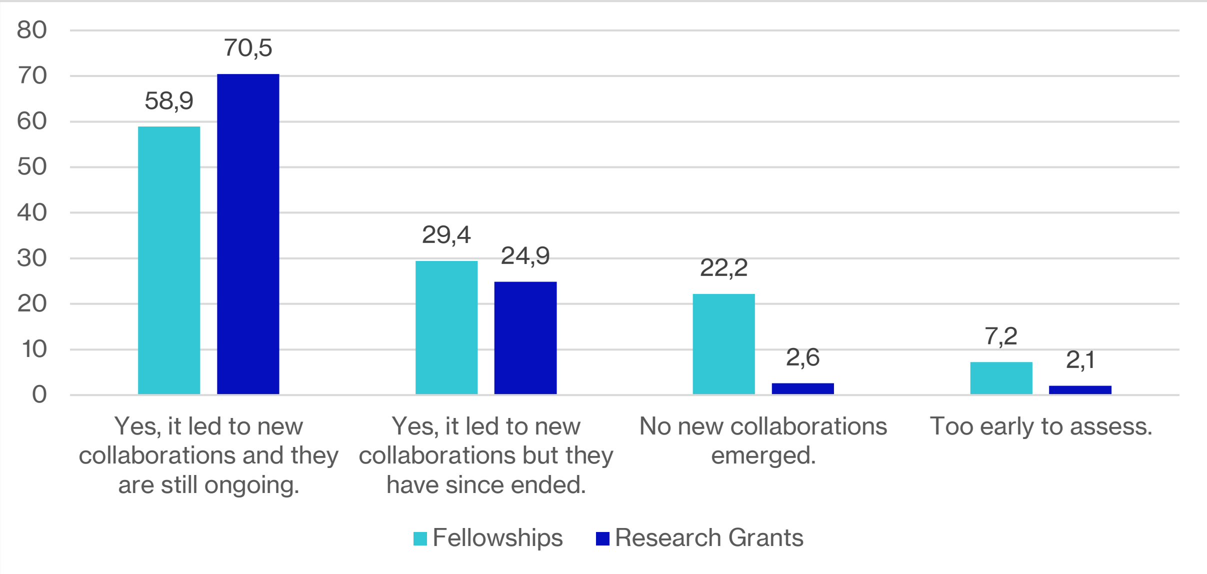
This recent novelty analysis shows that HFSP’s frontier character lies not in disciplinary breadth alone, but in its sustained support for research that operates at the conceptual boundaries of existing fields and challenges prevailing ways of explaining biological function across multiple areas of biology. By funding work that systematically rethinks and re-evaluates the fundamental drivers in complex biological systems, HFSP funds frontier science in its most demanding form: work that reshapes explanatory frameworks rather than merely expanding them.

4.2 The Value of International Collaboration for Awardees

The high level of international collaboration is a unique feature of HFSP. No other funding organization in the life sciences has such a global reach and facilitates collaboration across continents to the same extent. This is confirmed by interviews, the survey, case studies, and an analysis of comparable funders (s. Annex 11.2). The figure below illustrates that the vast majority of HFSP projects led to new collaborations.

Figure 11: Collaboration activity of awardees (in %)

Did your HFSP project lead to new or re-activated scientific collaborations, and are they still ongoing today?

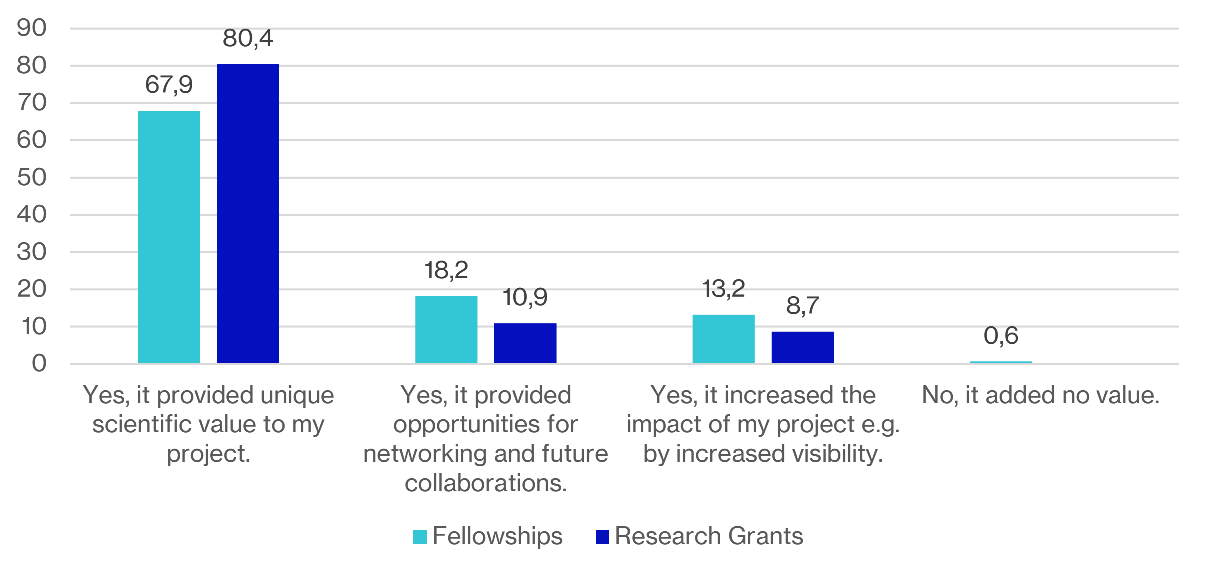


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 405.

More than half of collaborations were still ongoing, with the Research Grants in particular fostering long-lasting partnerships. Even when looking only at the oldest cohort (2009–2011), one finds that about one-third of participants continue the collaborations that originated from their HFSP project. One reason for the longevity of these collaborations is their scientific value. The figure below shows that among those who engaged in collaborations, roughly three-quarters attributed a unique scientific benefit to them.

Figure 12: Self-reported value of collaboration (in %)

Did the collaboration provide value to your project?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 343.

Many interviewees emphasized that HFSP's international scope enables them to work with the best – or most suitable – experts in a given field. Many projects only became possible because specialists from different countries and continents came together to combine their unique expertise. This applies particularly to the Research Grants. Case studies, such as the one on molecular motors, show that HFSP projects have often served as the starting point for decades-long, highly productive collaborations among researchers pooling their expertise. Another case study, focusing on adaptive immunity of mosquitoes to viruses, illustrates another way in which intercontinental collaboration can be fruitful. In this case it allowed for easy on-site data collection of mosquito DNA to be combined with the expertise and infrastructure needed to analyze these data scientifically. This case study does not, of course, generalize to all types of projects, but it clearly illustrates the potential that international collaboration offers for a specific subset of the life sciences. In particular, it refers to projects that deal with genetic variation and specific ecosystems. However, this is ultimately only a specific example of a more general phenomenon: geographical flexibility enables the combination of specific skills and expertise available only in particular locations.

According to the awardees' self-assessment, the Fellowships also benefit greatly from international collaboration and are only slightly less collaborative than the Research Grants. However, the underlying mechanisms are fundamentally different. Rather than funding a team and thereby directly supporting collaboration, HFSP requires fellows to move to a new country and work with a host supervisor they have not collaborated with before encouraging them to make new connections.. Both the survey results and the interviews show that this is a well-functioning model. It is described as particularly valuable that researchers are placed in a new and unfamiliar environment, which offers them opportunities to acquire new skills, knowledge, and techniques, as well as to forge long-term collaborations. They can then take all of this back home or to other locations, disseminate it, and integrate it into their subsequent scientific work.

Quantitative data analysis confirms the high degree of collaboration inherent in HFSP projects and their intercontinental nature. To this end, patterns of international collaboration and changes in grant recipients' international collaboration practices in their grant-related publications and post-grant research careers, are compared across HFSP funding schemes.

4.2.1 International Collaboration pre, during and post Award

Quantitative evidence from HFSP fellowship and grant funding schemes shows a consistent pattern of expanded and sustained international collaboration associated with HFSP support. Across funding schemes, the average number of countries involved in publications increases during the funding period and remains elevated afterwards, indicating that HFSP funding contributes to the formation of durable international research networks rather than short-lived multinational activity (Table 7).

For the fellowship schemes, the Long-Term Fellowship (LTF) displays a clear stepwise increase in international engagement from the pre-award period through the fellowship and into the post-fellowship phase. This trajectory aligns with the funding scheme's aim to foster deeply rooted global collaborations that continue beyond the award. The Cross-Disciplinary Fellowship (CDF) shows a more modest but consistent increase, supporting the interpretation that HFSP involvement helps early-career researchers embed themselves in broader, more diverse international research ecosystems.

While interviews often highlight dramatic examples of long-range or high-impact collaborations, the publication-based indicators show that the average expansion of international co-authorship is incremental rather than transformative. This contrast is informative. It suggests that the long-term value of HFSP-supported collaboration lies less in increasing the number of collaborating countries and more in enabling strategically significant partnerships that provide access to specialized expertise. In this sense, the quantitative trends capture persistence and gradual widening of networks, while qualitative accounts illuminate the depth and scientific importance of these relationships.

A similar and complementary pattern is observed in the Research Grant funding schemes. Both Early Career Research Grants (RGEC) and Program Grants (RGP) show substantial increases in international collaboration during the funded period, followed by sustained elevation thereafter. For RGEC awardees, this pattern indicates that HFSP support enables early-career principal investigators to broaden their international connections and normalize a higher baseline of global engagement in subsequent work. Program Grants reach the highest levels of international collaboration during the funding period, consistent with their design to support more interdisciplinary, and internationally distributed consortia, while maintaining elevated collaboration after the grant concludes.

Taken together, these findings indicate that HFSP funding reliably internationalizes research activity in a persistent and meaningful way across career stages and funding schemes. As with the fellowships, qualitative evidence suggests that the enduring value of HFSP-supported collaboration lies not primarily in geographic breadth, but in the formation of high-quality, strategically important partnerships that continue to shape research well beyond the award period.

Table 7: Quantitative analysis of international collaboration pre, during and post award by HFSP funding scheme

The table reports the average number of countries involved in publications linked to each HFSP funding scheme. Both fellowship (LTF, CDF) and research grant schemes (RGEC, RGP) show clear increases in international collaboration during the funded period.

Funding scheme	Publication Timing	Avg. Nr Countries
Program Grant (RGP)	Pre Grant	1.55
	Grant Period	2.20
	Post Grant Period	2.00
Research Grant (Early Career, RGEC)	Pre Grant	1.66
	Grant Period	2.16
	Post Grant Period	2.00
Cross-Disciplinary Fellowship (CDF)	Pre Fellowship Period	1
	Fellowship Period	1.83
	Post Fellowship Period	1.86
Long-Term Fellowship (LTF)	Pre Fellowship Period	1.65
	Fellowship Period	2.00
	Post Fellowship Period	2.12

Source: Dimensions database, HFSP internal data

4.2.2 Collaboration Patterns within the HFSP Community

Beyond the broader international networks fostered by HFSP, it is equally important to examine how collaboration unfolds *within* the HFSP community itself. The following analysis focuses on co-authorship patterns among HFSP awardees and shows how strongly Research Grant (RG) teams collaborate during the funded period and how these patterns evolve once awardees move on to subsequent research activities.

The data visualized in Annex 11.13 demonstrate that RGP awardees collaborate extensively among team members during the lifetime of their HFSP project. A substantial number of grant-related publications involve multiple HFSP co-authors, indicating that these teams are not only international but also internally cohesive and scientifically integrated. This pattern is remarkably stable over time, with nearly every grant year showing extensive co-publication activity among HFSP investigators. This is evidence that HFSP Research Grants support genuinely joint research efforts rather than loosely connected partnerships.

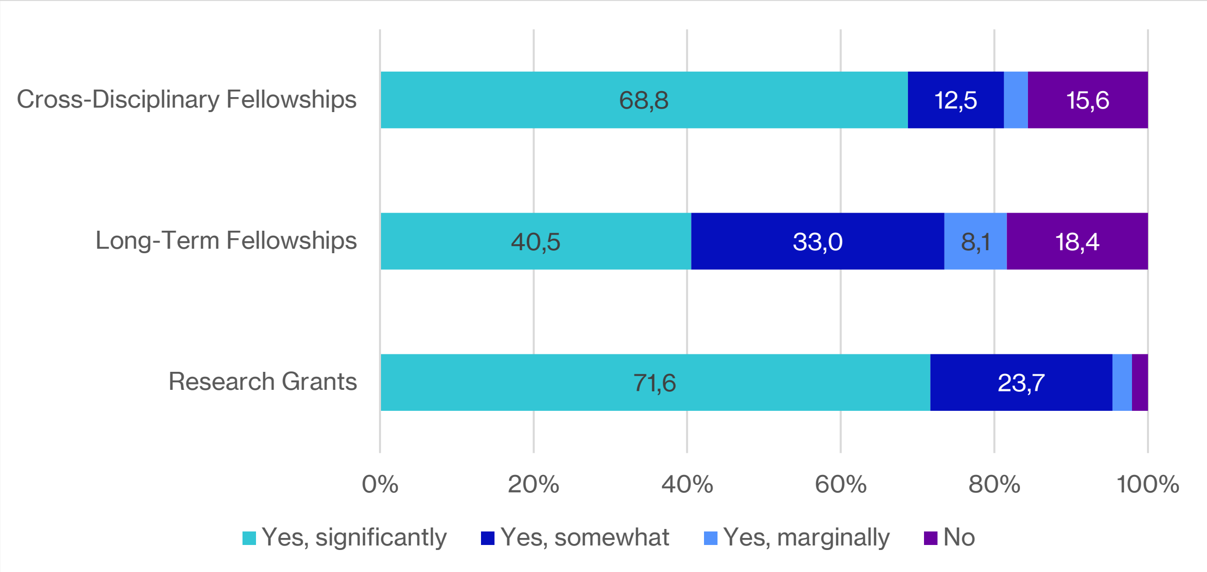
4.3 Interdisciplinarity

Interdisciplinarity has already been examined at the overall HFSP level. It is one of HFSP's distinguishing features. The following section takes a closer look at what it means for individual researchers. More than comparable institutions, HFSP both promotes interdisciplinary research and requires interdisciplinary research from its awardees. The following figure shows that across all funding schemes, HFSP funding contributes significantly to interdisciplinarity, especially with the Cross-Disciplinary Fellowships and the Research Grants.

4.3.1 Interdisciplinarity from the Perspective of Awardees

Figure 13: Influence of HFSP requirements on Interdisciplinarity (in %)

Did the requirement of HFSP for interdisciplinarity influence your project idea regarding the scientific approach or methodology?



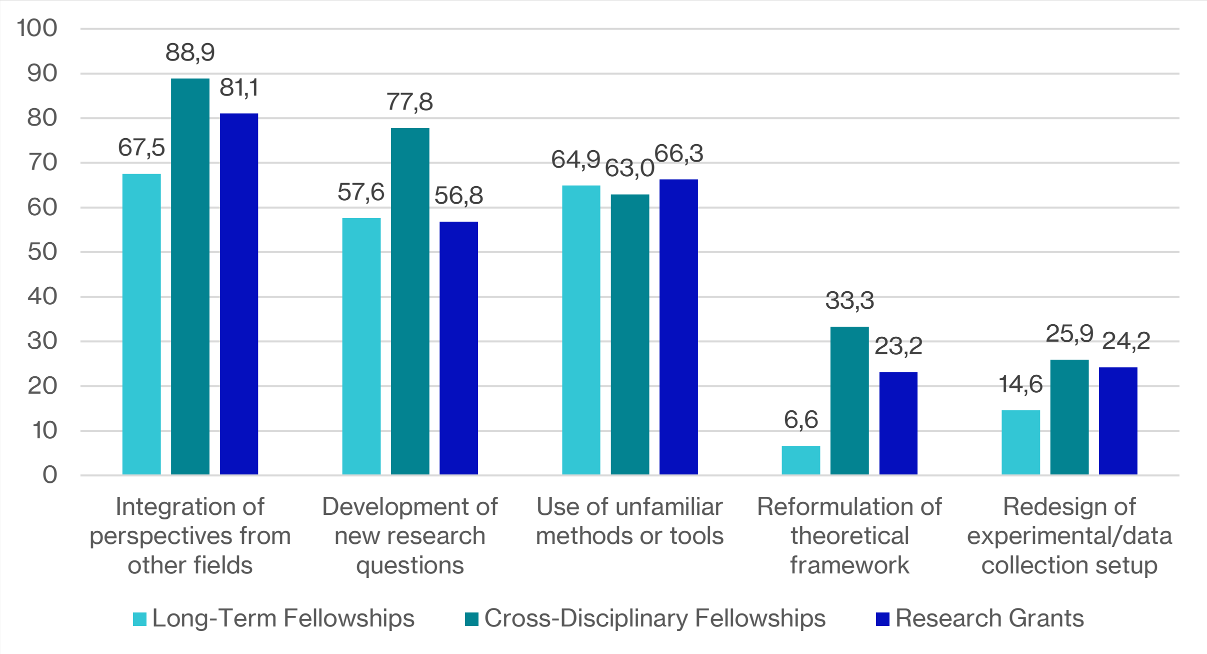
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 405.

The requirements of the Research Grants and the Cross-Disciplinary Fellowships have a strong impact on the interdisciplinarity of the projects. Interviews and case studies show that this occurs in two ways. First, HFSP funding enables interdisciplinary collaboration that would have not been possible otherwise. Often, contacts exists between scientists from different disciplines, naturally giving rise to ideas for interdisciplinary projects, and the researchers then look for ways to fund a joint project. Similar dynamics apply to Cross-Disciplinary Fellows. Second, HFSP also encourages applicants to actively seek out interdisciplinary opportunities and to make better use of them.

Interdisciplinarity in this context is not superficial but has a tangible impact on project design. The following figure gives an impression of the extent of this impact among those who were encouraged by HFSP to take a more interdisciplinary approach.

Figure 14: Impact of interdisciplinarity on the projects in %

In what way did the interdisciplinary approach of HFSP influence your project?

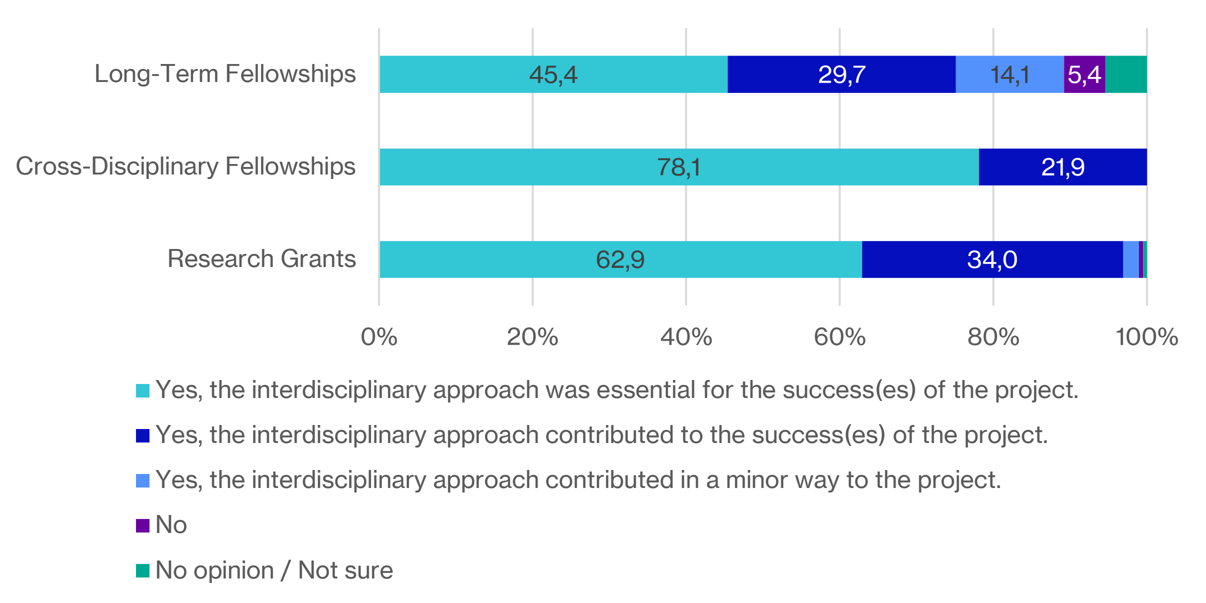


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 368.

More than half of the respondents integrated new research perspectives, developed new research questions, or adopted new methods and tools. As interviews and case studies show, the latter can have a particularly significant impact on an entire field – for example, when methods and tools from chemistry or physics are transferred into biology, enabling new kinds of manipulation or data gathering. In the Research Grants, case studies and interviews frequently show that the interdisciplinary orientation makes it possible to bring essential expertise from another field into the team. The case study on molecular motors, for example, illustrates how multiple disciplines had to come together to achieve a scientific breakthrough. The following figure shows that, according to the researchers, interdisciplinarity was extremely valuable for their projects.

Figure 15: Contribution of interdisciplinarity to success in %

Did the interdisciplinary character of the project provide added value beyond what a single-discipline project could have achieved?

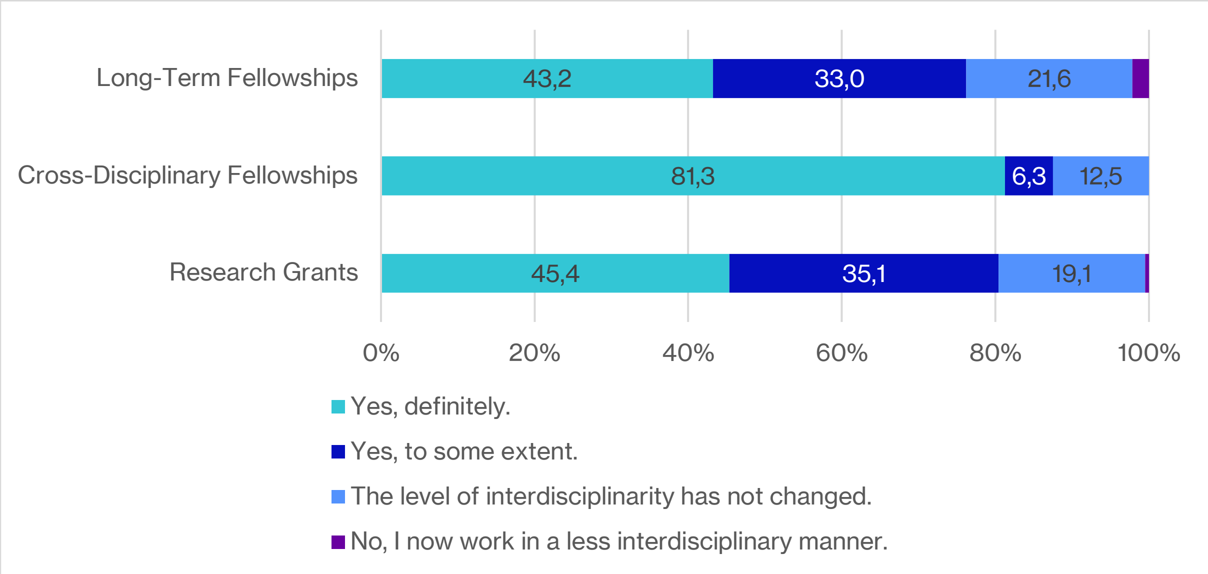


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 411.

Nearly 80 % of Cross-Disciplinary Fellows stated that the interdisciplinary approach was essential for the success of their project. Over 60 % of Research Grants recipients stated the same. Interviews revealed that HFSP promotes interdisciplinarity to a greater extent than other funding organizations. Not only related fields, e.g., within biology, but also completely different disciplines are linked through HFSP projects (s. also Chap. 4.1). The recipients appreciate not only new methods, tools, and solutions to problems, but also, in particular, the food for thought and outside-the-box thinking that comes with in-depth interdisciplinarity.

Figure 16: Long-term impact of HFSP on Interdisciplinarity

As a follow-up to your HFSP project: In your research activities, are you now working in a more interdisciplinary manner as compared to before securing HSFP funding?



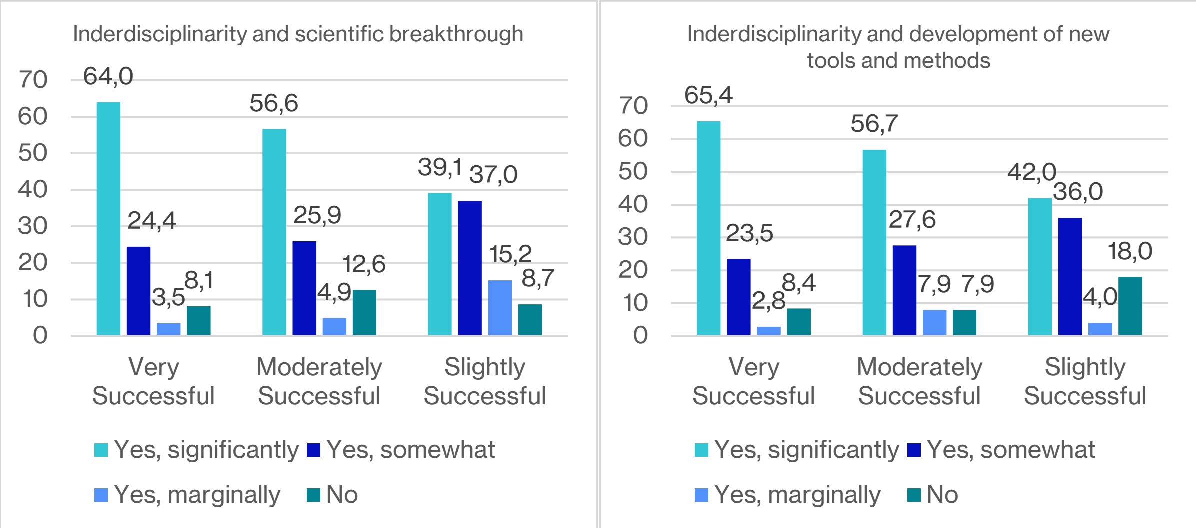
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 411.

The benefits of interdisciplinarity are also reflected in the fact that HFSP grantees often continue to work in an interdisciplinary manner after their HFSP project. Figure 16 shows, in particular, that Cross-Disciplinary Fellows are permanently pushed in an interdisciplinary direction by their fellowship. This effect is stable across cohorts and demonstrates the long-term impact that HFSP has on the interdisciplinarity of its awardees and, through them, on the life sciences.

A correlation analysis of survey questions underlines the role of interdisciplinarity in fostering the success of HFSP-supported research. Respondents deeming the requirement of interdisciplinarity to have significantly influenced their scientific approach or methodology rate their project's success in achieving a scientific breakthrough more highly (s. Figure 17).

Figure 17: Influence of the interdisciplinarity requirement regarding the success in generating scientific breakthrough and developing new tools and methods in % aggregated for all funding schemes

Correlation between "Did the requirement of HFSP for interdisciplinarity influence your project idea regarding the scientific approach or methodology?" and "How would you characterize the success of your funded project regarding the following categories?"

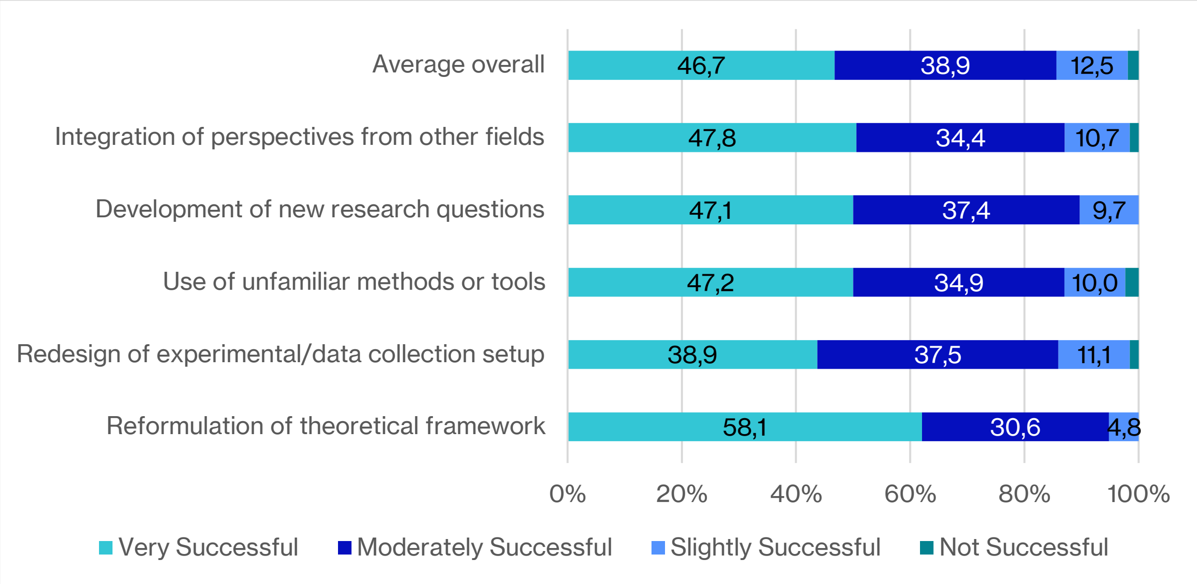


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 361 (left) and 356 (right).

Differentiating by funding scheme reveals a higher correlation between interdisciplinarity and the success rating for grantees. Although the long-term fellowships do not include an explicit requirement for interdisciplinarity, respondents who deem HFSP's strong profile towards interdisciplinarity to have significantly influenced their approach also rate their project's success in achieving a scientific breakthrough or developing new tools more highly. In case of the cross-disciplinary fellows, the correlation analysis does not have a robust sample size.

The correlation analysis further indicates that interdisciplinarity drives scientific breakthroughs, especially through the reformulation of theoretical frameworks, as perceived by more than half of the surveyed researchers. Interdisciplinarity further influences the success of achieving scientific breakthroughs through the use of previously unfamiliar methods and tools and the development of new research questions (s. Figure 18).

Figure 18: Influence of the interdisciplinary approach in different categories regarding the success in generating scientific breakthrough in % aggregated for all funding schemes
Correlation between "In what way did the interdisciplinary approach of HFSP influence your project?" and "How would you characterize the success of your funded project regarding the following categories?"



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 368.

The following quantitative publication analyses contextualize, validate, and differentiate the perspective of awardees. Overall, the quantitative findings reinforce the qualitative results.

4.3.2 Quantitative Aspects of Interdisciplinarity: Pre vs Post Award

The quantitative analysis of interdisciplinarity across HFSP funding schemes reveals a consistent and nuanced pattern. While the overall breadth of disciplines represented in publications does not change dramatically over the award lifecycle, there are subtle but meaningful shifts in how interdisciplinarity is distributed, reflecting the distinct strategic roles of HFSP's funding instruments.

A central finding is that HFSP's effect on interdisciplinarity is best understood through median rather than average values. Across all funding schemes, median interdisciplinarity consistently exceeds the arithmetic mean, indicating a shift in the center of gravity of research toward cross-disciplinary integration. This divergence suggests that while some outputs remain single-discipline or technically focused, a substantial share of HFSP-supported work routinely bridges multiple fields. In other words, interdisciplinarity under HFSP is not exceptional or marginal; it becomes typical for a large proportion of publications, even if it does not dominate every publication. This median-based shift toward typical interdisciplinarity aligns closely with interview accounts in which awardees describe sustained conceptual integration and long-term cross-field learning, rather than episodic or opportunistic collaboration. This pattern is most evident among Cross-Disciplinary Fellows, for whom HFSP funding often enabled them to establish themselves in the life sciences while transferring knowledge and approaches from their original field. In the Research Grants, interdisciplinarity is frequently closely intertwined with the collaborations enabled by the grant. In many cases, these collaborations persisted beyond the end of the project, resulting in a sustained increase in the level of interdisciplinarity.

Distinct behavioral patterns emerge across funding schemes. Program Grants show the strongest structural shift toward interdisciplinarity during the funded period with median values peaking when the project is active. This confirms that established teams use HFSP funding as a catalyst to intensify cross-disciplinary integration, mobilizing diverse expertise in ways that are difficult to sustain outside the dedicated project context. After the award, interdisciplinarity remains elevated but moderates, consistent with the conclusion of tightly coordinated, project-specific collaboration (s. Table 8).

By contrast, Early Career Research Grants exhibit a relatively stable but already high interdisciplinary baseline. Rather than prompting a sharp directional shift, HFSP funding appears to enable emerging leaders to consolidate and stabilize an existing interdisciplinary niche, supporting continuity as researchers transition to independence.

The fellowship schemes show complementary dynamics. Long-Term Fellowships are characterized by sustained high median interdisciplinarity and modest stepwise increases over time, indicating deep immersion in a defined interdisciplinary constellation rather than continual expansion into new fields. Cross-Disciplinary Fellowships display a very strong interdisciplinarity signal, with both averages and medians remaining high after the fellowship ends. This indicates that CDF support not only brings researchers into cross-field environments but also enables them to establish and maintain interdisciplinary careers over the longer term. This is a pattern consistently reinforced by interview evidence.

Taken together, these findings show that HFSP's contribution to interdisciplinarity lies less in dramatically expanding disciplinary breadth and more in stabilizing, deepening, and normalizing cross-field engagement. The funding schemes differ in how this effect is achieved: Either through catalytic integration in established teams, consolidation among early-career investigators, or immersive and durable boundary-crossing in fellowships. The overall pattern is consistent. HFSP supports interdisciplinarity as a sustained mode of scientific practice rather than a temporary or exceptional feature of individual projects, complementing the observed patterns in international collaboration and reinforcing HFSP's role in enabling strategically meaningful cross-disciplinary research.

Table 8: Primary Fields of Research (FoR) from pre-award to post-award publications

HFSP funded researchers' publication portfolios were analyzed before, during and after HFSP award on the disciplinary mix via the collection of FoR assignments per publication. Per researcher the basic statistics (of maximum number of FoR , the average number of FoR, and the (average of) the median number of FoR for the collective set of publications pre, during and post HFSP award are presented.

Funding scheme	Publication grant relationship	Maximum fields (FoR)	Average Fields (FoR)	Avg of Median Fields (FoR)
Research Grant (Early Career)	pre grant	6	1.32	1.46
	grant related	4	1.28	1.46

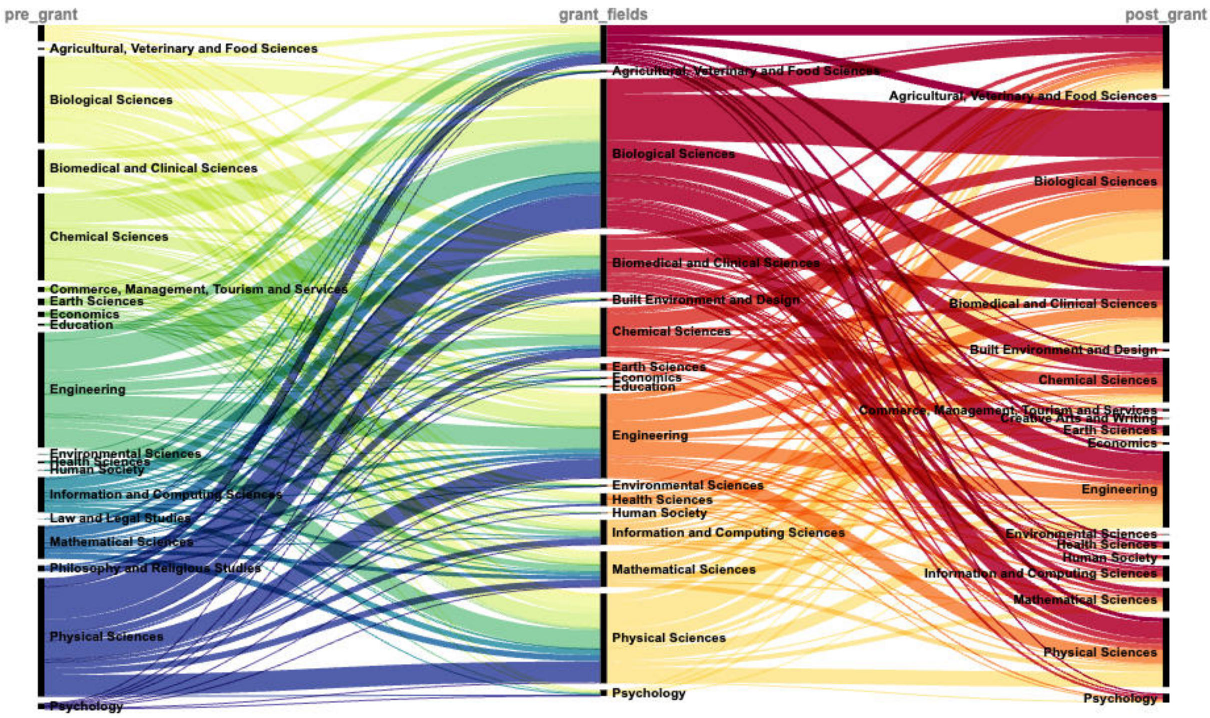
	post grant unrelated	5	1.37	1.40
Research Grant (Program)	pre grant	6	1.31	1.35
	grant related	4	1.29	1.70
	post grant unrelated	5	1.36	1.59
Long-Term Fellowship	pre fellowship	4	1.27	1.68
	fellowship related	4	1.28	1.75
	post fellowship unrelated	4	1.31	1.56
Cross-Disciplinary Fellowship	pre fellowship	4	1.32	1.53
	fellowship related	3	1.34	1.67
	post fellowship unrelated	4	1.41	1.57

Source: Dimensions data, HFSP data

The Sankey diagram in Figure 19 highlights this interdisciplinary mix pre, during and post award in the case of Cross-Disciplinary Fellowships (CDF). It, too, visualizes that the Cross-Disciplinary Fellowship functions as a powerful mechanism for disciplinary conversion, effectively importing talent from the quantitative sciences into the life sciences. A comparison of pre- and post-fellowship publication domains reveals a "migration": while a significant proportion of applicants originate from the Physical Sciences, Engineering, and Information & Computing Sciences (Figure 19, Left), the post-fellowship landscape (Figure 19, Right) shows a marked contraction of these disciplines in favor of expanded Biological and Biomedical publications. This indicates that these fellows do not merely apply their tools to biology temporarily before returning to their home disciplines; rather, they are successfully integrated into the life science research ecosystem, permanently enriching the field with perspectives from physics, mathematics, and engineering – a finding that is corroborated by qualitative evidence from interviews.

Figure 19: Interdisciplinary Pathways of HFSP Cross Disciplinary Fellowship researchers: A visual overview of disciplinary shifts based on FoR of the Fellows' publications before, during, and after funding.

The Sankey diagram traces the disciplinary composition of Cross-Disciplinary Fellows' publications before, during, and after HFSP award, illustrating how Fellows enter from diverse fields, engage with multiple disciplinary domains during the fellowship, and sustain or expand this interdisciplinarity in their subsequent research. Cross-Disciplinary Fellowship functions as a powerful mechanism for disciplinary conversion, effectively importing talent from the quantitative sciences into the life sciences. See Annex 11.23 for Wide Format.



Source: Dimensions database, HFSP data.

A key cross-scheme insight is that interdisciplinarity often remains elevated after the award period, particularly for fellowships and larger team grants. This suggests that HFSP support has a durable influence on how researchers structure both their scientific networks and conceptual approaches. Structural differences across funding schemes are also evident: team-based grants (RGEC and RGP) can span a wider maximum range of disciplines, reflecting the breadth of expertise assembled in collaborative projects, while fellowship-based outputs typically involve fewer fields, consistent with deep individual-level interdisciplinary immersion.

HFSP funding schemes tend to stabilize and deepen cross-field engagement rather than dramatically expand disciplinary breadth. Interview and case-study evidence confirms that this form of focused interdisciplinarity is often essential for tackling complex scientific problems and enables combinations of expertise that would be difficult to realize under other funding schemes. While these effects cannot be fully captured by publication metrics alone, they point to the longer-term intellectual and conceptual enrichment fostered by HFSP support.

4.3.3 Interdisciplinarity and Multidisciplinary Publication Patterns in HFSP-supported Research

Placement in multidisciplinary journals is a well-established bibliometric indicator of interdisciplinary character,[19] as such journals typically require conceptual breadth, cross-field integration, and relevance to broad scientific audiences. To assess HFSP's contribution to interdisciplinary science, we examined the extent to which HFSP-supported and HFSP-cofunded publications appear in multidisciplinary journals,[20] building on earlier benchmark analyses of basic science orientation and conceptual breadth.

Across the period analyzed, HFSP shows an exceptionally strong presence in multidisciplinary journals relative to major national and international funders. Despite its comparatively small publication volume, HFSP achieves one of the highest proportional shares of publications appearing in multidisciplinary outlets, both across its total output and within basic-science publications (s. Annex 11.12 for full comparative data and funder benchmarks). This places HFSP at or near the top of the global benchmark, with only a very small number of large public research organizations showing comparable proportional reach. These patterns indicate that HFSP-supported research, although modest in scale, frequently attains the level of conceptual integration and general relevance required for publication in high-visibility, multidisciplinary journals such as *Nature*, *Science*, and *PNAS*.

Across a wide range of partner agencies, publications that acknowledge HFSP alongside other funders show substantially higher rates of publication in multidisciplinary journals than those partners' standalone portfolios. In several cases, the share of multidisciplinary publications in co-funded publications is more than double that of the partner funder alone, indicating a consistent, systematic link between HFSP participation and broader, more integrative research scopes.

By contrast, publications exclusively acknowledging HFSP show lower multidisciplinary journal shares. This pattern may be indicative of HFSP's support for early-stage, high-risk, and conceptually exploratory research, which may not yet be framed for generalist outlets. When HFSP funding is combined with larger national or international schemes, however, the resulting research more frequently attains the scale, maturity, and integrative framing that leads to publication in multidisciplinary venues. In this sense, HFSP acts less to reinforce its own already interdisciplinary baseline and more to shift collaborative research upward into broader, more visible publication spaces.

These findings highlight HFSP's dual role in the global research ecosystem. HFSP not only supports frontier basic research that is highly visible in multidisciplinary journals in its own right but also exerts a catalytic effect amplifying the interdisciplinary reach and visibility of outputs supported jointly with other agencies. No other funder in the benchmark displays this combination as consistently: a high proportional presence in multidisciplinary journals alongside a clear, repeatable amplification effect on partner-funded research. This pattern underscores HFSP's distinctive contribution to fostering integrative, high-impact life-science research and to shaping the visibility of interdisciplinary discovery on the global stage.

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[19] Porter, A. L., & Rafols, I. (2009). Is science becoming more interdisciplinary? Measuring and mapping six research fields over time. Scientometrics, 81(3), 719–745.
[20] List of Journals. (2026.). Multidisciplinary journals. https://listofjournals.com/field.php?q=Multidisciplinary.

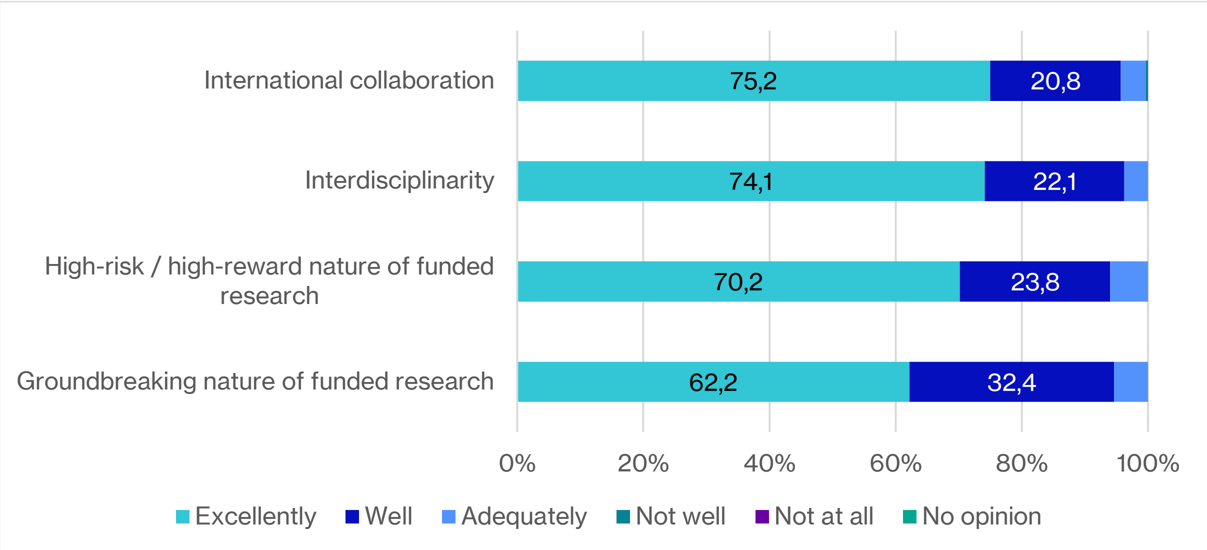
5 Value of HFSP to Researchers and Their Careers

5.1 Assessment of HFSP and its Significance for Respondents' Own Projects

As shown in the previous sections, HFSP occupies a distinct niche within the life sciences funding landscape, facing relatively little competition from other funding programs in this specific niche. This makes HFSP particularly valuable for a specific type of project and researcher. It enables the implementation of projects that would otherwise not be feasible, characterized by a high-risk/high-reward nature, interdisciplinarity, and international collaboration. The following figure illustrates how awardees perceive these characteristics in HFSP.

Figure 20: Assessment of the aspirations of HFSP by awardees in % aggregated for all funding schemes

How well does HFSP fulfill its own aspirations regarding the following thematic priorities?

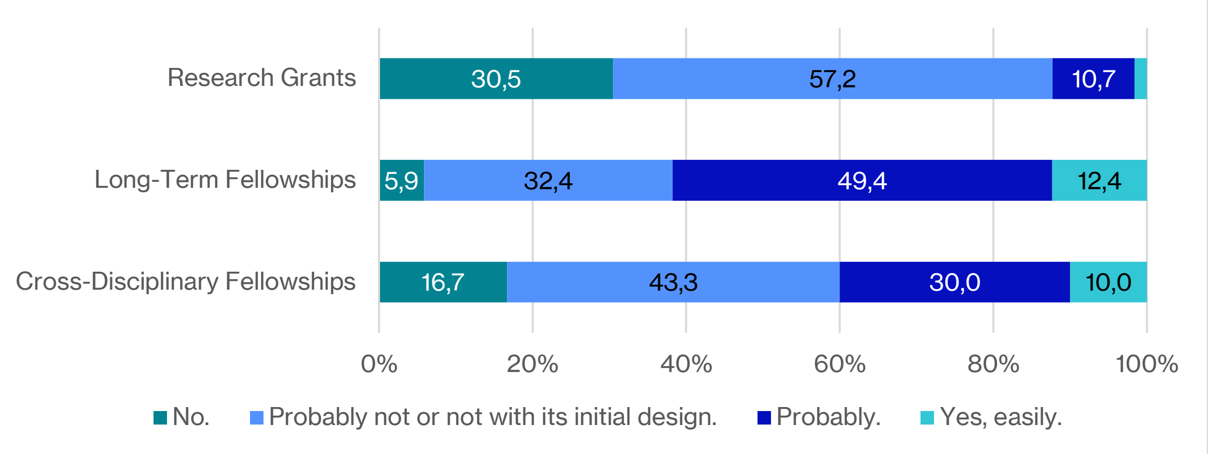


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 369-373.

From the perspective of awardees, HFSP largely meets its stated objectives. The category "groundbreaking nature" is rated slightly lower than the others, which is understandable given the exceptionally high standard it represents. Nonetheless, interdisciplinarity and international collaboration are identified as the defining features of HFSP.

The combination of these characteristics, including the high-risk / high-reward nature, constitutes a unique feature of HFSP and indicates that HFSP truly supports frontier science. This uniqueness reflected in the fact that HFSP projects could not easily have been funded through other sources. The following figure illustrates this finding.

Figure 21: Availability of alternative funding in % aggregated for all funding schemes
Without HFSP funding, would you have been able to fund your project with an alternative source?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 377.

As shown, the majority of respondents indicated that they would not, would probably not, or only with limitations, have been able to carry out their projects without HFSP support. This is especially true for the Research Grants confirming HFSP's unique position regarding the form of international collaboration it enables. Cross-Disciplinary Fellows also answered that, in the majority, their project could not, probably could not, or could only have been implemented in a modified form. This indicates that HFSP offers opportunities for interdisciplinarity that other funders do not. By a significant margin, Long-Term Fellows are the most likely to have been able to fund their projects from alternative sources. This suggests that HFSP's unique character most clearly manifests in the Research Grants and Cross-Disciplinary Fellowships. After all, only around 10% of Long-Term Fellows report that they could definitely have financed their project through other sources, implying that the Long-Term Fellowships also provide a distinctive value. Digging deeper also reveals some regional differences regarding this question: researchers from Europe and North America are most able to conduct their projects without HFSP funding, while those from the Asia-Pacific Region are least able to do so.

Interviews confirm that HFSP enables projects that would not otherwise have been realized. Most importantly, HFSP supports particularly high-risk and ambitious projects, some of which begin without any preliminary data. The most consistently raised issue among interviewees was the difficulty of obtaining follow-up funding for HFSP projects, precisely because these projects often fall outside the scope of other funding programs. The intercontinental collaboration, high degree of interdisciplinarity, and high-risk tolerance of HFSP mean that HFSP projects have a particular profile that often cannot be easily aligned with other funding programs. This does not imply that HFSP-supported researchers are generally unable to secure funding. On the contrary, their considerable success demonstrates the opposite. However, without HFSP support, it be challenging to continue pursuing high-risk research, particularly when the HFSP project has not yet produced robust or promising results. Interviews and open-ended survey responses clearly indicate substantial excess demand among researchers for the funding HFSP provides. This helps explain why HFSP is perceived so positively by its awardees, even when compared to other funding organizations.

Respondents who saw possibilities for alternative funding saw national and international programs as equal alternatives to HFSP. However, there are clear regional differences. International programs play a significant role primarily in Europe, often involving EU initiatives. In North America and the Asia-Pacific region, national programs are more prominent. When asked to name up to three specific alternative funding organizations, respondents mentioned a wide range of options, with European and US-American organizations leading.

Table 9: Most mentioned alternative funders

National/International	Name	Mentions in % of total mentions for Fellowships	Mentions in % of total mentions for Grants
International (European)	European Molecular Biology Organization (EMBO)	23	0
International (European)	European Research Council (ERC)	3	17
National (USA)	National Institutes of Health (NIH)	9	6
International (European)	Marie Skłodowska-Curie Actions (MSCA)	13	1
National (USA)	National Science Foundation (NSF)	2	8
National (Germany)	Deutsche Forschungsgemeinschaft (DFG)	4	4
International (UK-based)	Wellcome Trust	3	4
National (Switzerland)	Swiss National Science Foundation (SNSF)	4	1

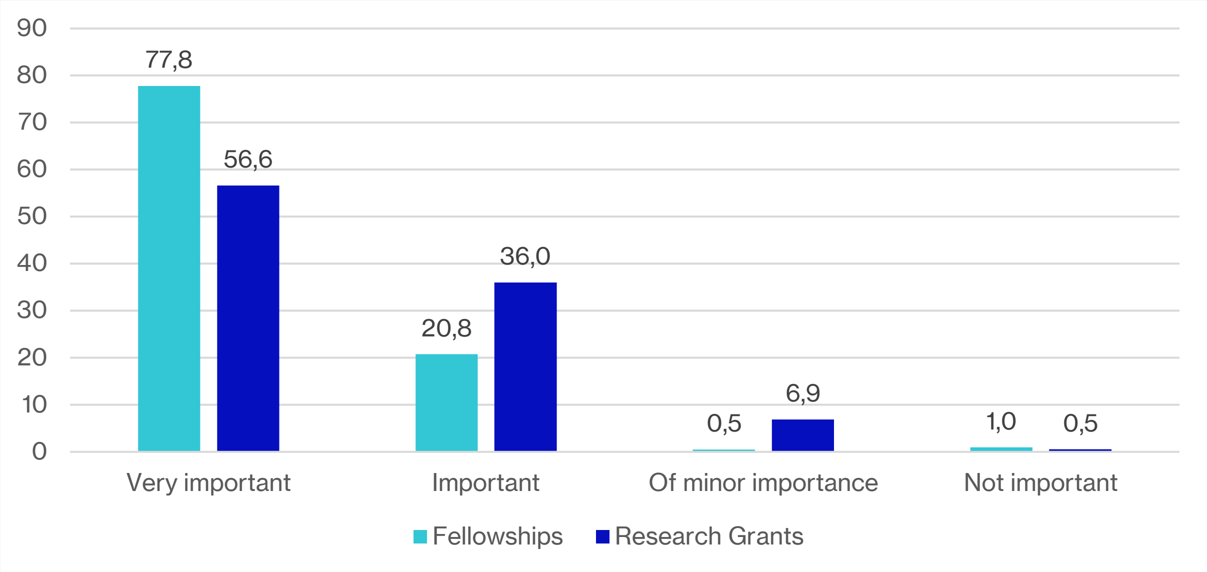
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 315, with each up to three mentions for a total of 607 mentions.

There is no clearly identifiable alternative to HFSP. Fellows most often named the European organizations EMBO and MSCA. Grant Recipients most often named ERC and the US organizations NSF and NIH. Even these most frequently mentioned funding organizations have distinct profiles compared to HFSP, with less focus on interdisciplinarity, international collaboration and high-risk research (s. Annex 11.2).

Researchers generally gain experience with many different funding organizations over the course of their careers. The following illustration demonstrates that HFSP occupies an exceptional position for its beneficiaries compared to other funding organizations.

Figure 22: Importance of HFSP compared to other funding organizations for career development in %

How important was HFSP funding for your career development compared to other funding organizations or other sources of funding?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 396.

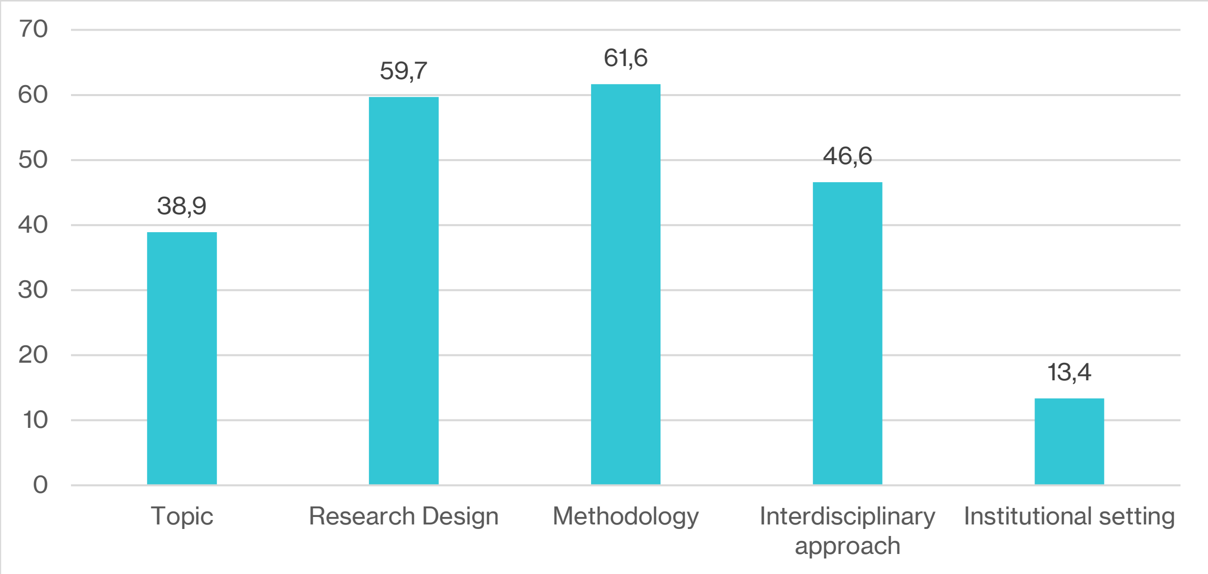
Figure 22 shows that HFSP played an important or very important role for the vast majority of its recipients. This effect is particularly strong for the fellowships demonstrating that HFSP is rarely just one funder among many but plays a significant role for its recipients. Interviews indicate that HFSP enables awardees to pursue projects that would otherwise have been beyond their reach due to their ambitious, interdisciplinary, or international nature. These projects often have a lasting formative impact on the researchers involved. HFSP allows many awardees to build connections, expertise, and credentials that form the foundation of their subsequent careers. As a result, their professional trajectories tend to be more interdisciplinary, international, and scientifically risk-taking than they likely would have been without HFSP support.

5.2 Impact of HFSP on the Funded Project

HFSP's impact goes beyond individual career advancement and extends to the thematic direction of researchers' work, fostering more interdisciplinary and internationally collaborative trajectories. Interviews indicate that, in some cases, HFSP enables researchers to permanently shift their field of work, pursue new scientific directions, and thus contribute sustainably to strengthening interdisciplinarity within the life sciences. While HFSP's impact on individual researchers and projects is evident, its overall footprint within the broader life sciences ecosystem should be viewed in proportion. HFSP supports a select segment of internationally collaborative basic research, and its influence lies less in scale than in demonstrating how such models can advance frontier science. By funding projects that might not otherwise find support, HFSP provides a distinctive and complementary contribution to the global research landscape, rather than representing its entirety. The survey results confirm the considerable impact of HFSP on the projects it supports. Only a small proportion of respondents stated that HFSP had not influenced their original idea, while approximately half described the program's impact as significant. The figure below illustrates the specific aspects of projects that were affected by HFSP, based on all respondents who reported that the program had at least some influence.

Figure 23: Influence of HFSP on funded projects in % aggregated for all funding schemes

What aspect of your project changed due to HFSP funding and support?



Source HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 352.

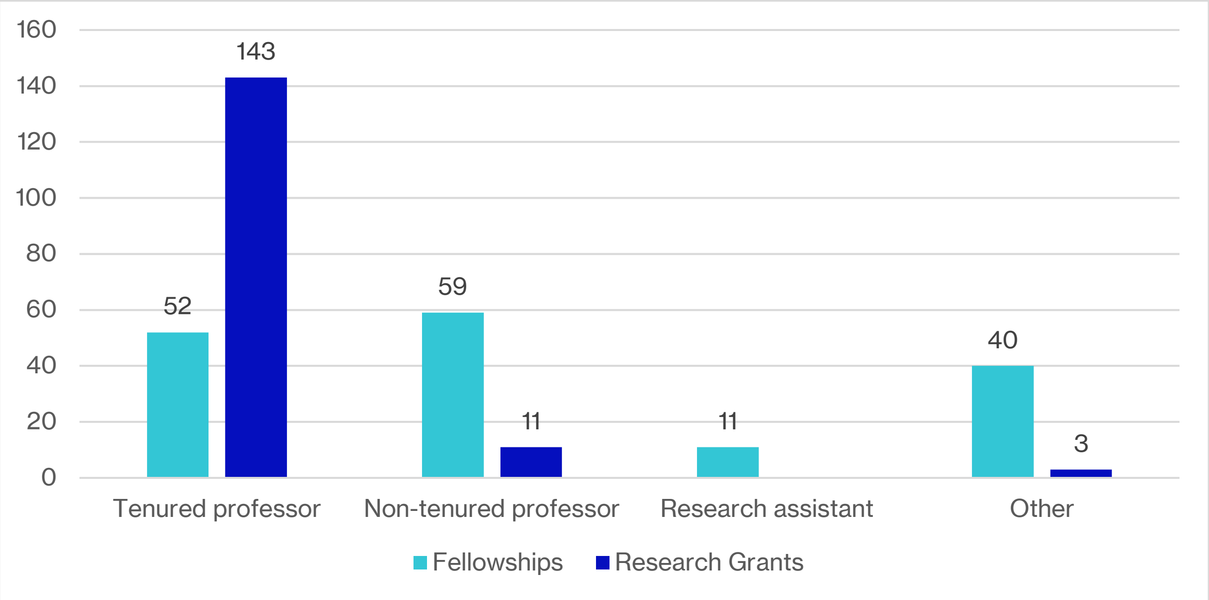
Approximately 60% of respondents stated that HFSP had influenced their research design or methodology. Nearly 40% even reported that HFSP had an impact on their research topic. These results underscore the substantial influence HFSP exerted on the projects it funded through its orientation and eligibility criteria. It is apparently not for all researchers the case that their initial ideas, research designs, and methodologies already align well with HFSP's criteria and therefore do not require significant adjustment. Rather, interviews confirm that the idea and its implementation often evolve, as it were, in dialogue with HFSP and its criteria. The perspectives and expertise of researchers from different fields and regions have, in many cases, led to new ways of addressing specific problems as well as to novel applications and development opportunities for scientific findings. Another aspect that many participants found particularly influential is the HFSP meetings, which the overwhelming majority of attendees describe as intellectually stimulating and inspiring. However, interviews also indicate that many awardees participate only rarely, or not at all, in these events due to their time and logistical demands.

5.3 Impact of HFSP on Careers of Awardees

Being funded by HFSP provides long-term benefits for its awardees. The HFSP name, as a recognized marker of excellence, often opens doors. However, interviews suggest that this effect varies considerably across regions and appears to be much weaker in the United States than elsewhere. The survey showed that the vast majority of respondents, around 80%, remains in academia. While this figure is likely somewhat inflated due to the survey bias (s. section Survey), the overall finding that HFSP awardees tend to stay in academia is supported by independent data analyses (s. section 9.4).

Figure 24: Current position of awardees in academia

What best describes your current employment position?



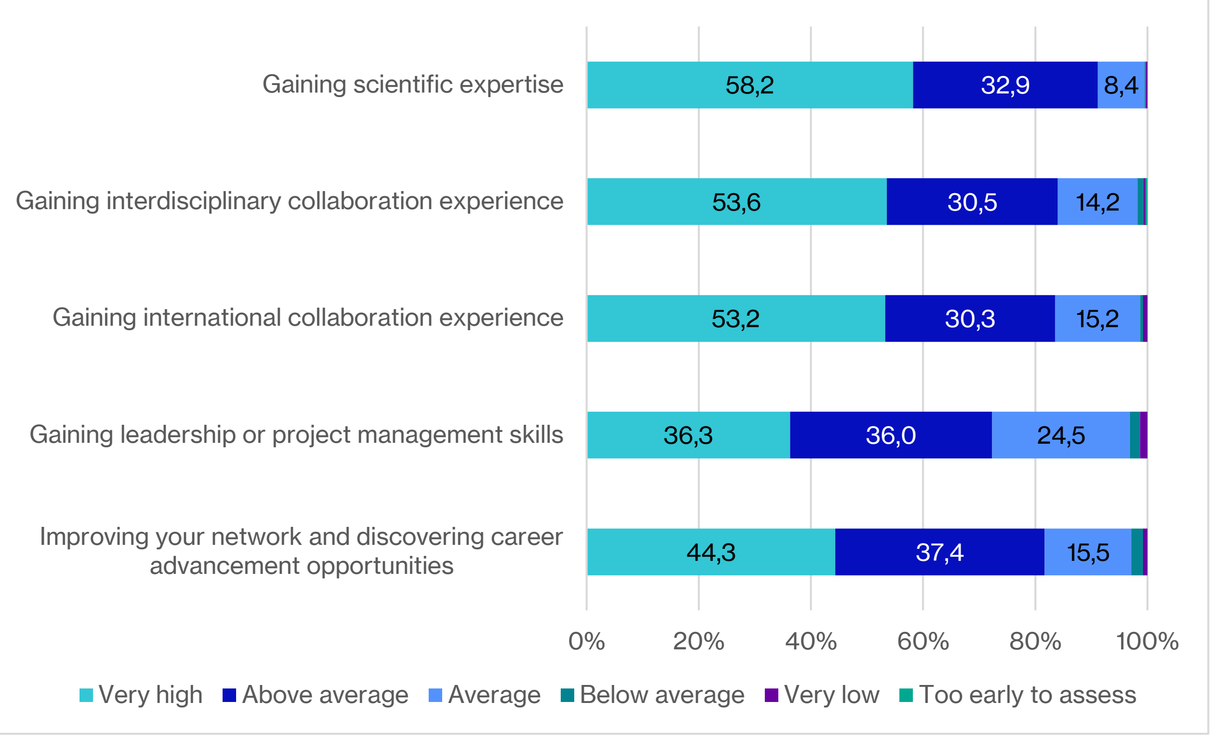
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 319.

Among those who remain in academia, the above figure demonstrates their success in this highly competitive environment. Recipients of Research Grants must be faculty members to be eligible grant applicants. Hence, HFSP already targets successful researchers by design. Still, the overall result confirms that HFSP effectively identifies talented and high-performing individuals for funding.

HFSP has a strong positive impact on the career trajectory of its awardees. This is supported by the survey results shown below, which attest HFSP's exceptionally strong contribution to various aspects of career development.

Figure 25: Contribution of HFSP to Career Development in % aggregated for all funding schemes

How do you rate the contribution of the participation in an HFSP-supported project to the following aspects of your career development?



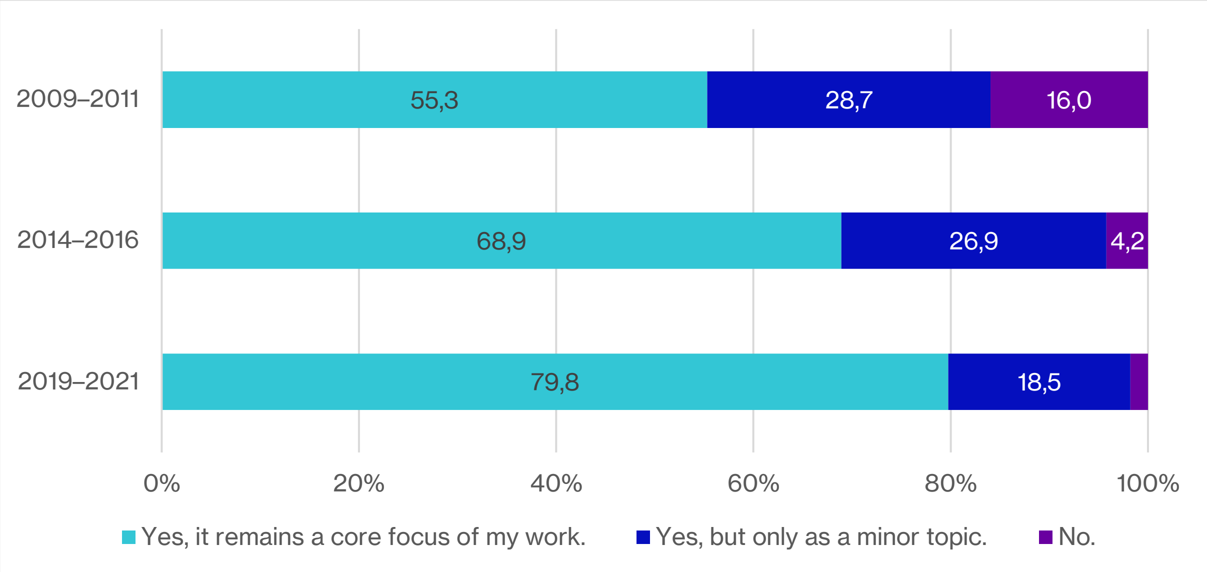
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 388-395.

In four categories, more than 80% of respondents reported that their HFSP-supported project had an above-average or very high impact. Interviews and case studies confirm this finding. By offering unique opportunities – particularly in international collaboration, as well as in interdisciplinary work and high-risk research – HFSP enables funding recipients to gain distinctive experiences, build capacity, and forge collaborations. This is a very strong contribution to capacity building in the life sciences, providing researchers valuable experience and expertise, which they often could not get anywhere else.

The success of HFSP researchers also means that the values embodied by HFSP are effectively transmitted into the broader scientific community. Many HFSP alumni hold positions that allow them to exert significant influence, for example, by leading their own laboratories. Through supervising and mentoring early-career scientists, they actively help shape the future of science. Interviews further revealed that one of the main ways potential applicants learn about HFSP is through mentors who themselves were former HFSP awardees.

Figure 26: Enduring importance of the HFSP-supported project in % aggregated for all funding schemes differentiated by cohorts

Are the research ideas or the results of your HFSP-supported project still relevant to your current research?



The marked time periods refer to the respective cohort of survey respondents, based on the year of the award.
Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 381.

Table 27 shows, that for more than two-thirds of respondents, the HFSP project has remained a cornerstone of their current work. Naturally, this share was highest among the most recent cohort, yet even among the oldest cohort (2009–2011), it still exceeded 50%. This finding indicates that the projects funded by HFSP are rewarding and sustainable. If this were not the case, researchers would be unlikely to secure further funding to build on their HFSP projects and would instead move more strongly in other, more promising directions. However, the findings also suggest – and interviews confirm this aspect – that in many cases, researchers no longer engage in high-risk research to the same extent after their HFSP-Project. This is largely because the results they achieve through their HFSP projects reduce the level of risk associated with continuing research in the same direction. Nevertheless, continuing along these lines can be boundary-pushing. Case studies show that precisely because HFSP supports highly ambitious and high-risk research, such work can remain relevant and at the scientific cutting edge for years or even decades.

Lastly, the finding underlines the enduring influence HFSP has on its awardees and, thus, on academia and life sciences. Combining these findings with HFSP's profile as a supporter of interdisciplinary, internationally collaborative frontier science, it can be concluded that HFSP actively strengthens these very values within the scientific community.

6 Interim Conclusion: Uniqueness of HFSP

This chapter synthesizes insights from the previous chapters and adds additional context to analyze the uniqueness of HFSP from multiple perspectives. It primarily draws on Chapters 4 and 5. The first of which has shown what distinguishes HFSP along the three dimensions of frontier science, international collaboration, and interdisciplinarity. Chapter 5 complemented this by adding the perspective of awardees. To better position HFSP within the broader funding landscape, comparable funding bodies were examined. The selection of these was based on statements from the survey, interviews and research. The results are summarized in the appendix and serve as additional evidence for the following examination (s. Annex 11.2).

The findings from the previous chapters unanimously show that HFSP occupies a unique position in the funding landscape for the life sciences. Other funders confirm this, recognizing HFSP as a leader in the life sciences that promotes interdisciplinary, internationally collaborative frontier science. CIHR states that HFSP supports "leading-edge research" and "interdisciplinary collaborations."[21] UKRI attributes to HFSP that it supports "novel, innovative and interdisciplinary basic research."[22] By contrast, AMED describes HFSP as an organization that funds "novel collaborative research at the cutting edge of the life sciences, drawing on the expertise of scientists from other research areas."[23]

The most noticeable unique feature of HFSP is the type of international collaboration it promotes. The broader funding environment has, in some respects, become more open. However, no other funding organization finances international research teams working in different countries and continents to that extent. For example, although European Research Council (ERC) grants are now accessible to non-European researchers, the work needs to be conducted within the EU or an Associated Country. HFSP thus enables international collaborations that could not be funded otherwise. These collaborations offer unique benefits for the researchers involved, science and the countries participating (for more information, s. section 9.2).

HFSP is also more strongly oriented toward interdisciplinarity than comparable funders, as reflected in its scientific outputs. Interdisciplinarity is not a binary category; there are different degrees of interdisciplinarity, which are often only imperfectly captured by quantitative indicators. When the qualitative evidence is taken into account, it becomes apparent that HFSP is also distinctive in the degree of interdisciplinarity it supports. In particular, the Cross-Disciplinary Fellowships bring researchers into the life sciences from fundamentally different fields. Moreover, the Research Grants frequently span greater disciplinary distances among funded researchers than is typically the case even in other interdisciplinary research projects. Interdisciplinarity is not an end in itself but demonstrably enhances performance. Contributions from computing, psychology, and clinical science frequently exceed within-cluster averages for biological disciplines, indicating

[21] Canadian Institutes of Health Research. (n.d.). Human Frontier Science Program. https://cihr-irsc.gc.ca/e/51826.html.
[22] UK Research and Innovation. (n.d.). Human Frontier Science Program (HFSP). https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/human-frontier-science-program/.
[23] Japan Agency for Medical Research and Development. (n.d.). Human Frontier Science Program (HFSP). https://www.amed.go.jp/en/program/list/20/02/001.html.

that interdisciplinarity functions as a mechanism for raising scientific impact (s. section 4.3.2). HFSP's interdisciplinarity is also reflected in the frontier-science character of the funded research: Different disciplines interact to open up new topics and fields (s. Annex 11.9).

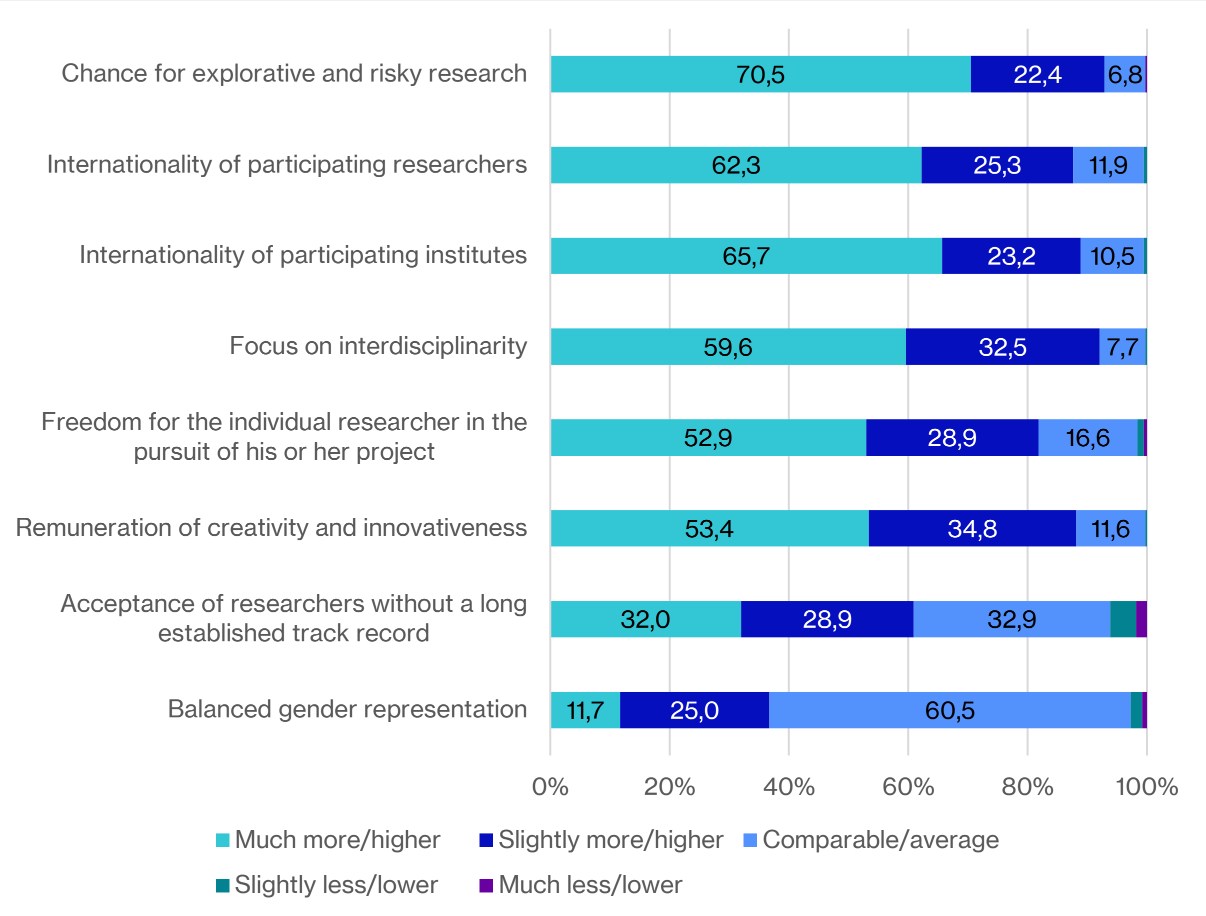
HFSP is unique in its approach to high-risk research and frontier science. However, the differences there are more gradual than fundamental. There are many other funders in the life sciences who promote high-risk research and frontier science. However, in most cases, this focus is much less pronounced than at HFSP. Interview findings also indicate that not all organizations consistently enact the risk affinity they claim to the extent that HFSP does. Some other funders, such as the National Institutes of Health, have individual funding schemes that explicitly target high-risk research, but are not generally geared toward it and require preliminary data. Few funders explicitly state that only limited preliminary data is necessary, and none besides HFSP state that no preliminary data is necessary. Section 4.1 showed how HFSP operates at the margins of the life sciences, advances into new, interdisciplinary and emerging fields, and gives rise to new concepts. The concept-level novelty analysis presented in Section 4.1.4 provides quantitative evidence of this frontier orientation, capturing the extent to which HFSP-supported research departs from prevailing explanatory frameworks within established life-science domains. Its outputs form durable, interconnected clusters rather than isolated projects, with methodological platforms, especially imaging and chromatin or genome technologies, driving advances across multiple fields and distributing influence rather than concentrating it in a single area. The next chapter will examine HFSP's profile as a funder of basic research and compare it with the profiles of other funders. To summarize, HFSP is more strongly oriented toward basic research than other funders and operates more at the margins of traditional biological research, i.e. in the domain of frontier science (as further substantiated in the subsequent chapter on excellence in section 7.1).

The degree of risk of research projects is difficult to quantify, because even projects that are formally unsuccessful – i.e., that do not achieve their objectives within the project period – can still yield success in measurable categories such as publications and citations. It is possible to identify a distinctive dispersion in citation counts (compare section 4.1.2), which is strong evidence for high-risk boundary pushing research. Failures are, however, not reflected in publication and citation metrics to the extent one might assume for high-risk research. Multiple case studies, interviews, and a focus group confirm that HFSP-supported projects are often highly ambitious and risky in terms of their stated goals. Therefore, these goals are frequently not fully achieved. This project trajectory does not translate into general scientific failure as it is possible to "fail successfully", for instance, by gaining insights into what does not work, by generating incremental findings that do not yet achieve the ultimate goal, or by obtaining results that do not lead to the original objective but point in other worthwhile directions. With the flexibility HFSP grants to its researchers, they can adapt their projects during the funding period.

One indication of the HFSP's uniqueness in terms of risk and other factors is the awardees' own perceptions, as shown in the following figure.

Figure 27: Perception of HFSP among awardees in % aggregated for all funding schemes

How do research projects funded by HFSP differ from projects funded by other support programs regarding the following aspects?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 256-380. The lower bound stems from many participants opting not to answer the question about gender representation.

HFSP receives exceptionally high ratings compared to other funding organizations across high-risk research, interdisciplinarity, internationality, and innovativeness. HFSP is also rated very highly for the autonomy it grants to its awardees – a feature that, as interviews confirm, is particularly valued by researchers. The only two subcategories that were not rated predominantly positive concern the acceptance of researchers without an established track record and gender balance. And even there only a very small minority attest HFSP a below-average performance. Interviews and open-ended survey responses confirm that HFSP is viewed very positively by its awardees, who consistently describe it as unique within the broader funding landscape. While awardees are not neutral observers, the fact that this strong assessment is also shared by members of the oldest cohort – who have since gained substantial experience with other funding organizations – provides further compelling indication that HFSP occupies a genuinely unique position (s. section 5 for more details regarding the perspective of awardees).

Overall, HFSP possesses several characteristics that make it unique. Looking beyond individual features, HFSP emerges as a comparatively small, specialized funder with a distinctive orientation. The most important test of a funder's uniqueness is ultimately whether it supports types of projects that would otherwise not receive funding. This can be confirmed for HFSP, particularly for the Research Grants and the international collaboration they enable. The survey findings reinforce this picture: the vast majority of respondents state that, without HFSP, their project could not have been carried out at all, or only in a substantially modified form (compare Figure 21). A related facet that makes HFSP unique is its high degree of exclusivity, reflected in a lower success rate than any of the comparable programs examined. This indicates that researcher demand relative to the available funding is exceptionally high in the case of HFSP (s. sections 3 and Figure 21), which aligns with the previous statement regarding HFSP's importance for a specific type of research.

Without HFSP, this specific type of research would no longer, or only to a much lesser extent, be funded. This applies in particular to internationally collaborative research extending beyond Europe, interdisciplinary research, and high-risk frontier science. These types of research, in turn, have disproportionately large impacts, as shown in the preceding and subsequent chapters. In the absence of HFSP, these impacts would not exist or would be significantly diminished.

7 Excellence of HFSP Research

This chapter assesses the scientific excellence and global influence of HFSP-supported research using established field- and year-normalized bibliometric indicators. The analysis focuses on the Field Citation Ratio (FCR) and the share of publications in the global top 10% by field-normalized citation impact, enabling robust comparison across disciplines and funding schemes and benchmarking against global basic-science portfolios and selected peer funders. The chapter also considers indicators of broader influence (e.g., patent citations) and research integrity (retractions) to provide a more rounded view of excellence beyond academic citations.

7.1 The Basic Science Benchmark

Because HFSP is rooted in basic science, its citation performance is benchmarked against a global corpus of "Basic Science" outputs as classified in the Dimensions database. This ensures HFSP is assessed like-for-like against comparable foundational research rather than against applied or translational outputs. For program-level benchmarking, analyses use the most recent publication year with stable field-normalized indicator FCR (up to 2023).

Table 10 summarizes HFSP's performance relative to global basic-science comparators. HFSP-supported research shows a very high share of cited publications and field-normalized citation (via FCR) substantially above global basic-science baselines. When restricting HFSP outputs tagged as basic science, the advantage strengthens further: the field-normalized citation is approximately three times higher than the comparable global basic-science benchmark in HFSP's dominant fields. These results indicate that HFSP publications consistently outperform their disciplinary context rather than simply concentrating in already highly cited areas.

Table 10 Citation rates and field citation ratio (FCR) for HFSP publications compared with global basic-science benchmarks (2008–2023).

HFSP's full publication corpus and its basic-science subset are benchmarked against global and disciplinary basic-science outputs.

	HFSP	HFSP (Basic Science categorization)	Global Basic Science (all disciplines (FoR))	Global Basic Science (Biological & Biomedical Sciences)
Total Nr. publications	15.945	8.836	4.466.201	4.045.607
Cited publications	95.72%	96.63%	78.99%	78.80%
FCR	5.91	6.46	2.28	2.31

Source: Dimensions database.
Methodological note: The analysis is restricted to publications up to 2023, as this is the most recent year for which a reliable field-citation ratio (FCR) can be derived.

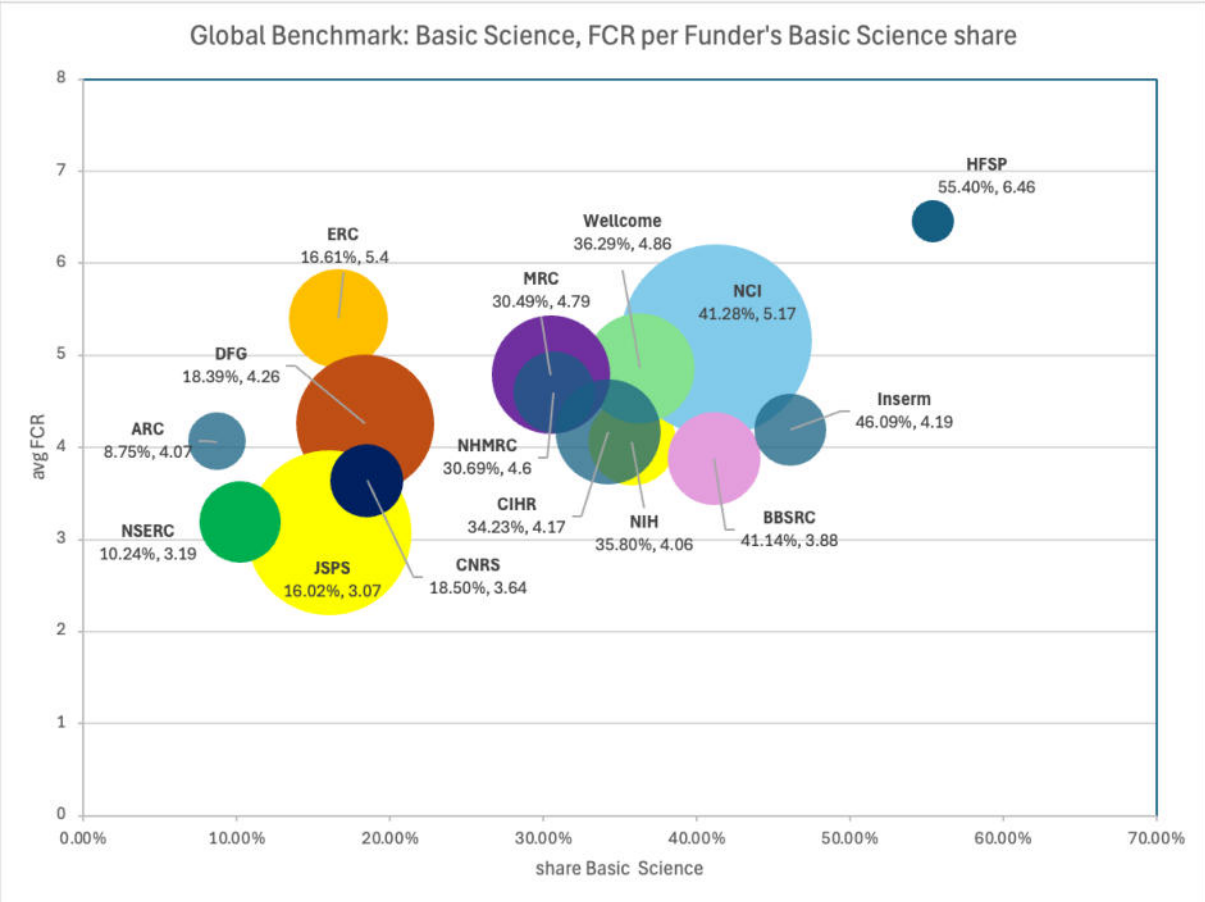
7.1.1 Global Benchmark

In the basic science-based benchmark with major research funders, HFSP stands out as a positive outlier. Figure 28 positions funders by (i) their share of publications classified as basic science and (ii) their average field citation ratio (FCR), with bubble size indicating output volume. HFSP stands alone in the high-basic-science, high-impact quadrant, demonstrating a uniquely discovery-driven portfolio with disproportionately high citation performance despite its small scale.

While HFSP operates at a comparatively small scale, its citation performance remains exceptionally strong even when compared with substantially larger portfolios.

Figure 28: Global benchmark of HFSP's basic-science intensity and citation performance relative to major international funders (2008–2023)

The bubble chart plots each funder by its share of basic-science publications and its field-normalized citation ratio (FCR), with bubble size indicating total basic-science output. Abbreviations are explained in 12 – List of abbreviations.

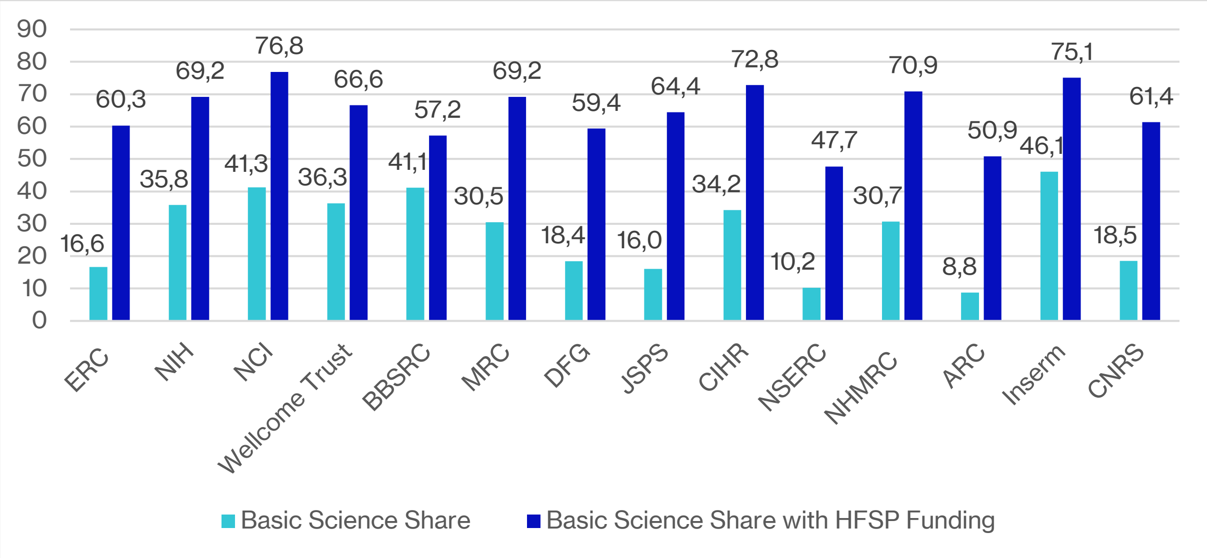


Source: Dimensions database.

A complementary perspective on HFSP's role in the wider funding system comes from the analysis of publications that acknowledge HFSP alongside other funders. Across partner agencies, publications that acknowledge HFSP alongside other funders show higher basic science intensity and higher citation impact relative to those agencies' baselines, indicating that HFSP participation is associated with a shift toward more foundational, higher-impact research outcomes in outputs that acknowledge multiple funders (s. Figure 29 and Figure 30).

Figure 29: HFSP's influence on partner funding portfolios regarding the basic science share

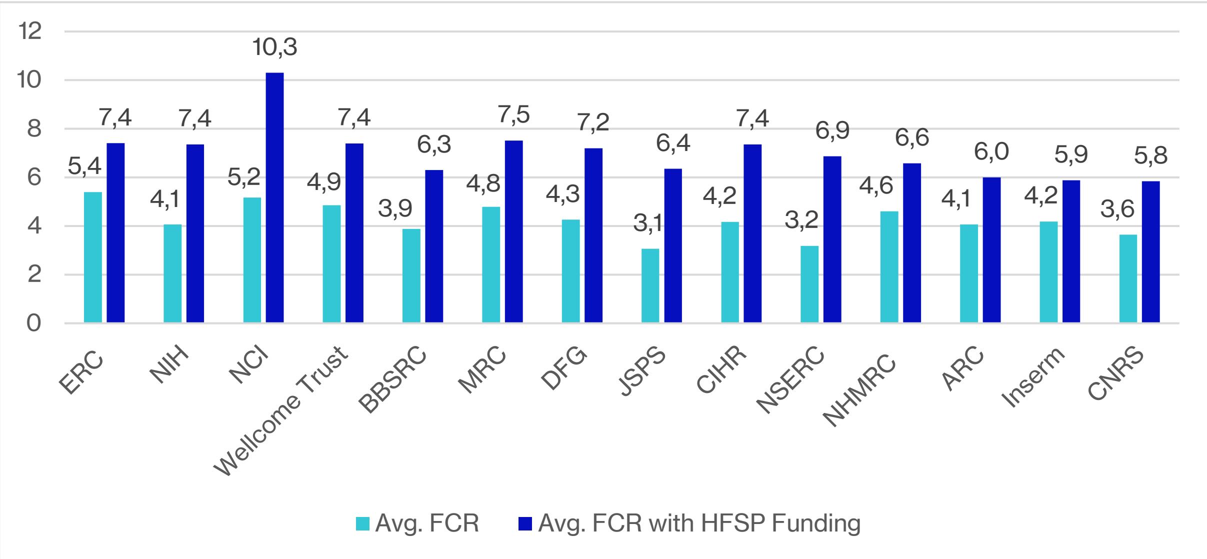
Shifts in basic-science share when HFSP is acknowledged jointly with other funders (2008–2023) in %. Abbreviations for funders can be found in 12 – List of Abbreviations.



Source: HFSP Data and Dimensions Database.

Figure 30: HFSP's influence on partner funding portfolios regarding citation performance

Shifts in citation performance when HFSP is acknowledge jointly with other funders (2008–2023) in %. Abbreviations for funders can be found in 12 – List of Abbreviations.

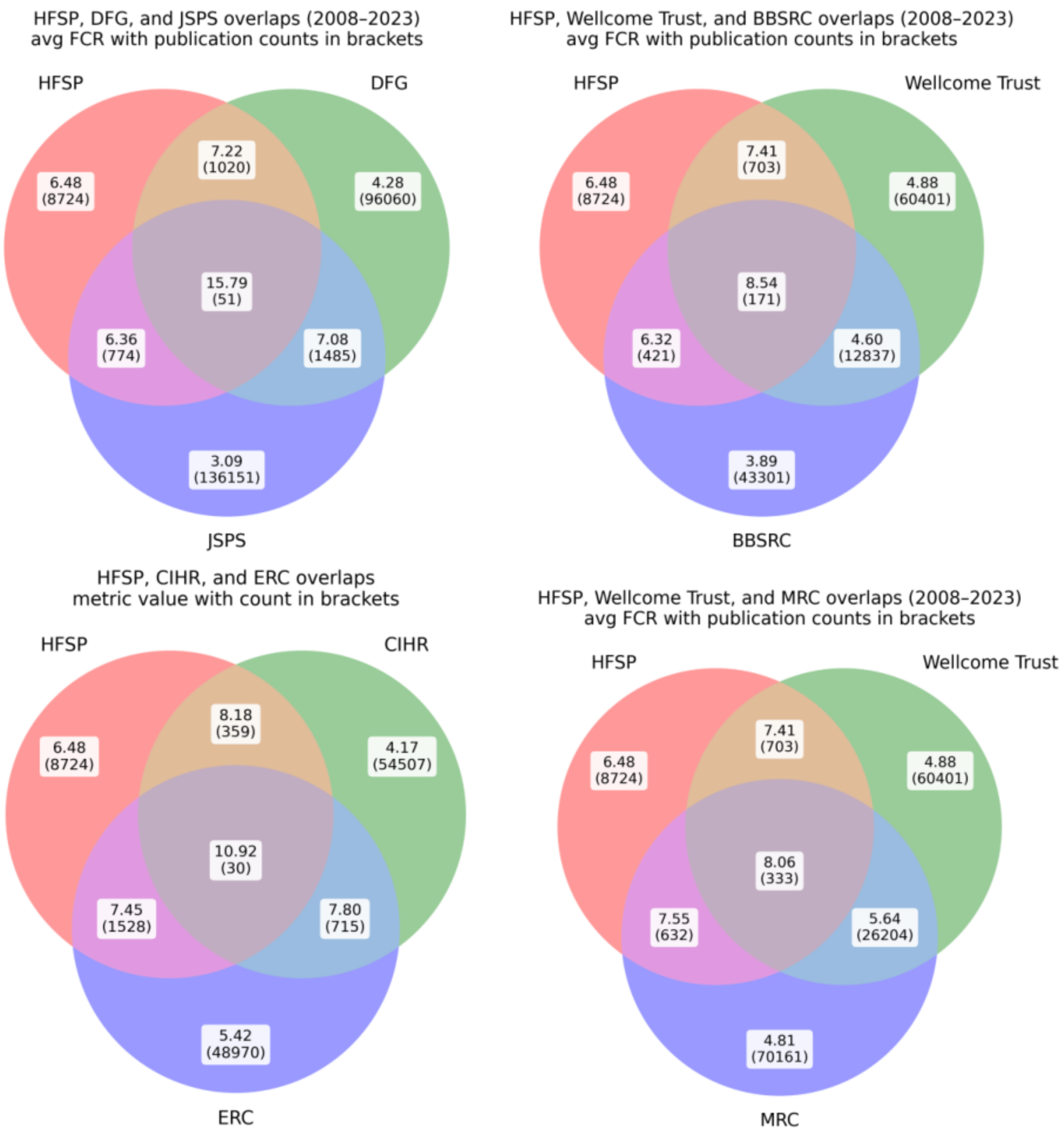


Source: HFSP Data and Dimensions Database.

Spot checks of collaborative publications involving two or three acknowledged funders indicate that joint funding is generally associated with an elevated field citation ratio (FCR) for basic research publications. While this uplift is not unique to HFSP, the effect appears consistently more pronounced when HFSP is part of the funding constellation compared with other funder combinations.

Figure 31: FCR of research supported by a combination of funders including HFSP

Abbreviations for funders can be found in 12 – List of Abbreviations.



Source: Dimension Database

Figure 31 shows the average FCR and publication counts for different funding constellations. Publications involving HFSP exhibit higher average FCR. Dual-funder configurations that include HFSP consistently outperform alternative dual-funder combinations between non-HFSP funders (exception: DFG & JSPS and ERC & CIHR), while triple-funded publications show the highest average FCR, albeit with small numbers. These patterns suggest that HFSP enhances the output in the Life Sciences within the funding system. Findings should be interpreted as directional, given the limited size of some funding constellations and only few constellations were tested.

7.1.2 Insights from HFSP-Only Funded Research Across Funding schemes

A small subset of HFSP-acknowledged publications lists HFSP as the only funder. Across HFSP funding schemes, the share of HFSP-only outputs is consistently modest, reflecting HFSP's position within a broader funding ecosystem. While the HFSP-only subset is small, it provides an additional lens on HFSP award type profiles, including variation in basic-science intensity across schemes and differences in field-normalized citation patterns.

Funding scheme-level detail on HFSP-only publications (total numbers, basic-science shares, and citation performance) is provided in Table 11. Only a small share of publications (3–7%) acknowledge HFSP as the sole funder, reflecting the program's inherently collaborative and international funding model. HFSP therefore operates primarily as a contributor within a wider research funding ecosystem rather than as an isolated sponsor.

Table 11: Publication only citing HFSP support by funding scheme: volume, basic-science share, and citation performance (2008–2023).

The table compares publications supported exclusively by HFSP across funding scheme (RG, RGEC, CDF, LTF), reporting the proportion of HFSP sole-funded work, its basic-science intensity, and associated field-normalized citation impact (FCR).

	HFSP Total	RGP (linked)	RGEC (linked)	CDF (linked)	LTF (linked)
HFSP supported publications (2008-2023)	15945	3512	1424	380	1795
HFSP-only supported publications (2008-2023)	839	249	63	11	62
% HFSP-only supported	5.26%	7.09%	4.42%	2.89%	3.45%
Basic Science	256	76	27	4	37
% Basic Science	30.51%	30.52%	42.86%	36.36%	59.68%
FCR	3.31	3.79	3.16	2.15	6.44

Source: Dimensions database
Methodological note: To analyze the HFSP funding schemes in detail, only linked and verified publications via researcher and award type are taken into consideration (labelled "linked").

Within this subset of publications exclusively funded by HFSP, clear funding scheme-level differences emerge. Long-Term Fellowships show the strongest orientation toward basic science.

Early Career Research Grants similarly display a pronounced basic science focus, reinforcing their role in supporting the transition to independent research leadership.

Program Grants and Cross-Disciplinary Fellowships exhibit lower, but still substantial, basic science shares, consistent with the broader, more integrative research modes of established teams and interdisciplinary investigators. Across all schemes, lower field-normalized citation rates for HFSP-only publications reflect the exploratory nature of work in emerging or niche areas rather than diminished quality. Taken together, these patterns confirm HFSP's distinctive role in sustaining frontier biological research and supporting high-risk discoveries where conventional funding mechanisms are less effective.

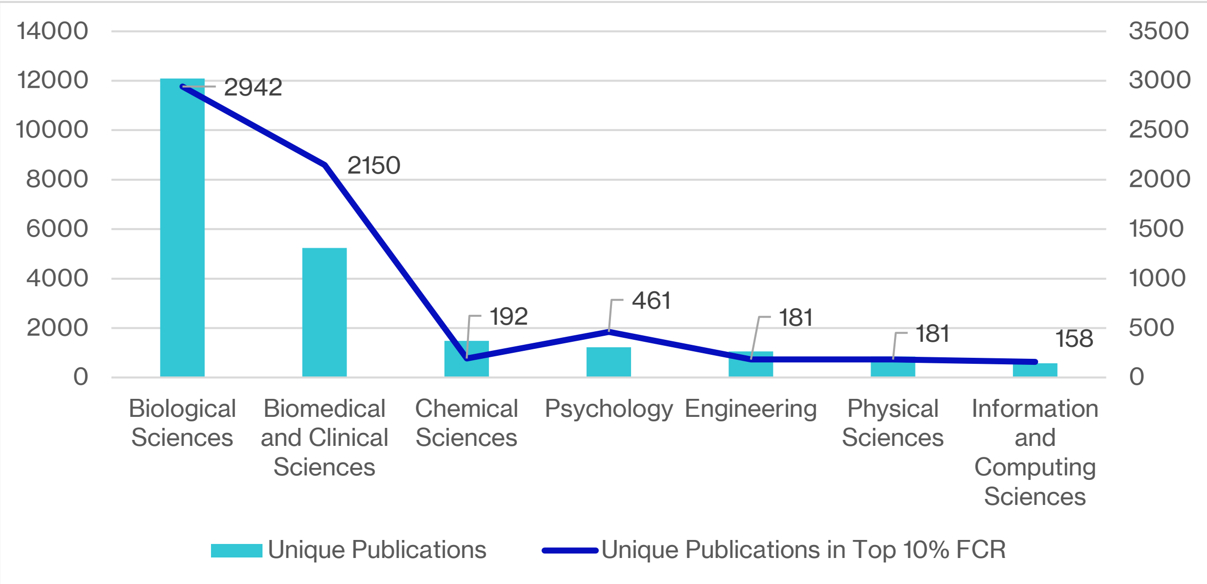
7.2 HFSP Top 10% FCR and Research Program Performance

Excellence is also summarized using the share and volume of HFSP publications in the global Top 10% by field-normalized citation. Figure 32 shows that high-impact publications concentrate in Biological Sciences and Biomedical & Clinical Sciences, but that HFSP also generates substantial volumes of Top 10% publications in adjacent fields such as Psychology, Chemical Sciences, Physical Sciences, and Information & Computing Sciences. This dispersion of highly cited publications beyond the life-science core is consistent with HFSP's emphasis on interdisciplinary research at disciplinary interfaces and the discipline mix across the HFSP portfolio as shown in section 4.1.

Figure 32: Performance of publications supported by HFSP (2008-2023) by discipline (Field of Research, FoR).

Only the top 7 FoR are displayed.

Left Axis counts unique publications. Right Axis counts unique publications in Top 10% FCR.



Source: Dimensions database.

Across HFSP award types, the patterns are complementary. Research Grants contribute the largest absolute volume of Top 10% outputs, reflecting their role as the main engine of portfolio scale.

Long-Term Fellowships contribute strongly to high-impact publication in the core life sciences and show meaningful presence in cognitive and computationally adjacent areas. Cross-Disciplinary Fellowships, despite a smaller volume, exhibit a pronounced interdisciplinary signature, with high-impact publications distributed across a wide disciplinary range. This is consistent with the program's design to support boundary-crossing early-career trajectories. Detailed funding scheme-by-discipline breakdowns and supporting tables are provided in the Annex 11.14.

The distribution of Top 10% papers across non-biological FoRs demonstrates that HFSP's interdisciplinarity amplifies impact beyond the life-science core. Research Grant teams drive breadth and depth, while Long-Term Fellowships push cognitive/computational frontiers. Table 12 summarizes the figures and key insights into the largest HFSP award schemes that exhibit comparable high numbers of Biological Sciences publications in the Top 10% FCR category.

Table 12: A comparison of top 10% FCR publications by main discipline (FoR category) of publication by HFSP Research Grants versus Long-Term Fellowships

FoR Category	RG (Top 10% FCR)	LTF (Top 10% FCR)	Insight
Biological Sciences	1,409	1,218	Both contribute almost equally large volumes of high-impact papers to the core field.
Biomedical Sciences	1,021	890	Very similar pattern: both successfully drive clinical/medical relevance.
Psychology	285	277	Nearly identical performance, highlighting that LTF-supported individual fellows are as crucial as RG teams in driving excellence in cognitive and behavioral sciences.
Chemical Sciences	122	52	RG leads, suggesting team-based grants may be better suited for complex, resource-intensive chemical projects.
Engineering	145	90	RG leads, likely reflecting the resource demands of large-scale, team-driven engineering/technology development projects.

Source: Digital Science, based on Dimensions database.

Overall, both the Research Grants and Long-Term Fellowships funding schemes make substantial and complementary contributions to HFSP's high-impact research profile. The parallel success of the collaborative, team-based RG model and the individual-investigator LTF mechanism validates HFSP's dual approach to supporting frontier research. Collectively, these findings affirm the program's continuing role as a facilitator of high-impact, interdisciplinary science at the global level.

The Cross-Disciplinary Fellowship (CDF) funding scheme demonstrates a strong interdisciplinary signature: whereas Research Grants broaden impact by integrating teams, the CDF empowers individual fellows to bridge distinct fields, producing high-quality publications across a wide disciplinary span. This excellence extends well beyond the life sciences, generating high-impact publications in foundational fields such as engineering, physical sciences, and psychology. Evidence of this transformative potential is clear in the high proportion of Top 10% papers: 67% in Psychology and 44% in Biomedical Sciences, alongside strong shares in Engineering (25%) and Physics (23%). These figures reinforce the CDF's role as a vital catalyst for physics–biology and engineering–biology interfaces, fitting fields that are foundational for advancing frontier biology in the 21st century[24].

7.3 Citation Benchmark: HFSP and EMBO

To contextualize HFSP fellowship performance against a closely comparable excellence-oriented funder, HFSP Fellowships (Long-Term and Cross-Disciplinary) were benchmarked against EMBO Fellowships based on the acknowledgement, respectively, in publications in the Dimensions database (s. Table 13). Both funders show similarly high visibility (nearly identical shares of cited publications and comparable concentrations of outputs in the Top 10%). HFSP publications display a higher average field-normalized citation ratio (FCR) than EMBO in this comparison, indicating stronger relative performance.

Table 13: Basic bibliometric indicator comparing EMBO Fellowship and HFSP Fellowship citation performance (2008-2023)

Metric	EMBO	HFSP
Total Publications	7,348	4,385
% Cited	96.5%	96.4%
Avg Citations	99.9	119.8
Avg FCR	12.35	15.07
% Top 10% Cited	58.3%	58.2%

Methodological note: To allow for greatest comparability, for both EMBO and HFSP Fellowships only those publications were retrieved from the Dimensions database where HFSP or EMBO Fellowships were acknowledged, respectively. This dataset does not contain linked HFSP LTF and CDF Fellowship data.
Source: Dimensions database.

The Field Citation Ratio (FCR), which normalizes disciplinary and temporal differences, reinforces this trend. HFSP's average FCR of 15.07 notably exceeds EMBO's 12.35, evidencing a stronger relative impact within global citation norms. This indicates that HFSP-supported research performs substantially above the world average for its respective fields, even when benchmarked against another leading life sciences funder.

Both funders show similar proportions of highly cited papers in the global top decile (Top 10% FCR: EMBO 58.3%; HFSP 58.2%). This parity suggests that both programs maintain exceptionally high concentrations of elite research output. Nonetheless, HFSP's higher average citation and normalized impact metrics imply a marginally stronger performance at the upper end of the citation distribution, reflecting the program's success in nurturing breakthrough and interdisciplinary research with broad resonance across scientific communities.

[24] see for example (https://haseloff.plantsci.cam.ac.uk/resources/SynBio_reports/NewBiologyfor21stCentury.pdf] and Osman et al { 2013, https://www.sciencedirect.com/science/article/pii/S1877042813042687]

In summary, the benchmarking analysis positions HFSP's Fellowships citation performance as highly competitive with, and in some respects superior to, that of EMBO Fellowships. Despite a smaller publication volume, HFSP achieves higher per-research article citation impact and a stronger normalized performance, underscoring its effectiveness in supporting globally influential, high-quality science within the life and biological disciplines.

A focused analysis of methods and protocol publications suggests that this subset of HFSP outputs has particularly strong reach and reuse, including very high citation performance and notable patent uptake (s. Table 14). While methods papers represent a small share of total number of publications, they function as high-leverage contributions that can accelerate diffusion across fields and research areas.

Table 14: Bibliometric indicators for methods publications supported by EMBO and HFSP (2008-2023)

	EMBO	HFSP
Nr. Publications	127	103
% cited	98.43	100.0
Avg citations	156.09	207.17
Avg FCR	12.21	20.1
% top10	60.63	70.87
% patent cited	37.01	41.75
Avg patent families	3.85	4.2
top_FoRs, Nr. of publications	Biological Sciences, 107 Biomedical and Clinical Sciences, 26 Chemical Sciences, 5 Physical Sciences, 3 Engineering, 2	Biological Sciences, 88 Biomedical and Clinical Sciences, 12 Chemical Sciences, 7 Physical Sciences, 6 Engineering, 3

Source: Dimensions database. Based on a manually curated list of journals for Life Sciences

Within HFSP's portfolio, the subset of publications in methods and protocol focused journal titles shows exceptionally strong influence: every paper is cited, average citations reach 207.17 per paper, field-normalized impact is exceptionally high (FCR 20.1), and 70.87% of papers fall in the global top 10% for their field and year – outpacing the citation statistics for HFSP total, grants, or Fellowships respectively.

Against the EMBO comparator (127 papers; 98.43% cited; 156.09 citations per paper; FCR 12.21; 60.63% in the top-10%), HFSP publishes slightly fewer such outputs (103) but achieves markedly higher per-paper impact across all indicators, including patent citations. This performance is consistent with the program's broader portfolio pattern in which methodological "engines" (e.g., imaging pipelines, chromatin/genome toolkits, analysis software and protocols) possibly amplify discovery across multiple clusters and accelerate reuse and cross-field diffusion. In short, HFSP's methods papers are a high-impact asset. Albeit smaller in count than EMBO's, but more influential per paper, this helps to explain the program's strong interdisciplinary footprint and its sustained bibliometric excellence across the wider body of HFSP-supported research.

7.4 Retraction analysis

To complement citation-based indicators of excellence, retraction rates were examined as an integrity-oriented portfolio signal. In cross-funder comparisons (2001–2024), HFSP's retraction rate aligns with the overall benchmark level observed across comparator portfolios (Table 15). This indicates that HFSP's emphasis on frontier, high-uncertainty research is not associated with elevated retraction incidence at the portfolio level.

Table 15: Retraction rates of HFSP and other funding agencies (2001 – 2024)

	Publication Years 2001-2024		
Funder	**Retracted**	**Nr. of Publications**	
HFSP	11	22028	0.05%
Australian Research Council	37	224659	0.02%
Biotechnology and Biological Sciences Research Council	33	129211	0.03%
Deutsche Forschungsgemeinschaft	141	642620	0.02%
European Research Council	68	329458	0.02%
French National Centre for Scientific Research	62	185259	0.03%
Japan Society for the Promotion of Science	347	983100	0.04%
Medical Research Council	165	272582	0.06%
National Cancer Institute	718	575446	0.12%
National Health and Medical Research Council	62	129453	0.05%
National Institutes of Health	115	148200	0.08%
Natural Sciences and Engineering Research Council	70	400372	0.02%
Wellcome Trust Ltd	98	209922	0.05%
Grand Total	1917	4239827	0.05%

Source: Dimension database.

Across the complete comparator set of 4.24 million publications, the average retraction rate is 0.05%, providing a benchmark for large, multidisciplinary research portfolios; HFSP aligns exactly with this level, with 11 retractions among 22,028 publications. Compared with individual funders, HFSP's retraction rate falls within international norms – lower than agencies with strongly experimental biomedical portfolios (e.g., NIH, MRC, NCI) and slightly higher than funders dominated by more discipline-stable fields – reflecting differences in portfolio composition rather than concerns about research quality or integrity.

This global comparison highlights that HFSP supports innovative, high-risk frontier science without incurring a disproportionate level of retractions. The fact that HFSP's retraction rate exactly matches the cross-funder average – despite its unique emphasis on ambitious, interdisciplinary life science research – underscores the program's effectiveness in supporting high-quality scientific practices. This result provides strong evidence that HFSP-supported researchers successfully balance scientific novelty with methodological rigor, maintaining integrity outcomes fully in line with other leading public research funders worldwide.

Retractions patterns by funding scheme can be found in the Annex (11.15).

7.5 Conclusion

Across all analyses, HFSP demonstrates a sustained and internationally recognized standard of scientific excellence. Field-normalized indicators place HFSP publications well above global basic science baselines. HFSP occupies a distinctive position in the global benchmark: it combines the highest basic-science intensity with the highest field-normalized citation impact, outperforming far larger national and international agencies in biological and biomedical research. Its outputs attract roughly three times the expected field-normalized citations, with approximately 25% of all publications ranking within the global Top 10% for their respective field and year. This result indicates that HFSP successfully identifies outstanding researchers, and that HFSP's orientation and the concrete implementation of its funding process effectively translate this into excellent research outcomes. HFSP publications also appear disproportionately in multidisciplinary journals, and cluster analyses show that HFSP has a consistent structural core of life-science thematic areas shaping emerging research at the interfaces of biology with physics, chemistry, engineering, computing, and psychology. Each award scheme contributes uniquely to this excellence: Research Grants (RGP, RGEC) drive high-impact basic science at scale, Long-Term Fellowships deepen conceptual discovery in core life science, and the Cross-Disciplinary Fellowship extends HFSP's influence into cross-domain methodological and conceptual innovation.

The Fellowship schemes serve as powerful catalysts for long-term frontier research careers. Benchmarking against EMBO Fellowships demonstrates that HFSP Fellows achieve higher average citation impact and stronger field-normalized performance, confirming that HFSP supports early-career researchers for sustained success at the cutting edge of life sciences. HFSP's excellence is further reinforced by its exceptionally strong methodological contributions: methods and protocol papers show very high citation impact, significant patent uptake, across all HFSP award types and notable influence in policy documents and clinical trial citations underscore their broad scientific and societal relevance.

Importantly, HFSP delivers this high-impact science without compromising research integrity. HFSP's retraction rate matches global norms despite its focus on frontier, high-uncertainty research, demonstrating that ambitious and exploratory work is conducted with high methodological rigor and robust scientific standards.

These findings show HFSP strengthens global scientific capacity, accelerates breakthrough discovery, and plays an indispensable role in advancing the conceptual and methodological frontiers of the life sciences.

8 Valorization of Basic Research

Fundamental research is a major driver of innovation in life sciences. This chapter discusses the contribution of HFSP-supported research to innovation within the respective field and also technological innovation. It further discusses the dissemination of knowledge generated in HFSP projects and the contribution to the research and innovation landscape in the life sciences.

8.1 The Place of Basic Research in the Innovation Cycle

Basic scientific research plays a critical role in generating innovations, especially in the life sciences. Unlike applied R&D, basic science yields fundamental knowledge that can spark breakthrough technologies over long time horizons. In the life sciences, many transformative innovations simply would not exist without prior fundamental discoveries in biology, chemistry, or genetics.[25]

Empirical studies confirm that knowledge from basic research is a key input to innovation across industries. More recently, an analysis by Marx and Fuegi (2020) revealed a steady rise in science's influence on inventions: the average U.S. patent now cites over four scientific papers, up from fewer than one in 1980.[26] This reflects the growing reliance of modern innovation on fundamental science. Moreover, scientific knowledge has a broader and more enduring impact than technical know-how tied to a single product. According to an IMF analysis, citations to journal articles (basic research) peak around 8 years after publication, indicating that fundamental discoveries remain useful over a longer period.[27] In short, basic research feeds a long pipeline of innovation, seeding ideas that innovators may combine in unpredictable ways to create new solutions.

Long-Term Benefits and Long Innovation Cycles

In the life sciences, especially, the journey from initial discovery to practical application can span decades. Multiple studies have attempted to quantify these innovation lags. A widely cited analysis in health policy literature concluded that, on average, it takes around 17 years for biomedical research findings to be translated into routine clinical practice.[28] This "17-year gap" is an approximate figure but it underscores the protracted timelines involved in turning basic biological knowledge into new health interventions.

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[25] Stevens, A. et al. (2023). Role of global public sector research in discovering new drugs and vaccines. The Journal of Technology Transfer, 49(3), 1029–1039.
[26] Marx, M., & Fuegi, A. (2020). Reliance on science: Worldwide front-page patent citations to scientific articles. Strategic Management Journal, 41(9), 1572–1594.
[27] Barret, P., Appendino, M., Nguyen, V. H., & de Rochegonde, A. (2021). Why basic science matters for economic growth. IMF Blog. https://www.imf.org/en/blogs/articles/2021/10/06/blog-ch3-weo-why-basic-science-matters-for-economic-growth.
[28] Hanney, S. et al. (2015). How long does biomedical research take? Studying the time taken between biomedical and health research and its translation into products, policy, and practice. Health Research Policy and Systems, 13, Article 1.

In fields like medicine, development and regulatory hurdles necessarily stretch timelines. For instance, a novel drug must pass years of testing. Such high risk and long development cycles mean the fruits of basic research often appear in the long run, but when they do, the impact can be profound. Importantly, basic science's payoff often comes in unexpected ways. Because it is not directed at a single narrow goal, one field's fundamental discovery can stimulate innovation in another. Harrison et al. (2023) caution that weakening support for basic research today may hobble the ability to generate such transformative innovations in the future due to long innovation cycles.[29]

For policymakers and research funders, these findings underscore that sustained support for basic science is an investment in future innovation. Because the benefits often manifest in the long term and are diffused across society, basic research is a classic public good that tends to be underprovided by markets.[30] One major study in the Review of Economic Studies found that targeted support for basic research produces significantly higher welfare and growth outcomes.[31] Countries or companies that maintain robust basic research enterprises tend to generate more radical innovations and can better respond to unexpected challenges.[32] In practice, this means initiatives like stable funding for university research and grant programs for high-risk/high-reward science. For life sciences in particular, long innovation cycles demand long-term commitments. This aligns with the concept of "patient capital" in research: consistent investment sustained over time.

8.2 Innovative Character of HFSP-supported Research

As shown in the previous chapters on uniqueness and excellence, HFSP supports globally influential and high-quality research in the life sciences contributing to advancements in the research field. The awarded researchers attribute the research conducted in their HFSP project a highly transformative character (s. Figure 33 below), indicating its contribution to innovation. Especially among the surveyed cross-disciplinary fellows and grantees, the respective HFSP project is viewed to have significantly contributed to opening an entirely new research field by over 40 % of the respondents. The funded research is hence attributed a high degree of novelty by the survey respondents pushing the boundaries of the field and marking HFSP research as frontier science.

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[29] Harrison, R. and Barnard, R. (2023), Restoring Australia's long-term innovation requires investment in basic research, in: Microbiology Australia Vol. 44 (1), pp. 57-61.

[30] Leten, B. et al. (2022), How does basic research improve innovation performance in the world's major pharmaceutical firms?, in: Industry and Innovation Vol. 29 (3), pp. 396-424 & Barret, P. et al. (2021), Why Basic Science Matters for Economic Growth, IMF Blog, https://www.imf.org/en/blogs/articles/2021/10/06/blog-ch3-weo-why-basic-science-matters-for-economic-growth (last accessed 04.12.2025).

[31] Akcigit, U. et al. (2021), Back to Basics: Basic Research Spillovers, Innovation Policy and Growth, in: The Review of Economic Studies Vol. 88 (1), pp. 1-43.

[32] Harrison, R. and Barnard, R. (2023), Restoring Australia's long-term innovation requires investment in basic research, in: Microbiology Australia Vol. 44 (1), pp. 57-61.

EXAMPLE

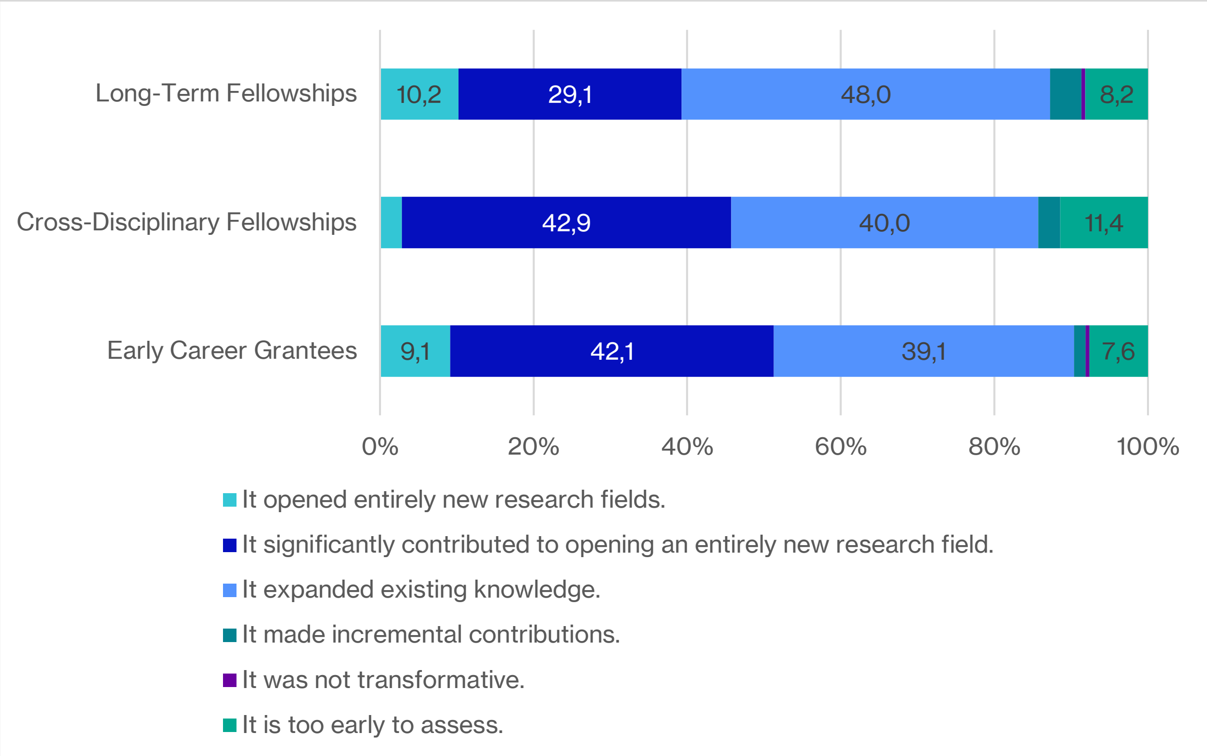
Contributing to the emergence of marine chronobiology

In the HFSP-supported project "Characterization of light-dependent rhythmic processes in the marine environment", a research team challenged the implicit assumption that chronobiological concepts and mechanisms extrapolated from land-based organisms applied in the ocean. The project's central objective was to understand how marine organisms perceive, process and respond to complex light-dependent rhythms, and how endogenous biological clocks interact with environmental signals to shape organismal function and ecosystem processes. By establishing experimental access to daily and lunar rhythms in diverse marine systems, the project made significant contributions to what has emerged as the field of marine chronobiology.

Source: Case study interview, Literature: Häfker, N. S., Andreatta, G., Manzotti, A., Falciatore, A., Raible, F., & Tessmar-Raible, K. (2023). Rhythms and Clocks in Marine Organisms. *Annual review of marine science*, *15*, 509-538.

As already discussed in section 5.1, the majority of the research funded by HFSP would not have been funded otherwise, or only with a more limited scope. One important factor is that HFSP does not require preliminary data, as frequently highlighted in interviews and case studies. The transformative character is further linked to the interdisciplinary character of the program. Around 48 % of the long-term fellows view their HFSP project as having contributed to expanding existing knowledge.

Figure 33: Assessment of the transformative character of HFSP-supported projects in %

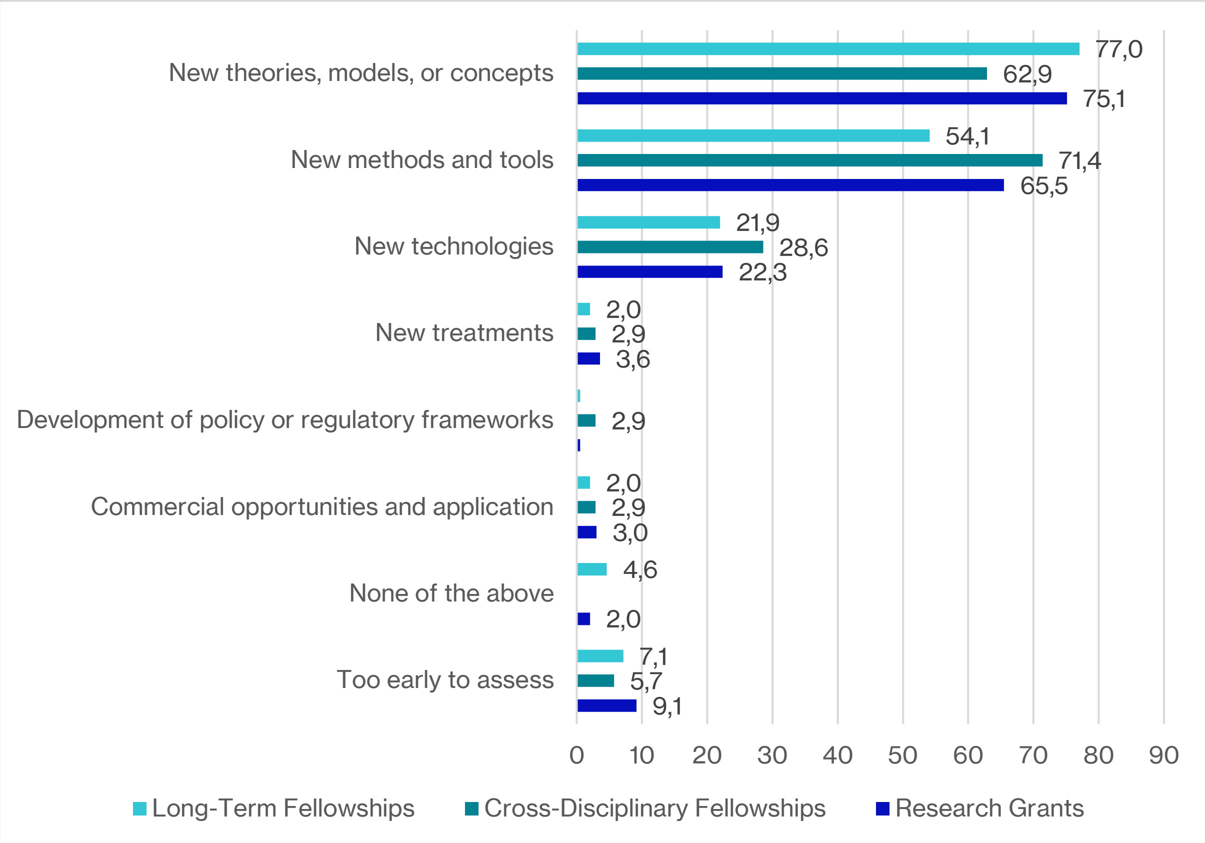


Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 428.

According to the survey respondents, the HFSP projects largely contribute to innovation in research fields through the development of new theories, models, and concepts, as well as new methods and tools. As shown in Figure 34 around 28 % of the cross-disciplinary fellows further developed new technologies with a slightly higher share than the surveyed long-term fellows and grantees (around 22 % each).

Figure 34: Contribution of HFSP-supported projects to different forms of innovation in %

Did your HFSP-supported project lead or significantly contribute to any of the following forms of innovation?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 428.

More applied forms of innovation seem to play a minor role, although it should be noted that the survey shows a certain response bias favoring academics (compare section 2.3.2).

EXAMPLE

Methodological advances translate into innovative business models

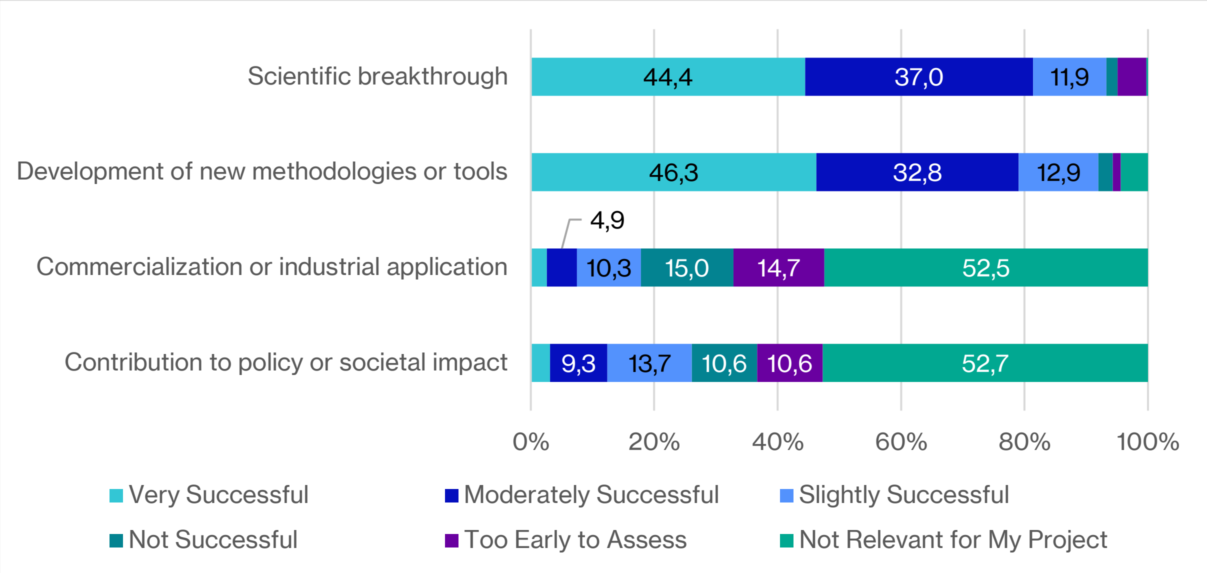
The HFSP-supported project helped establish phase separation as a fundamental principle of cellular organization, showing that cells can form dynamic, liquid-like condensates to spatially control biochemical reactions such as metabolism. At the project's outset, this idea was highly unconventional, but the interdisciplinary work provided compelling evidence that biomolecular condensates play functional roles across many cellular processes. These insights triggered a broader paradigm shift in cell biology and helped create a new research field at the interface of biology and physics. The results further inspired the founding of Dewpoint Therapeutics, a biotechnology company that applies phase separation biology to drug discovery by targeting dysregulated biomolecular condensates.

Sources: Case study interview; Literature: Hyman, A. A., Weber, C. A., & Jülicher, F. (2014). Liquid–liquid phase separation in biology. Annual Review of Cell and Developmental Biology, 30, 39–58..

8.3 Contribution to Technological Innovation

As shown in Figure 34, the HFSP projects of the surveyed awardees mainly contribute to the development of new theories and models (around 77 %) as well as new methods and tools (60 %). Around 23 % of the projects contributed to the development of new technologies with the share being higher among the cross-disciplinary fellows. Applied forms of innovation play a minor role in the HFSP projects. When asked about the success of the HFSP project based on different dimensions, the majority of the awardees assess their HFSP project to have been very or moderately successful with respect to its contribution to a scientific breakthrough and the development of new methodologies (Figure 35). The respondents assess the HFSP projects' success as more limited with respect to achieving commercialization or industrial application and contributing to wider policy or societal impact. With respect to both categories, respondents have largely either deemed them to not be relevant to the project or too early to assess.

Figure 35: Assessment of success of HFSP-supported research in %
How would you characterize the success of your funded project regarding the following categories?



Source: HFSP survey 2025 among awardees from the years 2009-2011, 2014-2016 and 2019-2021, n = 387.

HFSP projects are clearly positioned at the beginning of the innovation cycle. The interviews and case studies confirm that most researchers supported by HFSP do not consider application and commercialization a primary goal. However, the interviewees underline that it is often too early to assess the actual contributions. They indicate long-term implications of projects for various fields, for example medicine, agriculture, climate and computing.

EXAMPLES

In for the long run – examples of HFSP funded basic research turned into marketable products

One example demonstrating the link between HFSP funding and commercialization is the case of Lumicks, a spin-off from Vrije Universiteit Amsterdam. A key technology that forms the basis for LUMICKS' products, called Acoustic Force Spectroscopy (AFS), was developed in part by HFSP Long-Term Fellow Raya Sorkin. The foundational research supported by HFSP was then translated into a marketable technology by the spin-off company LUMICKS, which now provides instruments based on AFS to researchers and companies globally.

Another example is Alex Koglin, an HFSP Long-Term Fellow from 2009. His foundational research focused on mRNA technology. This work was a key step in the development of mRNA-based vaccines and drugs, which gained prominence during the COVID-19 pandemic. Koglin's research played a direct role in the establishment of CureVac, a German biotech company that became a global leader in mRNA-based therapies and vaccine development.

A central obstacle to the commercialization of research results identified in interviews is that researchers need contact with investors and entrepreneurs but rarely have access to such networks. This is not an exceptional problem; it affects researchers almost everywhere. In some countries, such as the United Kingdom and especially the United States, access to such networks should, in principle, be easier. The data basis of the survey is not sufficiently robust to draw firm conclusions on this point. However, an analysis of patents citing HFSP research suggests that valorization and commercialization are more effective in the USA than elsewhere (s. Table 18).

The following subsections reflect HFSP’s contribution to technological innovation and application based on patent citation analysis.

8.3.1 Tracing Innovation Pathways through Patent Citations

To examine how HFSP-supported basic research contributes to technological innovation, patent citation analysis was used to trace downstream uptake of HFSP-supported publications. Across the full HFSP portfolio since 2008, 17.1% of HFSP-acknowledged publications are cited by patents, indicating a substantial connection between HFSP-supported research and subsequent technological development (s. Table 16 below).

Differences across funding schemes highlight complementary roles within the portfolio. Long-Term Fellowships (LTF) and Cross-Disciplinary Fellowships (CDF) show the highest patent-citation shares, reflecting the frequent production of methods, tools, and conceptual advances with technological relevance, possibly encouraged and nurtured in their respective host environment. Research Grants (RG) exhibit a lower citation share but account for the largest absolute number of citing patents and assignee organizations, underscoring their role in seeding a broad base of downstream innovation. Together, these patterns indicate that HFSP supports both the generation of reusable foundational knowledge and the diffusion of that knowledge across multiple technological pathways.

Patent citations to HFSP-supported work originate from more than 2,200 organizations across 51 countries, demonstrating a wide and internationally distributed innovation footprint. This breadth suggests that HFSP-supported research contributes not only to isolated technological advances but also to the global stock of scientific knowledge reused across sectors and regions.

Table 16: Patent citations data for 2008 onwards

	HFSP publications linked to grants	RG	LTF	CDF
Publications	15945	10045	4443	380
Patent citation	17.1%	14.0%	24.0%	20.8%
Citing patents	13790	6699	7526	793
Assignee organizations	2259	1396	1368	161
Countries	51	43	47	21

Source: Dimensions database and HFSP data.

Patent citations for HFSP-supported work originate from over 2,200 organizations across 51 countries, highlighting the program's broad global reach. Together, these results confirm that HFSP's funding mechanisms operate in a complementary manner: Research Grants provide the collaborative knowledge base, and the Fellowships drive methodological innovation.

8.3.2 Patent Citation Benchmarking: Influence on Technology and Innovation (HFSP Fellows vs EMBO)

To contextualize HFSP's technological influence, patent-citation patterns for HFSP Fellowships were benchmarked against publications supported by the European Molecular Biology Organization (EMBO), a closely comparable excellence-driven funder in the life sciences. Using harmonized acknowledgement-based datasets, HFSP-supported Fellowship publications are slightly more cited by patents than EMBO publications (Table 17).

This suggests that HFSP-supported Fellowship research is at least as effective – and in some respects more effective – in diffusing into technological and applied contexts. When viewed alongside academic citation performance, the results indicate that HFSP Fellowships combine strong scientific excellence with a comparatively high degree of technological reuse.

Table 17: Citations in patents

Methodological note: The set of HFSP-supported publications (n=4385) in this analysis is composed of LTF and CDF acknowledged publications identified as "Fellowship" in the Dimensions database (hence slightly lower to the sum of the individual, linked publications in the patent citation analysis above. This allows for better comparisons against EMBO-acknowledged publications in Dimensions.

Metric	EMBO	HFSP
Total Nr. Publications	7,348	4,385
% Cited (academic literature)	96.5%	96.4%
Avg Citations (academic literature)	99.9	119.8
Avg FCR (academic literature)	12.35	15.07
% Top 10% Cited (academic literature)	58.3%	58.2%
% Patent-Cited	19.9%	22.0%
Avg Patent Fam. Cites	0.86	1.19

Source: Dimensions database.

In addition, the average number of patent family citations per publication further highlights HFSP's relative strength in this domain. HFSP-supported Fellowship publications attract, on average, 1.19 patent citations, compared to 0.86 for EMBO. This higher average suggests that HFSP-supported outputs not only reach the patent literature more often but also tend to be cited by multiple patent families, indicating deeper or broader technological relevance.

In summary, the patent citation benchmarking underscores HFSP's dual impact: Excelling not only in advancing fundamental scientific understanding but also in producing knowledge that informs technological progress. This reinforces HFSP's distinctive position as a funding mechanism that bridges disciplinary and sectoral boundaries, enabling frontier science to translate into tangible innovation outcomes.

8.3.3 Patent Assignees citing HFSP Research

Analysis of patent assignees citing HFSP-supported publications shows that HFSP-originated knowledge is translated into technological innovation by a concentrated group of world-leading academic and medical research institutions, alongside a smaller but significant set of biotechnology and research-tool companies (s. Table 18). The most frequent assignees include elite US and European universities, research organizations, and academic medical centers (such as MIT, Harvard, UC San Diego, Inserm, CNRS, and major research hospitals), while the ranking by citing patents also highlights firms developing platforms, instrumentation, and therapeutics (e.g. 10x Genomics, Bio-Rad, Becton Dickinson, Moderna).

EXAMPLE

Application of HFSP-supported research reflected in patent citations

The US biotechnology company 10XGenomics is a top patent assignee citing HFSP research. 286 patents at different stages cite 14 publications supported by HFSP research grants, for example, on single-cell and single-molecule biology as well as biological engineering (nanotechnology and imaging platforms).

Source: Dimensions database.

The substantial overlap between assignees with the largest patent portfolios and those citing the highest number of HFSP publications indicates both breadth and depth of reuse, showing that HFSP-supported science functions as widely reused prior art across the innovation chain, from discovery environments to clinical and commercial applications. Detailed rankings of assignees per award type are provided in the Annex (s. Annex 11.16).

Table 18: Top 20 assignee organizations sorted by number of citing patents

Rank	Name	Country	Citing patents (descending order)	Nr. of cited HFSP-supported Publications
1	Massachusetts Institute of Technology	USA	636	264
2	Harvard University	USA	626	194
3	Broad Institute	USA	450	160
4	University of California, San Diego	USA	387	188
5	10X Genomics Inc	USA	357	33
6	Stanford University	USA	304	135
7	Inserm	France	246	185
8	Massachusetts General Hospital	USA	231	126
9	French National Centre for Scientific Research	France	220	156
10	California Institute of Technology	USA	220	105
11	University of Washington	USA	131	78
12	Dana Farber Cancer Institute Inc	USA	124	89
13	University of California, Berkeley	USA	120	104
14	Bio Rad Laboratories Inc	USA	118	7
15	Duke University	USA	101	56
16	Max Planck Society	Germany	97	74
17	Columbia University	USA	97	67

18	Becton Dickinson and Co	USA	95	6
19	Brigham and Women's Hospital Inc	USA	94	65
20	Moderna Tx Inc	USA	88	10

Source: Dimensions database.

8.4 Wider Societal and Economic Benefits

Beyond patents, HFSP-supported research also diffuses into other curated, non-academic knowledge domains. A small but non-trivial share of HFSP publications is cited in policy documents and clinical trial records, reflecting uptake in advisory and practice-adjacent contexts. Such citations are rare for basic research at the beginning of the innovation pipeline by design, and their presence therefore signals that selected HFSP-supported outputs are considered sufficiently robust and relevant to inform decision-making beyond academia.

EXAMPLE

Informing global health policy

A prominent example of the uptake of HFSP-supported research in policy is the World Health Organization (WHO). In total, 26 WHO policy papers cite 14 articles building on HFSP-supported research. For instance, the 2017 update of the WHO public health research agenda for influenza draws on insights from HFSP-supported publications on influenza antigenic dynamics and antibody landscapes after influenza virus infection or vaccination.

Source: Dimensions database; World Health Organization. (2017). WHO public health research agenda for influenza: 2017 update.

In a global benchmark of basic-science-classified publications across major international funders,[33] HFSP shows the highest rate of patent citation (22.2%), exceeding comparable organizations such as the ERC (18.8%), Wellcome Trust (19.3%), Inserm (20.0%), DFG (17.1%), CIHR (17.7%), BBSRC (16.0%), JSPS (13.8%), and NHMRC (18.1%), positioning HFSP at the upper end of knowledge diffusion into technological domains (s. Table 19).

Taken together with patent-citation evidence, these signals indicate that HFSP-supported research contributes to innovation and societal benefit primarily through indirect knowledge transfer, rather than through immediate application.

Table 19: Citation indices outside the academic world

	HFSP (2008 onwards)	RG	LTF	CDF

[33] For this global benchmark the basic science classification has been applied to allow for comparison. Hence the overall HFSP patent citation for this dataset (22.2 %) is higher than the 17.1 % for the full dataset in Table 19.

	Nr. of Publications	15945	10045	4443	380
Policy document citation	Share of cited publications	0.80%	0.70%	1.30%	1.10%
	Nr. citing policy documents	203	131	78	6
	Organizations	42	31	25	4
	Countries	15	10	13	3
Clinical trial citation	Share of cited publications	0.60%	0.40%	1.00%	0.50%
	Citing clinical trials	116	44	62	3
	Organizations	234	65	153	8
	Countries	23	11	21	1
Patent citation	Share of cited publications	17.10%	13.60%	24.00%	20.80%
	Nr. citing patents	13790	6699	7526	793
	Organizations	2259	1396	1368	101
	Countries	51	43	47	21

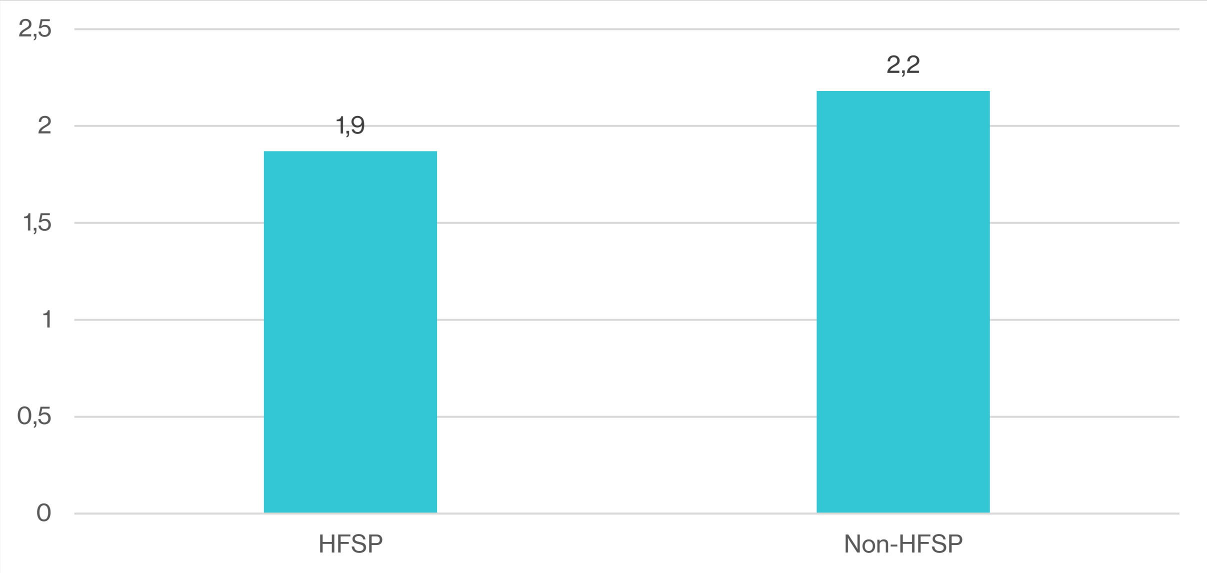
Source: Dimensions database, Altmetric database.

Direct collaboration between HFSP-supported researchers and industry, as measured by co-authorship, remains limited. Only a small share of HFSP publications include industry-affiliated co-authors, a level slightly below that observed in comparable publication sets (s. Figure 36).

The low rate of industry co-authorship contrasts with the relatively high level of patent citation, indicating that HFSP's influence on innovation operates predominantly through knowledge spillovers. Foundational ideas, methods, and tools generated in academic settings diffuse outward and are subsequently taken up by industrial and translational actors without requiring formal collaboration at the publication stage.

Figure 36: Comparison of industry collaboration in HFSP and non-HFSP publications aggregated for all funding schemes

Percentage of publications with co-authors from for-profit entities.



Source: Dimensions database, HFSP data.

This interpretation is reinforced by the assignee patterns observed in the patent data. The list of "assignees" (i.e. the organizations that own the patents citing HFSP-supported publications) provides a window into who is using HFSP-originated research in technological development. The most frequent assignees are tool and platform companies such as firms producing instrumentation, diagnostics, or single-cell technologies as well as academic medical centers. These actors typically integrate foundational methods and conceptual advances from academic science into products, clinical workflows, or R&D pipelines without requiring formal collaboration or co-authored publications with the originating researchers. Their strong representation among patent assignees thus aligns with the low industry co-authorship rate: HFSP-supported breakthroughs diffuse outward through knowledge spillover and are taken up by downstream innovators, even in the absence of direct academic–industry partnerships.

8.5 Conclusion

The analysis shows that HFSP-supported research primarily contributes to innovation by generating foundational knowledge with broad downstream reuse rather than by pursuing near-term applications. Patent-citation evidence demonstrates substantial and internationally distributed technological uptake. A substantial fraction of HFSP publications are cited in patents from more than two thousand organizations across over fifty countries. Benchmarking against EMBO indicates that HFSP-supported Fellowship research performs at least as strongly in technological diffusion as comparable excellence-driven programs. Policy and clinical citations, though rare by design, provide additional signals of relevance beyond academia.

Across funding schemes, HFSP's contribution to innovation reflects complementary roles: Research Grants establish a broad collaborative knowledge base, while Long-Term and Cross-Disciplinary Fellowships generate methods and concepts that diffuse widely across scientific and technological domains. Consistent with HFSP's mission, valorization occurs predominantly through long-term knowledge spillovers rather than direct commercialization, though prominent examples for the latter exist. The findings reinforce HFSP's position at the beginning of the life science innovation cycle.

HFSP's recognizable contribution to the central position of biology in the 21st-century research and innovation landscape is reflected in the profile of the organizations that reuse HFSP-supported knowledge. The mix spans universities, academic medical centers, public research organizations, and private firms, showing HFSP outputs reach across the full innovation chain, from basic research environments to clinical and commercial settings.

9 Value Added for HFSP Member States

This chapter discusses the value added HFSP provides for its member states. Building on the insights on the value added of international collaboration discussed in chapter 3.2, it reflects on international collaboration patterns and the perception of HFSP through its members from a more macro-level perspective.

9.1 Needs of Members

The focus group with members of the Board of Trustees and the accompanying interviews, reflect that the members value HFSP's orientation and funding scheme structure and see no need for major changes. Rather, it was repeatedly emphasized that HFSP should concentrate on its existing funding schemes and maintain, while further sharpening, its distinctive profile. Partly underlying this is the members' need for HFSP to operate in a complementary manner to national and other funders, rather than in competition with them.

Especially valuable to the Members is HFSP's focus on basic science and frontier high-risk research. They want HFSP to have a substantial and lasting scientific impact and to enable forms of research that cannot be supported by national or other funders. This applies in particular to international collaborative research. This is regarded not only as a means of generating excellent research, although this is an important factor, but also as a value in its own right. It is valuable for the Members when researchers from their country go abroad, when researchers from abroad come to their country, and when international research collaboration is strengthened in general. The members want HFSP to catalyze truly international collaborations, translating into lasting scientific and institutional value that complements national research strategies.

Naturally, member states would like HFSP funding to benefit their own country by funding researchers from or in it, particularly members whose national funding systems are less well developed. Beyond this, however, there is also an awareness that the type of international research funding practiced by HFSP constitutes a positive-sum game from which, ultimately, all parties benefit. This applies in particular to the type of basic research and high-risk research that HFSP finances, as these are especially suited to driving scientific and, indirectly, technological and societal progress in the long term, ultimately benefiting all member states and humanity as a whole. From this perspective, HFSP offers a means of spreading risk across many countries and thereby investing more heavily in this form of research than feasible for national funders, especially smaller ones.

The member states have a strong interest in enabling HFSP to continue fulfilling its role effectively. In this context, they are also committed to placing HFSP's funding on the broadest possible footing, which implies admitting new member states. At the same time, there is concern that such expansion may entail the risk of losing or diluting HFSP's core values. For this reason, any such enlargement should be conducted through a transparent, clearly defined process involving the member states.

The preceding chapters have already examined HFSP's uniqueness, as well as the excellence and impact of the research it supports. These aspects are, of course, relevant to the needs of the members. The present section will complement these earlier analyses with several additional in-depth explorations. It will assess HFSP's value through interconnected dimensions: international collaboration and its durability; sustained research impact through follow-on funding; long-term academic retention; and researcher mobility. Together, these analyses show how HFSP extends its influence beyond the lifetime of individual awards, strengthening both global research linkages and the institutional capacity of its member states.

9.2 Benefits of International Collaboration

As shown in chapter 4.2, the support for international collaboration is a distinct feature of HFSP, fostering long-lasting collaboration between researchers providing a unique scientific value to the projects conducted (compare Figure 12). Some projects are only possible because the specific expertise and local capabilities of researchers from different countries and continents are brought together. Moreover, interviews indicate that international collaboration makes a substantial contribution to the dissemination of valuable ideas, perspectives, tools, and techniques.

Bibliometric analysis of co-authorship patterns confirms this qualitative evidence. By tracking collaboration before, during, and after HFSP funding, the analysis shows that HFSP support is associated with a sustained expansion of international collaboration networks. These collaborations typically involve more than two countries and persist beyond the formal funding period, indicating that HFSP funding fosters durable international research linkages rather than short-lived partnerships. Further methodological details, including regional groupings of member states (Africa, Asia–Pacific, Europe, Latin America, and North America), are provided in the Annex 1.1.

9.2.1 Top Collaboration Beneficiaries

To assess how collaboration benefits are distributed across countries, a Benefit Index was constructed (s. Annex 1.1 for more details) that captures both proportional and absolute gains in HFSP-linked international collaboration. The results (Table 20) show that HFSP generates value for both established scientific hubs and emerging research systems.

Table 20: Summary table of top collaboration beneficiaries via the Benefit index

A higher Benefit Index for a smaller or emerging research system reflects strong proportional integration into the HFSP network from a low starting point. In contrast, a moderate Benefit Index for a large, mature system (e.g., Germany's 0.33) indicates substantial absolute collaboration gains on top of an already extensive international footprint. The index thus captures different but complementary types of benefit: entry and inclusion for emerging systems, and consolidation and expansion for established global hubs.

<table>
<tr><th>Rank</th><th>Country</th><th>Benefit index</th><th>Region</th><th>Interpretation</th></tr>
<tr><td>**1**</td><td>United States</td><td>0.51</td><td>North America</td><td>Large absolute gain; consolidation of global centrality.</td></tr>
<tr><td>**2**</td><td>Germany</td><td>0.33</td><td>Europe</td><td rowspan="2">Core and expansion synergy; Europe remains dominant, Africa broadens.</td></tr>
<tr><td>**3**</td><td>Ethiopia</td><td>0.33</td><td>Africa</td></tr>
</table>

4	United Kingdom	0.32	Europe	
5	Cyprus	0.29	Europe	Small to Mid-sized or emerging systems showing rapid growth from low baselines.
6	Luxembourg	0.27	Europe	
7	Peru	0.26	Latin America	
8	Kenya	0.25	Africa	
9	Belgium	0.25	Europe	
10	Ireland	0.25	Europe	Consistent mid-tier strengthening; HFSP fosters cross-regional integration.
11	Bangladesh	0.24	Asia-Pacific	
12	Singapore	0.24	Asia-Pacific	
13	Estonia	0.24	Europe	
14	Finland	0.24	Europe	
15	Republic of Korea	0.23	Asia-Pacific	
16	India	0.23	Asia-Pacific	

Source: Dimensions database; methodological note: Uganda (outlier) with a benefit index of 0.66 was removed from this table

These results indicate that HFSP's collaboration benefits extend beyond its traditional European–North American core, showing clear traction among smaller and newer participants. This pattern reflects two complementary dynamics within the HFSP network.

First, HFSP provides emerging and modestly resourced research systems with an entry point into high-level international collaborations that would otherwise remain out of reach. Countries such as Ethiopia, Kenya, Peru, and Bangladesh start from relatively limited collaborative baselines; HFSP's multinational team structure allows them to connect directly with major scientific hubs. Their high Benefit Index values show that HFSP funding does not merely generate isolated collaborations but fosters structural integration into sustained, diversified international networks that continue after funding ends.

Second, the data demonstrates that HFSP's collaborative model is open and inclusive, enabling participation from researchers in countries with less developed research systems. The presence of smaller European member states (e.g., Cyprus, Luxembourg, Estonia) and mid- to large-sized Asia–Pacific systems (e.g., Singapore, Republic of Korea, India) among the top beneficiaries illustrates how HFSP effectively supports cross-regional partnerships across institutional scales. These collaborations are typically driven by specific expertise or unique research capabilities rather than by size or pre-existing network centrality, allowing a broader range of participants to benefit.

Together, these patterns highlight HFSP's dual role:

- reinforcing the collaborative strength of established global research hubs, and
- broadening participation across emerging and underrepresented systems.

This dual role is a distinctive strength of HFSP, ensuring that the benefits of international collaboration are widely distributed and that member states, regardless of size or scientific maturity, gain meaningful access to frontier-science networks.

To understand how these country-level gains translate into broader regional trends, the next section aggregates Benefit Index patterns across continents, revealing how HFSP partakes in shaping the global architecture of scientific collaboration at the regional scale.

9.2.2 Regional Collaboration Patterns and Value for Member States

When aggregated at the regional level[34], collaboration patterns reveal a balanced but differentiated distribution of value. Table 21 shows that North America remains a central anchor of the HFSP collaboration network, showing strong absolute gains. Africa exhibits particularly high proportional growth, indicating that HFSP contributes to integrating emerging systems into global research networks. Europe and Asia–Pacific display steady gains consistent with their mature research infrastructures, while Latin America shows early but growing participation.

These regional patterns suggest that member states at different stages of scientific development derive meaningful benefits from participation in the program.

Table 21: Regional overview

Average Benefit Index values by region, summarizing how HFSP funding expands and strengthens international research collaboration across member states.

Region	Average benefit index	Summary insight
North America	0.35	Strong absolute expansion; US and Canada remain dominant anchors of the HFSP network.
Africa	0.30	Highest proportional growth; clear evidence of inclusion and new collaborative entry.
Asia-Pacific	0.18	Consolidation of regional hubs (Singapore, India, Republic of Korea); balanced growth.
Europe	0.16	Mature network; limited but positive change among smaller member states.
Latin America	0.11	Weak but emerging participation; scope for future engagement.

Source: Dimensions database, HFSP data.

9.3 Follow-On Funding and Sustained Research Impact

1.1HFSP's value for member states also manifests in the sustained success of its awardees beyond the lifetime of individual grants and fellowships. Analysis of follow-on funding shows that HFSP-supported researchers frequently secure additional competitive funding from a wide range of national and international agencies. Awardees succeed in obtaining subsequent grants,

[34] Countries were grouped into major geographic regions based on HFSP membership categories: Africa, Asia–Pacific, Europe, Latin America, and North America.

indicating that HFSP support strengthens research credibility, independence, and long-term capacity over time.

The diversity of follow-on funders underscores HFSP's global reach and reputation. The presence of HFSP itself among subsequent funders reflects continuity in supporting high-performing researchers rather than redundancy (s. Annex 11.20 for more details).

SPOTLIGHT

ERC Success Among HFSP Awardees

Further evidence of HFSP's long-term value is provided by the strong presence of HFSP alumni among recipients of European Research Council (ERC) grants. ERC funding is used here not as a success-rate benchmark, but as a widely recognized indicator of sustained excellence and leadership in frontier research within a highly competitive international funding environment.

HFSP-supported researchers are represented across ERC Advanced, Consolidator, and Synergy schemes, demonstrating that a subset of HFSP alumni continue to operate at the forefront of global science over extended periods of their careers. Importantly, ERC success emerges at different stages: some researchers secure ERC funding relatively soon after HFSP support, while others reach ERC-level leadership much later. This temporal spread highlights HFSP's role in supporting both early consolidation and long-term maturation of frontier research careers, rather than acting as a short-term accelerator alone. Detailed funding scheme-level and temporal analyses are provided in the Annex (Table 39 and Table 40).

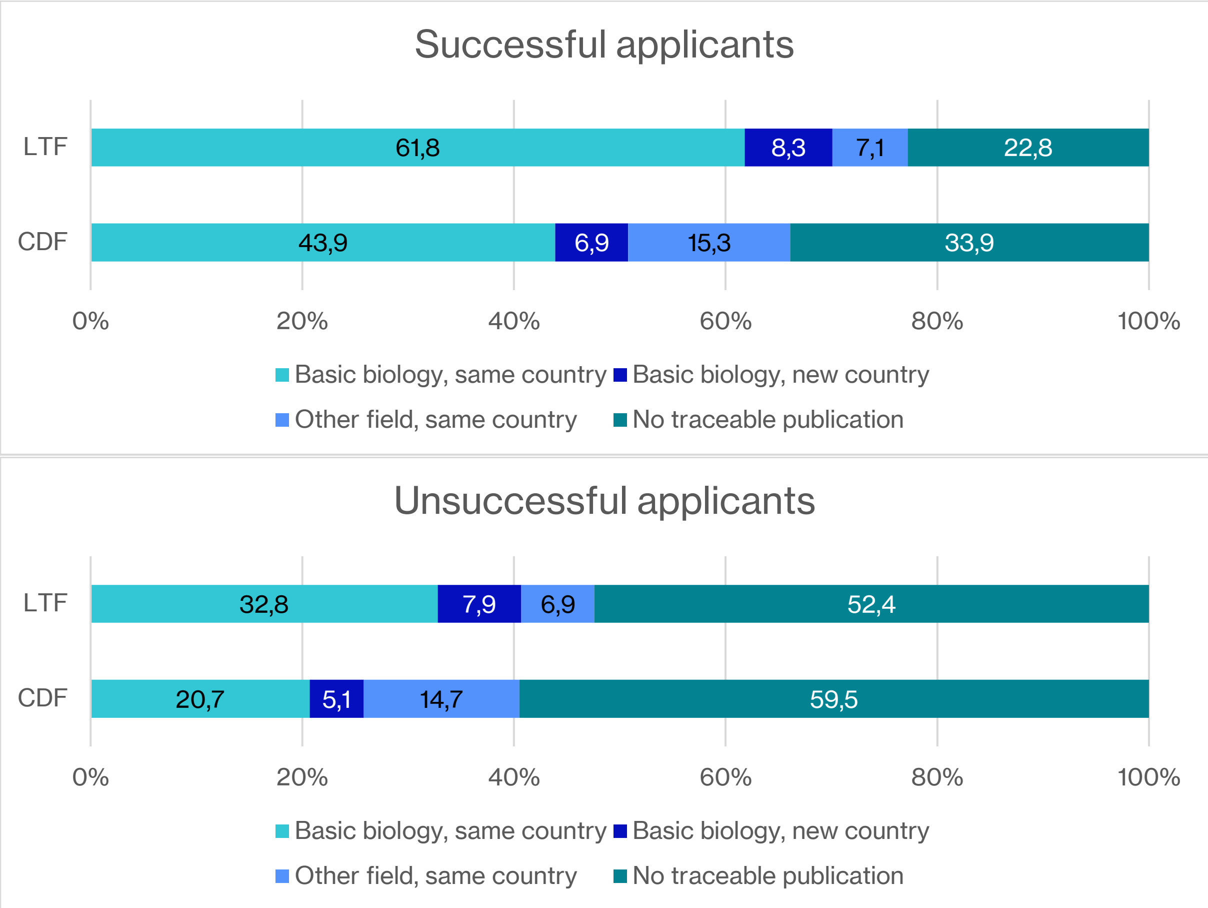
Interview evidence reinforces this interpretation. Awardees frequently describe HFSP support as a formative credibility signal that strengthened their ability to pursue ambitious, high-risk research over time, thereby remaining competitive in elite funding environments. The observed presence of HFSP alumni among ERC awardees thus reflects the sustainability of HFSP-supported research trajectories, rather than a direct or expected progression from one funding scheme to another.

9.4 Academic Attrition and Continuation in Research Careers

HFSP support is associated with a strong and durable effect on research careers. Figure 37 compares the post-application research trajectories of successful and unsuccessful HFSP Fellowship applicants over a five-year period and shows a clear and consistent pattern across both Fellowship schemes: HFSP Fellows are more than twice as likely to remain active and publish in basic life science research as unsuccessful applicants. While over half of unsuccessful applicants show no traceable publication activity five years after application, the majority of HFSP Fellowship awardees continue to publish in core biological disciplines.

Figure 37: Post-application research trajectories by HFSP Fellowship scheme and publication tracking 5 years past HFSP Fellowship award

The figure compares successful and unsuccessful applicants with respect to their publication activity five years after the HFSP Fellowship award. It distinguishes between those who continue to publish in the field of Basic Biology in the same country, those who do so in another country, those who publish in the same country but in a field other than Basic Biology, and those for whom no publications could be identified.



Source: Dimension Database.
Successful applicant: LTF n=3,344 | CDF n=189.
Unsuccessful applicant: LTF n=10,266 | CDF n=1,139.

The share of researchers with no traceable publications is surprisingly high for both successful and unsuccessful applicants, given their profiles and available evidence on attrition in academia.[35] This is partly attributable to inevitable bibliometric matching gaps resulting from unidentified or unmatched researchers (mostly name variants, e.g., a full set of initials vs. a first name only). If the authorship of a publication is not assigned to the correct, or to any, researcher profile, that publication will not appear in searches for that researcher's publications. Furthermore, this type of data gap is more common where researchers have fewer publications, especially few publications

[35] CUPA-HR. (2025). Higher ed workforce turnover. https://www.cupahr.org/resource/higher-ed-workforce-turnover/.; National Center for Education Statistics. (1997). Retirement and other departure plans of instructional faculty and staff in higher education institutions (NCES 98-254).

in the same field of research. The absence of publications should be understood to represent at least low publication productivity. Since there is no reason to assume that this effect would asymmetrically affect successful versus unsuccessful applicants, comparability between the two groups remains intact.

Fellowship holders display substantial international and interdisciplinary mobility while maintaining research continuity, whereas similar mobility among unsuccessful applicants is far more often associated with disrupted or discontinued research activity. Together, these patterns indicate that HFSP not only identifies high-potential researchers but also reliably converts that potential into sustained participation in active basic research, strengthening the long-term research capacity of member states.

Interviews and the survey confirm HFSP's catalytic role in researchers' career trajectories, particularly for those drawn to highly ambitious, interdisciplinary, and collaborative research. The comparatively high attrition rate among unsuccessful applicants is, in part, likely reflects the substantial difficulties such researchers face in securing funding for the intended research without HFSP support (s. sections 5.1).

9.5 Mobility of Researchers across Countries

Researcher mobility is another dimension of HFSP's value for member states. The fellowship schemes (Long-Term and Cross-Disciplinary Fellowships) are associated with high levels of international mobility, reflecting their design to encourage movement across institutions, countries, and disciplinary environments. In contrast, Research Grant recipients, typically representing more established investigators, show greater geographic stability, consistent with senior career stages.

The mobility patterns of Fellows (s. Figure 38) indicate that HFSP facilitates international exchange while supporting reintegration into member-state research systems over time. In particular, Long-Term Fellows often return to or remain connected to European research environments after periods abroad, whereas Cross-Disciplinary Fellows exhibit more dispersed global trajectories. Together, these patterns show how HFSP contributes to global knowledge circulation while strengthening the research capacity of its member states.

Figure 38: Researcher mobility of Long-Term Fellowship (LTF, top) and Cross-Disciplinary Fellowship (CDF, bottom)

Figure 39: Fellow nationality or earliest affiliation (by region), Applicant region (by publication affiliation), Host (HFSP member state region) and the most recent destination (known by affiliation). LTF and CDF originate predominantly from Europe, reflecting th

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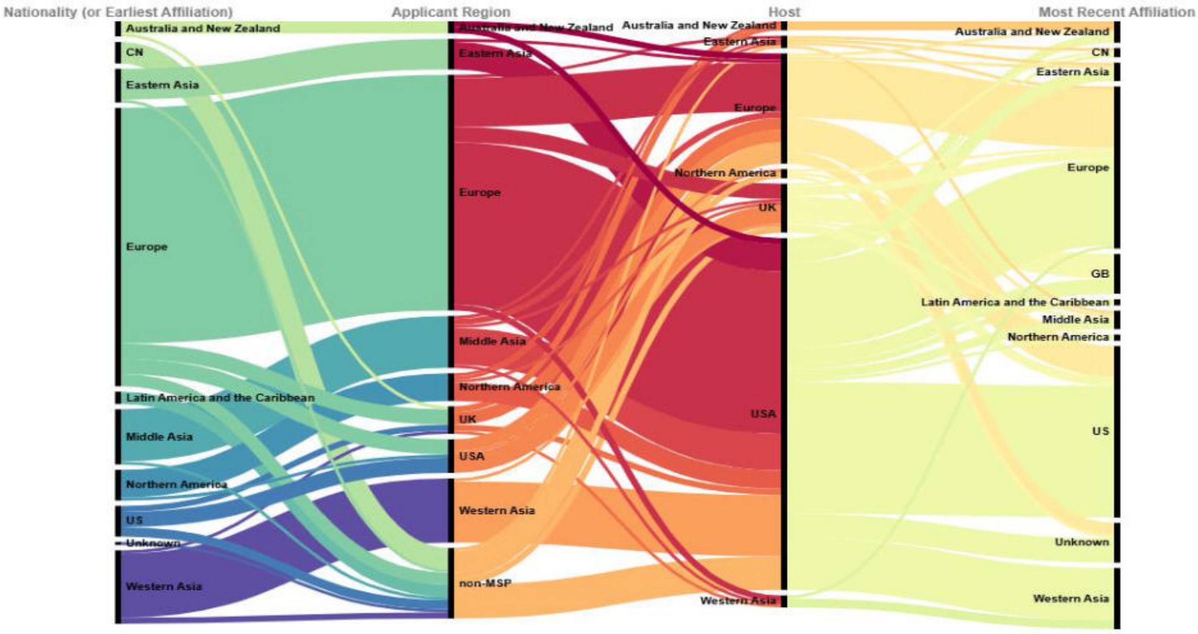


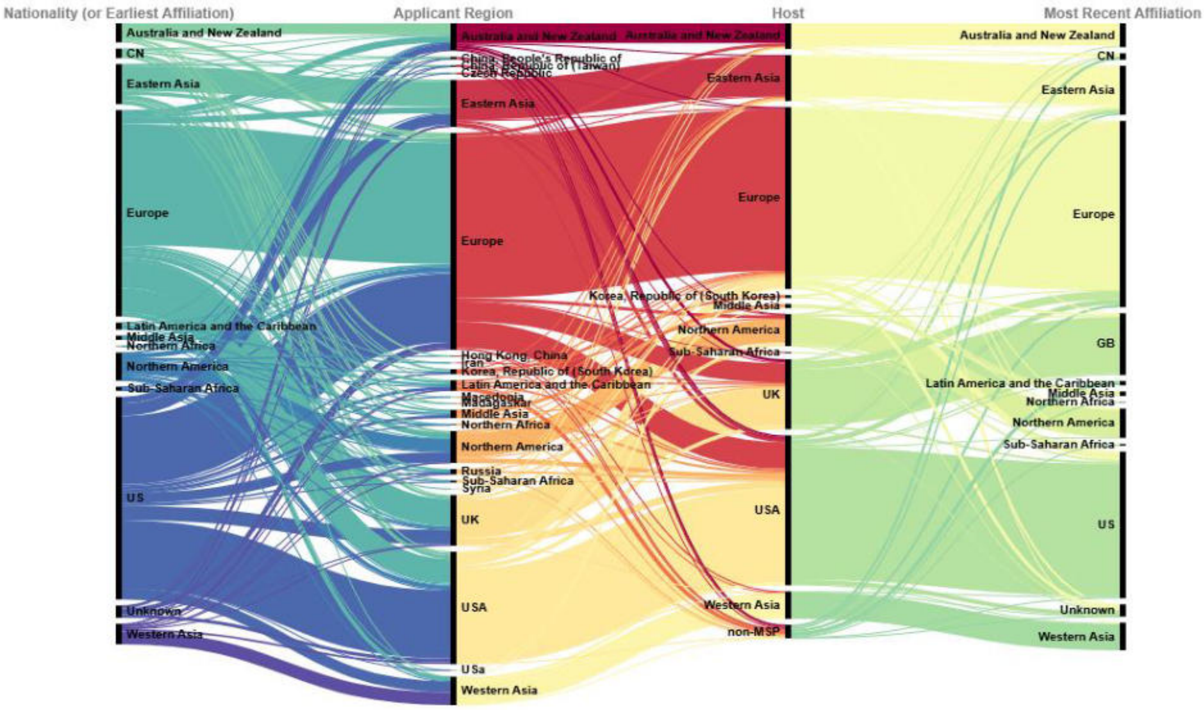
Source: Dimensions database, HFSP data.

In contrast, Research Grant Program (RGP) awardees show substantially lower geographic mobility than Fellowship holders, consistent with their career stage as established senior investigators embedded in long-term institutional roles. Their research trajectories are typically regionally stable across application, host, and subsequent affiliations, reflecting leadership consolidation rather than mobility-driven development (s. Figure 40)

The comparison of 'host' (third column) and 'most recent affiliation' (fourth column, on the right) across Fellows (Figure 38) and Grantees (Figure 40) visualizes these contrasting mobility patterns clearly, highlighting the dynamic, career-shaping mobility associated with the Fellowship funding schemes in contrast to the greater geographic stability characteristic of Research Grant recipients.

Figure 40: Researcher mobility of Research Grant Awardees

From left to right in this sankey diagram: Grantee nationality or earliest affiliation (by region), Applicant region (by publication affiliation), Host (HFSP member state region) and the most recent destination (known by affiliation). See Annex 11.23 for Wide Format.



Source: Dimensions database, HFSP data.

9.6 Conclusion

Overall, the evidence collected demonstrates that HFSP delivers clear and sustained value to its member states. HFSP naturally generates value for the member countries through the excellent research results it helps produce (s. chapter 7), hence fulfilling the need articulated by member state representatives. It spurs genuine international collaboration activity that remains elevated beyond the project period. Early Career Research Grants show one of the strongest signals, with international engagement increasing from roughly one and a half to just over two countries per publication and stabilizing at this higher level post-grant. Program Grants are the most internationally collaborative during the grant period, reflecting their design as larger, multi-investigator consortia. Fellowship holders likewise maintain elevated levels of international co-authorship after their HFSP support ends. Collaboration patterns extend beyond traditional scientific hubs, strengthening global connectivity and enhancing the visibility of smaller or emerging research systems. The distribution of the HFSP Benefit Index across regions illustrates a balanced yet differentiated pattern of value among member states. Member countries explicitly value HFSP as a complement to national schemes: it enables high-risk, cross-border teams that would be difficult to fund domestically, and it provides a risk-pooling mechanism for long-horizon research.

HFSP's mission is to identify and support bold, frontier research in the life sciences by investing in early career scientists and enabling transformative international collaboration. The post-application trajectories demonstrate that this mission is being fulfilled in a measurable and durable way. HFSP funding does more than select promising individuals: it actively converts high potential into sustained scientific careers. Awardees of LTF and CDF fellowships remain embedded in basic science and use HFSP support as a platform for meaningful international movement and cross-disciplinary exploration, exactly as the funding schemes intend. Early-career grant recipients (RGEC) show some of the strongest effects: HFSP support stabilizes their transition into independent research roles, with funded investigators far more likely to remain productive and influential in basic biology than comparable unfunded applicants. These patterns underscore HFSP's unique global role: by supporting high-risk, curiosity-driven projects and the researchers behind them, HFSP cultivates a cohort of scientists who continue pushing disciplinary boundaries long after the award period ends. HFSP-enabled collaborations are perceived by participants and member representatives as scientifically distinctive, often bringing together unique combinations of expertise and infrastructure that would not otherwise converge.

The mobility patterns indicate differences between younger and more senior researchers corresponding to the design of the respective HFSP funding schemes. Fellows demonstrate highly dynamic and globally distributed movements, whereas the patterns for grantees are less pronounced, showing the expected stance of established senior investigators.

Next to the benefits generated by the funded science and the contribution to innovation, HFSP generates adds value for its members through its design as a risk-pooling funding mechanism that enables high-risk research in life sciences, fosters international collaboration beyond the scope of national funding and enhances global talent mobility. The findings further show the significant contribution of HFSP support to the career development of researchers, from which the national research ecosystems again benefit.

10 Summary and Outlook

The HFSP Grand Review 2025 assesses the organization according to the following categories: uniqueness, excellence, valorization, and value for members. It draws on a curated corpus of almost 16,000 HFSP-acknowledged publications (2008–2025) benchmarked against other funders of the life sciences, a survey of 428 awardees, interviews, case studies and focus groups.

Uniqueness of HFSP

The review finds that HFSP occupies a distinct niche in the global life-science funding landscape. The analysis shows a portfolio with an unusually high share of basic science and field-normalized citation impact that places HFSP at the top of both dimensions when compared with major national and international funders (s. section 7.1).

Analyses of disciplinary composition and publication clusters show that HFSP-supported research frequently operates at the interfaces of established fields, integrating biology with physics, chemistry, engineering, computing, and cognitive science. Projects that receive funding from multiple organizations exhibit a measurable shift toward more basic, interdisciplinary work and higher citation impact when HFSP support is present, indicating that HFSP funding is associated with changes in research direction rather than incremental supplementation of existing trajectories (s. sections 4.1, 4.3 and 7.1).

Concept analysis provides additional evidence of HFSP's distinctive profile. Between 2020 and 2024, HFSP-supported publications are disproportionately represented among the top decile of conceptually novel research relative to global comparators in the same thematic areas. This novelty arises primarily from research that challenges prevailing explanatory frameworks within established fields, often re-prioritizing mechanisms traditionally treated as background, such as metabolic state, RNA regulation, immune context, or intrinsic neuronal properties, as central drivers of biological function (s. section 4.1.4).

Awardees and Member representatives consistently describe HFSP as complementary to national schemes and a unique actor in the funding landscape for the life sciences. Awardees rate HFSP exceptionally highly on high-risk research, interdisciplinarity, internationality and autonomy. Survey and interview evidence indicates that HFSP support is often crucial for the projects it funds. Most respondents report that they could not, or only in substantially modified form, have realized their projects with alternative funding. This notion is strongest for Research Grants and Cross-Disciplinary Fellowships. The type of international collaboration enabled by HFSP's Research Grants is considered unique in the broader funding landscape (s. sections 4.2, 5 and 6).

Excellence of HFSP-supported research

Across all major indicators, HFSP-supported research is of outstanding scientific quality and clearly frontier-extending. Bibliometric analysis shows that HFSP's field-normalized citation impact is several times higher than world averages and in many dimensions above that of leading national and European funding agencies. The results indicate that HFSP successfully identifies excellent researchers and enables them to produce excellent research results, confirming that

HFSP's orientation and the concrete implementation of its funding process are highly effective. HFSP outputs are strongly represented in multidisciplinary journals, at roughly twice the rate observed for many comparable national funders. Cluster analyses reveal that HFSP plays an outsized role in the emergence and redirection of research areas at the interfaces of biology with physics, chemistry, engineering and computing (s. section 7.1).

The fellowship programs are effective stepping stones into long-term frontier research careers. HFSP fellows and grantees are more than twice as likely as unsuccessful applicants to remain active and publish in basic science five years after the application was submitted. Long-Term and Cross-Disciplinary Fellows display productive international and interdisciplinary mobility combined with high publication continuity, indicating that HFSP support turns potentially risky moves into career accelerators rather than derailers. The Cross-Disciplinary Fellowship has a particularly distinctive profile. By design, it brings non-life-science PhDs into biological research. Quantitative analyses confirm that Cross-Disciplinary Fellowship alumni have the highest share of post-award publications in 'other' fields, signaling sustained activity at disciplinary interfaces rather than simple absorption into biology (s. sections 9.4 and 9.5).

At the publication level, HFSP's field-normalized citation ratios and share of outputs in the global top-10% most-cited range are consistently above benchmark portfolios. The rate of retracted publications in the HFSP corpus is, 0,05 %, which is at or below global averages, indicating that the emphasis on high risk has not translated into elevated integrity problems (s. sections 7.2 and 7.4).

Valorization of basic research

The evaluation adopts a broad concept of valorization, focusing on how HFSP-supported basic research feeds into scientific, technological, clinical, industrial and societal innovation over time. Analyses consistently show that HFSP-supported research drives scientific innovation while simultaneously laying the foundations for innovation in other domains, as is expected of basic science (s. sections 8.1 and 8.4).

Survey data show that HFSP projects most commonly generate conceptual and methodological advances: respondents highlight new theories, models and experimental techniques as primary outcomes. More applied innovations, such as commercial products or direct policy contributions, are less frequent, which is consistent with HFSP's position at the start of the innovation pipeline and with the long-time lags typical for basic research. Case studies exemplify the pathways from HFSP-supported work into application-oriented domains, e.g., from protein design into drug discovery. They also highlight the challenges researchers face in translating their scientific discoveries into economic applications. The main way in which HFSP contributes to innovation in the economy, health, and society is therefore by creating foundational knowledge on which others can build (s. section 8.2).

This is evidenced, for example, by the patent-citation analysis, which indicates that HFSP's contribution to innovation is measurable and strong in relative terms. Across fellowships and grants, about 17 % of publications that acknowledge HFSP support are cited in patents, with particularly high rates for methodological and tool-oriented outputs. Benchmarking against EMBO Fellowships, HFSP Fellowship publications are more likely to be cited by patents and are referenced across more patent families on average, implying wider technological reuse. In total, 13,790 patent publications from 2,259 organizations in 51 countries cite HFSP outputs, illustrating the breadth of HFSP's technological footprint (s. section 8.3).

Value added of HFSP for its members

HFSP generates value for the member countries through the excellent research results it helps to produce. In particular, basic research of the kind supported by HFSP drives overall scientific progress, which ultimately benefits the member countries and humanity as a whole. Beyond this, member countries especially value that HFSP enables forms of international collaboration and career development that would otherwise not, or only with great difficulty, be possible. Member representatives emphasize that HFSP should continue to support research that cannot be funded nationally, especially high-risk, basic projects involving geographically distant partners. International collaboration is valued both as a means to excellent science and as a goal in its own right, strengthening institutional links and researcher mobility between member states (s. section 9.1).

Quantitative analyses show that HFSP funding is associated with a sustained increase in international collaboration. Across major programs, the average number of countries represented in awardee publications increases during the funding period and remains higher after funding ends. Early Career Research Grants show particularly strong increases, while Program Grants display high levels of international collaboration consistent with their design. Fellowship holders likewise maintain elevated levels of international co-authorship following HFSP support. Case studies and survey confirm these findings regarding international collaboration. HFSP-enabled collaborations are perceived by participants and member representatives as scientifically distinctive, often bringing together unique combinations of expertise and infrastructure that would not otherwise converge. This often gives rise to long-term, scientifically productive collaborations. Even when looking only at the oldest cohort surveyed, accepted for HFSP funding between 2009 and 2011, one finds that about one-third of participants continue the collaborations that originated from their HFSP project (s. section 9.2).

Quantitative analyses also show that HFSP alumni successfully secure further funding, in some cases from prestigious elite programs such as ERC Advanced, Consolidator or Synergy Grants. These findings demonstrate that HFSP not only seeds collaborations but also helps member countries cultivate scientific leaders over entire careers (s. section 9.3).

The way forward

Drawing on the objectives of the strategic plan (s. section 3), HFSP is on a very good path with regard to the first goal ("Expand Frontier Science") and has made good progress on the third goal ("Become a globally inclusive organization"), although room for further development remains, which must be balanced against other considerations and existing constraints. Potential for improvement concerns HFSP's community-building and the second goal ("Strengthen HFSPO through Engagement"). Based on the feedback from several interview partners there is increased demand for these activities. This must, however, be balanced against the limited human and financial resources of HFSPO.

Neither awardees nor representatives of the member states see a fundamental need to adjust HFSP's funding schemes, structure or profile. In interviews and focus groups, participants noted though that the level of funding provided under individual schemes – given inflation – varies in how adequate it is to cover research costs, depending on the country. The duration of funding was also discussed: depending on the specifics of a project, it can be restrictive, but it is inherently in direct tension with overall costs and therefore with the number of projects that can be funded (s. also Figure 7).

Looking ahead, a number of specific challenges remain for HFSP. The biggest of them mentioned widely across interviews and focus groups is the current external economic and political uncertainty, which is recognized as a potential challenge to long-term funding stability. Bringing in new members could help address this challenge. Representatives of the member countries emphasized that this process should be transparent and strongly involve the existing membership base to ensure that HFSP maintains its core identity and its well-functioning structures (s. section 9.1).

Another major challenge concerns the rising number of applications. In view of the global funding situation and the increasing use of AI in applications,[36] HFSP should examine measures to prepare for a future with high and rising application numbers.

An ongoing challenge for a comparatively small organization like HFSP is how to remain at the forefront of supporting excellent science, particularly given that other funders are making efforts, at least in sub-programs, to become more interdisciplinary, more international, and more willing to take risks.

In sum, HFSP is well positioned to maintain its leading position in life sciences and to achieve its self-defined objectives. HFSP's core orientation and program design are highly valued by all stakeholders, with little perceived need for adjustment. HFSP's governance and organizational set-up function very well and deliver excellent outcomes for researchers, Member States, the life sciences, and scientific progress more broadly. If the identified challenges can be successfully addressed, there is nothing to prevent HFSP from further strengthening its unique position as a driving force in the life sciences.

[36] For an informative broader look at job applications and AI compare Job applicants are winning the AI arms race against recruiters. (2026). *The Economist*. Retrieved 2 February 2026, from https://www.economist.com/business/2026/01/12/job-applicants-are-winning-the-ai-arms-race-against-recruiters.

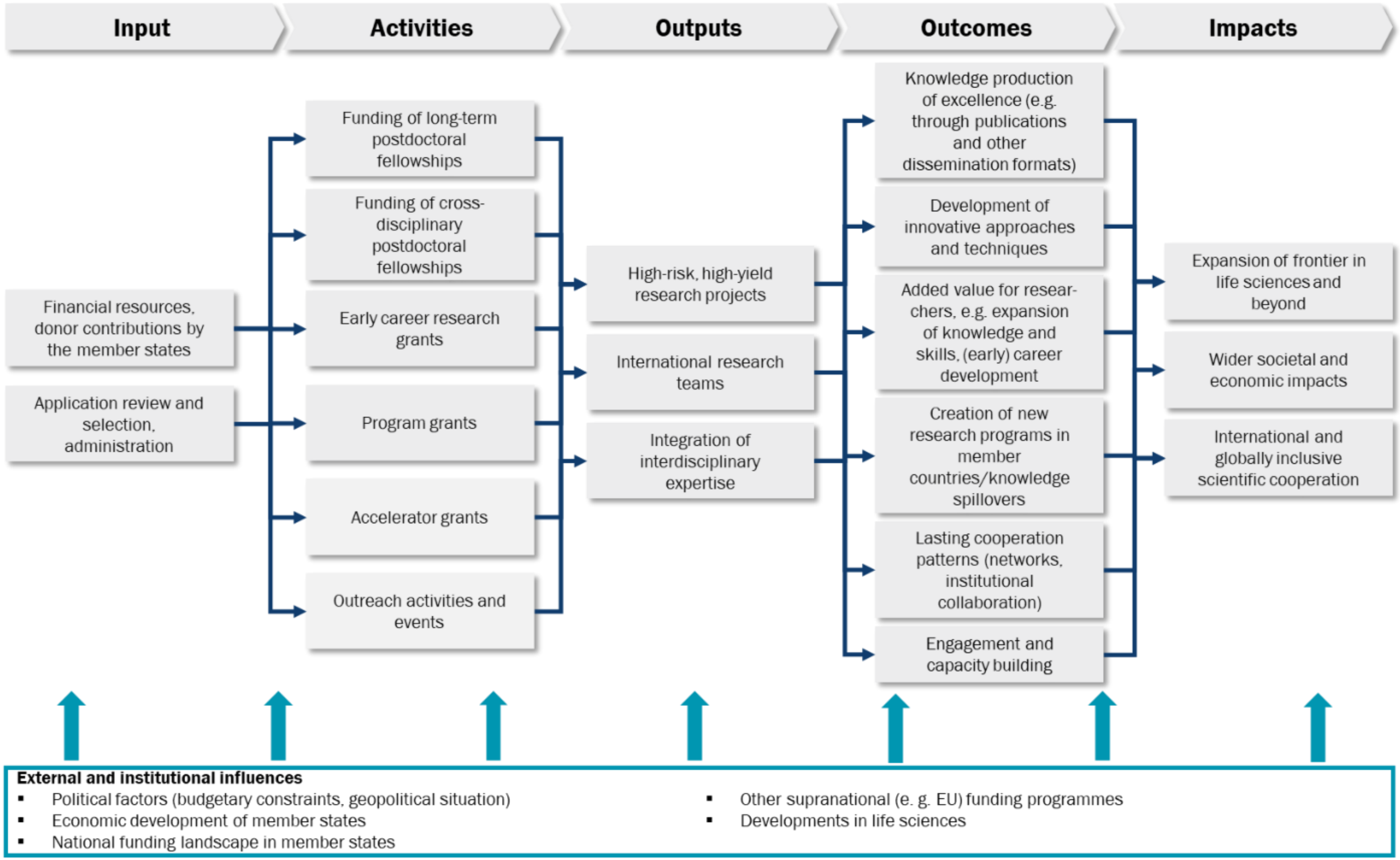
11 Annex

The annex provides additional and more detailed information and explanations on various aspects of the analysis. In the main body of the report, the corresponding sections of the annex are linked.

11.1 Theory of Change (ToC)

The Theory of Change provides a schematic representation of how HFSP generates impact. The Grand Review examines HFSP's outputs, outcomes, and impacts at different levels and substantiates this model with empirical findings.

Figure 41: Theory of Change for HFSP and HFSP-supported research



11.2 Overview of relevant global Funders of the Life Sciences

Table 22: Overview of Global Funders of the Life Sciences

Organization	Location / Country	Annual Budget (approx., latest public data)	Approach to interdisciplinarity	Approach to high-risk research	Approach to international collaboration	Target group (who / where)	Link to source
Canadian Institutes of Health Research (CIHR)	HQ: Ottawa, Canada Federal health research funding agency (Government of Canada)	~CAD 1.35bn total actual spending (2023–24)	Supports excellence across four pillars: biomedical, clinical, health systems/services, population health	Project Grants welcome innovative and high-risk lines of inquiry	International Research Framework; ~40 international initiatives and partnerships	Researchers and trainees (all career stages) Primarily Canada-based institutions; international collaborators supported	https://cihr-irsc.gc.ca/e/53955.html https://cihr-irsc.gc.ca/e/49051.html
European Molecular Biology Organization (EMBO)	HQ: Heidelberg, Germany Intergovernmental EMBC organization (European member states)	~€30m per year EMBO program budget (via EMBC funding)	Focus on molecular and cellular life sciences Interdisciplinarity mainly within life-science subfields via courses, workshops and networks	Curiosity-driven basic research Emphasis on originality and excellence; no dedicated high-risk scheme Insufficient evidence for an explicit high-risk policy	Strong focus on cross-border mobility within EMBC states Fellowships and networks open worldwide in several schemes	Outstanding life scientists at postdoc and group-leader level Researchers of any nationality; hosts mainly in EMBC member states (plus selected global schemes)	https://www.embo.org/about-embo/mission/
European Research Council (ERC)	Based in Brussels, Belgium Host institutions in EU Member States and Horizon Europe Associated Countries	>€16bn total budget 2021–27 ≈€2.3bn per year average over 2021–27	Bottom-up frontier research across all disciplines Strong support for interdisciplinary and cross-panel projects, including Synergy Grants	Supports ambitious, creative, potentially breakthrough research High-gain frontier projects welcome even with limited preliminary data No separate branded high-risk program	PIs of any nationality eligible if hosted in EU / associated country Teams can include international partners; some members may be hosted outside Europe	Individual investigators (Starting, Consolidator, Advanced, Synergy) PIs from any country; research performed at eligible European host institutions	https://erc.europa.eu/about-erc/erc-glance

Institut national de la santé et de la recherche médicale (Inserm)	HQ: Paris, France Public scientific and technological institute (Ministries of Health & Research)	~€1.225bn initial budget (2025)	Multidisciplinary health research across life and health sciences (basic to public health)	Manages 'Impact Santé' (France 2030): breakthrough, high-risk, high-impact health research	European & international cooperation; >7,000 collaborations with foreign partners annually	Inserm research units and clinician-scientists in France; manages competitive programs/calls (e.g., Impact Santé)	https://www.inserm.fr/en/about-us/inserm-at-a-glance/ https://www.inserm.fr/en/about-us/research-programs/
National Health and Medical Research Council (NHMRC)	HQ: Canberra, Australia Independent statutory agency (Australian Government)	~A$924m (2023–24 budgeted administered expenses) Transfer to MREA ~A$911m (research grants)	Synergy Grants support outstanding multidisciplinary teams	Ideas Grants support innovative/creative projects Portfolio includes longer-term investigator funding	International collaborative health research funding (bilateral & multilateral arrangements)	Australian researchers (all career stages) Typically via Australian administering institutions	https://preview-api.transparency.gov.au/delivery/assets/80a82ed1-3e33-027b-b7e0-6493f97f18f8/ea239215-98c5-4c45-b87a-ddfaf2564208/2023-24_portfolio_budget_statement_health_and_aged_care.pdf https://www.nhmrc.gov.au/funding/find-funding/synergy-grants
National Institutes of Health (NIH)	U.S. federal agency (Department of Health & Human Services) HQ in Bethesda, Maryland; funds mainly U.S. institutions	≈US$48.6bn per year (recent appropriations and requests)	Numerous cross-institute initiatives and Common Fund programs Integrates basic, clinical, population, data and behavioral sciences	Dedicated High-Risk, High-Reward Research (HRHR) program Includes Pioneer, New Innovator, Transformative Research and Early Independence Awards	Grants primarily to U.S. institutions Foreign components and some direct foreign awards possible when justified Multiple global health initiatives and international partnerships	Trainees and investigators at U.S. institutions (all career stages) Some sub-awards and programs involve foreign organizations and researchers	https://commonfund.nih.gov/highrisk

				Explicit focus on bold, potentially transformative projects with limited preliminary data			
Marie Skłodowska-Curie Actions (MSCA)	EU program managed by the European Commission Hosts mainly in EU Member States and Horizon Europe Associated Countries	€6.6bn total budget 2021–27 ≈€0.9–1.0bn per year average	Explicitly promotes international, interdisciplinary and inter-sectoral cooperation Doctoral Networks and Staff Exchanges require multi-disciplinary consortia	Bottom-up research in any discipline, evaluated on excellence and feasibility Encourages innovative projects but requires credible training and workplans Insufficient evidence for a formal dedicated high-risk scheme	Cross-border mobility mandatory in all core schemes Global Fellowships and staff exchanges involve partners worldwide	Doctoral candidates and postdoctoral researchers of any nationality Work mainly at host organizations in EU / associated countries, with some outgoing global phases	https://marie-sklodowska-curie-actions.ec.europa.eu/about-msca
National Science Foundation (NSF)	Independent U.S. federal agency Funds research mainly at U.S. colleges, universities and research organizations	≈US$10.2bn requested for FY2025 (≈12% above FY2024)	Supports convergence research and cross-directorate initiatives Many programs explicitly encourage interdisciplinary teams	EAGER mechanism funds early-concept, high-risk, high-payoff ideas Broader emphasis on transformative and unconventional research	Office of International Science & Engineering coordinates global partnerships Numerous co-funded calls and collaborations with foreign agencies	Researchers and educators at eligible U.S. institutions (all career stages) International partners usually participate via collaborations with U.S.-based teams	https://www.nsf.gov/about
Deutsche Forschungsgemeinschaft (DFG)	Germany's central self-governing research funding organization Funds researchers at German universities and public research institutions	~€3.9bn annual funding volume (around 2024)	Serves all fields of science and humanities Collaborative Research Centers and Excellence Strategy clusters are highly interdisciplinary	Explicit mandate to provide space for high-risk and unconventional basic research High-risk projects can be proposed across individual and coordinated programs	Extensive bilateral and multilateral funding schemes with foreign agencies International Research Training Groups and joint projects with partner countries	Researchers at German institutions at all career stages International partners typically funded by their own agencies in joint schemes	https://www.dfg.de/en/about-us/about-the-dfg/what-is-the-dfg

Wellcome Trust (incl. Wellcome Leap)	Independent charitable foundation based in London, UK Global remit with strong focus on UK, Ireland and low-/middle-income countries	Plans to spend £16bn between 2022–2032 (~£1.6bn per year) Reported £1.57bn charitable expenditure in 2023–24	Discovery Research and strategic programs are deliberately cross-disciplinary Major challenges (mental health, infectious disease, climate & health) require trans-disciplinary teams	Discovery Awards fund bold, creative research aiming for major shifts in understanding Wellcome Leap operates a DARPA-like global program explicitly pursuing high-risk, high-impact projects	Funds research worldwide, often prioritizing LMIC institutions Works with governments, WHO and international partners on global health initiatives	Early-, mid- and established-career researchers in eligible not-for-profit organizations worldwide Strong emphasis on UK/Ireland and LMIC-based teams; collaborations often multi-country	https://wellcome.org/our-priorities/strategy
National Cancer Institute (NCI)	Part of NIH; HQ in Bethesda, Maryland, USA Funds cancer research mainly at U.S. institutions and cancer centers	≈US$7.22bn per year (FY2024 and FY2025 under continuing resolution)	Research portfolio spans basic, translational, clinical and population sciences NCI-designated Cancer Centers integrate multiple disciplines and sectors	Provocative Questions initiative targeted challenging, under-explored cancer questions Other initiatives (e.g. Cancer Moonshot, technology programs) support novel approaches Insufficient evidence for a single overarching high-risk framework	Center for Global Health advances international cancer research and training Participates in global consortia and supports collaborations, including in LMICs	Investigators at U.S. universities, hospitals and cancer centers (all career stages) International partners mainly via collaborations, sub-awards and selected global initiatives	https://www.cancer.gov/about-nci/budget
Biotechnology and Biological Sciences Research Council (BBSRC)	Part of UK Research and Innovation (UKRI) Supports researchers mainly in the UK	Core research & innovation budget ≈£320m per year (around 2022–25) UKRI core allocation for 2024/25 ≈£322m	Funds bioscience across agriculture, food, biotechnology and health Strong emphasis on work at interfaces with engineering, maths, physical and computational sciences	Invests to push back frontiers of biology and support transformative technologies Some calls seek emerging or transformative research Insufficient evidence for a unified, council-wide high-risk program	Promotes international partnerships via joint calls and partnering schemes Supports travel, exchanges, workshops and collaborative projects with overseas organizations	Researchers at eligible UK universities and BBSRC-supported institutes International partners usually funded by their own agencies or specific joint schemes	https://www.ukri.org/councils/bbsrc/

Medical Research Council (MRC)	UKRI council funding medical research Supports research primarily in the UK	Core research budget ≈£1.75bn over 2022–25 ≈£580–600m per year; UKRI core allocation for 2024/25 ≈£604m	Funds groundbreaking research into human health and disease across the spectrum Encourages multidisciplinary and cross-council programs (e.g. integrating engineering or social science with medicine)	Supports innovative discovery and clinical research including experimental medicine Will fund higher-risk projects when backed by strong rationale and evidence Insufficient explicit evidence for a single high-risk framework	Runs extensive international partnerships and programs, including in LMICs Co-funds global health initiatives with overseas funders and organizations	Researchers based at eligible UK research organizations (universities, institutes, NHS partners) International collaborators commonly included in UK-led consortia and some LMIC units	https://www.ukri.org/councils/mrc/
Japan Society for the Promotion of Science (JSPS)	Japan's sole independent national research funding agency Supports research at Japanese universities and institutes plus global programs	≈¥318.8bn total budget in FY2025 (≈¥319bn scale of projects)	Mission covers all disciplines (natural sciences, engineering, social sciences and humanities) Core-to-Core and similar programs build multi-disciplinary international research networks	Grants-in-Aid for Scientific Research support creative, investigator-initiated basic research Describes support for courageous challenges initiated by researchers Insufficient detailed evidence on explicit high-risk criteria in English materials	Extensive bilateral programs and international fellowships for incoming and outgoing researchers Core-to-Core Program establishes long-term international hubs (e.g. Asia–Africa networks)	Researchers at Japanese universities and research institutes (all career stages) Excellent overseas researchers hosted in Japan or partnered via JSPS fellowships and networks	https://www.jsps.go.jp/english/e-organization/mission/
Natural Sciences and Engineering Research Council of Canada (NSERC)	Federal agency of Canada Funds research at Canadian universities and colleges	≈CA$1.3–1.4bn per year Actual spending ≈CA$1.38bn in 2023/24	Discovery Grants provide flexible support that can include interdisciplinary directions Co-leads New Frontiers in Research Fund (NFRF) focused on interdisciplinary, transformative projects	NFRF Exploration and Transformation streams explicitly fund high-risk, high-reward research Discovery Grants allow investigators to pursue exploratory lines within a broader program	Many programs allow or encourage international partners from academia, industry or public sector NFRF International stream requires Canadian-led projects with international research partnerships	Faculty and trainees at eligible Canadian universities and colleges Many scholarships restricted to Canadian citizens/permanent residents; partners abroad usually funded by their own agencies	https://www.nserc-crsng.gc.ca/index_eng.asp

Australian Research Council (ARC)	Australian Government statutory agency Funds research mainly at Australian universities and eligible organizations	Total budgeted resources ≈AU$934.6m in 2023/24 Special appropriation for National Competitive Grants Program ≈AU$896m in 2023/24	Covers all non-clinical disciplines Formal Statement of Support for Interdisciplinary Research to ensure fair assessment of cross-disciplinary proposals	National Competitive Grants Program funds fundamental and strategic research with varying risk levels Policy discussions include possible Breakthrough-type schemes for ambitious research Insufficient evidence that a mature dedicated high-risk mechanism is fully implemented	Linkage Program promotes collaborations with industry, community and international partners ARC "International" strategy highlights joint schemes with overseas agencies	Researchers at eligible Australian higher-education and research organizations as project leaders International researchers mainly as partners or as recruits to Australian host institutions	https://www.arc.gov.au/national-competitive-grants-program
Centre national de la recherche scientifique (CNRS)	French public research organization headquartered in Paris Operates laboratories across France and internationally	≈€4bn annual budget in recent years	Active in all scientific fields (biology, chemistry, physics, environment, humanities, etc.) Launches cross-cutting interdisciplinary challenges and programs on complex societal issues	Mission emphasizes basic, long-term and exploratory research Supports disruptive and emerging areas through thematic and interdisciplinary programs Insufficient detailed evidence for explicit high-risk evaluation criteria	Maintains numerous International Research Laboratories, Projects and Centers worldwide Strong engagement in European and global partnerships and mobility of scientists	CNRS researchers and staff within CNRS units and joint laboratories with universities International collaborators integrated via joint laboratories and international projects	https://www.cnrs.fr/en/the-cnrs

11.3 Interview Program

Table 23: Conducted or scheduled interviews

Program	Year of funding	Interviewee
LTF	2018	Elizabeth Amadei
LTF	2013	Nicolas Lehrbach
LTF	2017	Zena Hadjivasiliou
LTF	2013	Anjana Badrinarayanan
CDF	2013	Simone Köhler
CDF	2017	Sarbina Simoncelli
CDF	2013	Anne-Florence Bitbol
Early Career Grant	2012	Rhoel Dingsalan
Early Career Grant	2013	Agnel Sfeir
Early Career Grant	2018	Emilio Kropff

11.4 Case Studies

Table 24: Conducted Case Studies

Case Study	Year of funding	Principal investigator	Interviews carried out
A modular protein design route to exploring the operating principles of molecular motors	2007	Heiner Linke	3
Exploring the concept of adaptive immunity to viruses in mosquitoes	2017	Mariangela Bonizzoni	2
Do hydrocarbons induce membrane curvature in photosynthetic organisms?	2019	David Lea-Smith	1
Characterization of light-dependent rhythmic processes in the marine environment	2010	Kristin Tessmar-Raible	1
Multi-scale functional investigations into mechanosensing response in archaea	2021	Alex Bisson	2
Phase separation of glycolytic machinery as a fundamental mechanism in energy metabolism	1993	Tony Hyman	1
Molecular and physical mechanisms of gamete	2020	Victoria Deneke	1

binding and fusion in zebrafish

11.5 Survey Questions

Groundbreaking Research

This section addresses the contribution of HFSP to research that is considered groundbreaking and leads to transformative outcomes across science, policy, and industry.

1. Which scientific fields does your project belong to? Classification according to ANZSRC - Australian and New Zealand Standard Research Classification, 2020 (Multiple choice question)

1. Agricultural, Veterinary and Food Sciences (including Agricultural Biotechnology, Food Sciences, ...)
2. Biological Sciences (including Bioinformatics and Computational Biology, Ecology, ...)
3. Biomedical and Clinical Sciences (including Medical Biotechnology, Neurosciences, ...)
4. Chemical Sciences (including Medicinal and Biomolecular Chemistry, Theoretical and Computational Chemistry, ...)
5. Earth Sciences (including Climate Change Science, Geochemistry, ...)
6. Engineering (including Biomedical Engineering, Nanotechnology, ...)
7. Environmental Sciences (including Ecological Applications, Environmental Biotechnology, ...)
8. Health Sciences (including Health Services and Systems, Public Health, ...)
9. Information and Computing Sciences (including Artificial Intelligence, Human-Centred Computing, ...)
10. Mathematical Sciences (including Applied Mathematics, Numerical and Computational Mathematics, ...)
11. Physical Sciences (including Medical and Biological Physics, Space Sciences, ...)
12. Psychology (including Biological Psychology, Cognitive and Computational Psychology, ...)

2. Did your HFSP-supported project lead or significantly contribute to any of the following forms of innovation? (Multiple choice question)

- New theories, models, or concepts
- New methods and tools
- New technologies
- New treatments
- Development of policy or regulatory frameworks
- Commercial opportunities and application
- None of the above
- Too early to assess
- Other (free text)

3. “Transformative” refers to research that opens new directions of inquiry, challenges existing paradigms, and/or creates lasting impact within its field. How transformative was the project for its research field? (Single choice question)

- It opened entirely new research fields.
- It significantly contributed to opening an entirely new research field.
- It expanded existing knowledge.
- It made incremental contributions.
- It was not transformative.
- It is too early to assess.

4. What new research field did your project open? (Free Text)

5. To the opening of which new research field did your project significantly contribute? (Free Text)

Interdisciplinary Research

This section explores whether HFSP funding supported interdisciplinary research in ways that changed scientific practices, added value to the project, and shaped future research behavior.

6. Did the requirement of HFSP for applying interdisciplinary approaches influence your project idea regarding the scientific approach or methodology? (Single Choice)

1. Yes, significantly
2. Yes, somewhat
3. Yes, marginally
4. No

7. (Filter: If ‘Yes’ was answered in the previous question) In what way did the interdisciplinary approach of HFSP influence your project? (Multiple Choice):

- Integration of perspectives from other fields
- Development of new research questions
- Use of unfamiliar methods or tools
- Reformulation of theoretical framework
- Redesign of experimental/data collection setup
- Other (free text)

8. Did the interdisciplinary character of the project provide added value beyond what a single-discipline project could have achieved? (Single Choice)

- Yes, the interdisciplinary approach was essential for the success(es) of the project.
- Yes, the interdisciplinary approach contributed to the success(es) of the project.
- Yes, the interdisciplinary approach contributed in a minor way to the project.
- No

9. (Filter: If not ‘No’ was answered in the previous question) In what way did the interdisciplinary character of the project provide added value beyond what a single-discipline project could have achieved? (Multiple Choice)

- Broader research impact
- Access to complementary expertise
- Novel combinations of methods or concepts
- Increased international visibility
- Enhanced publication potential
- Other (free text)

10. As a follow-up to your HFSP project: In your research activities, are you now working in a more interdisciplinary manner as compared to before securing HSFP funding? (Single Choice)

- Yes, definitely.
- Yes, to some extent.
- The level of interdisciplinarity has not changed.
- No, I now work in a less interdisciplinary manner.

11. (Filter: If ‘No, I now work in a less interdisciplinary manner.‘ was answered in the previous question.) Why do you now work in a less interdisciplinary manner? (Free Text)

Collaboration

This section investigates whether HFSP funding enabled new, lasting, and productive scientific collaborations. It also looks at how these collaborations evolved after the end of the HFSP project.

12. (Filter: If Fellows) Did your HFSP fellowship lead to new scientific collaborations, and are they still ongoing today? (Single Choice)

- Yes, it led to new collaborations and they are still ongoing.
- Yes, it led to new collaborations but they have since ended.
- No new collaborations emerged.
- Too early to assess.

13. (Filter: If any option other than ‘No new or re-activated collaborations emerged’ or ‘Too early to assess.‘ was answered in the previous question) What forms did/do these collaborations take? (Multiple Choice)

- Informal exchanges on research
- Joint publications
- Joint grant applications
- Scientific staff exchange
- Employment at the same lab or institute
- Joint patent activities
- Other (free text)

14. (Filter: If Research Team) Did your HFSP project lead to new or re-activated scientific collaborations, and are they still ongoing today? (Single Choice)

- Yes, it led to new collaborations and they are still ongoing.
- Yes, it led to new collaborations but they have since ended.
- Previous collaborations were re-activated and are still ongoing.
- Previous collaborations were re-activated but ended.
- No new or re-activated collaborations emerged.
- Too early to assess.

15. (Filter: If option "... still ongoing" is selected in questions 8 or 10.) In what formats did these collaborations continue? (Multiple Choice)

- Informal exchanges on research
- Joint publications
- Joint grant applications
- Exchange of scientific staff
- Joint development of infrastructure
- Joint patent activities
- Long-term institutional partnerships
- Other (free text)

16. (Filter: If any option other than "No new or re-activated collaborations emerged" is selected in questions 8 or 10.) Did the collaboration provide value to your project? (Single Choice)

- Yes, it provided unique scientific value to your project.
- Yes, it increased the impact of your project e.g. by increased visibility.
- Yes, it provided opportunities for networking and future collaborations.
- Yes, it provided other value to your project. (free text)
- No, it added no value.
- No, it made it harder to successfully complete the project.

Career Development

The following section looks at the impact HFSP had on your career development.

17. How would you describe your current employment status? (Single choice)

- Academic research and/or education
- Research at a non-university research institution
- Industry research and development
- Non-research career
- Unemployed (voluntarily)
- Unemployed (involuntarily)
- None of the above (free text)

18. (Filter: If last question was answered with ‘Academic research and/or education’, ‘Non-university research’, ‘Industry research and development’, ‘Non-research career’, Only show relevant answers.) What best describes your current employment position? (Single choice)

- (Academia) tenured professor
- (Academia) non-tenured professor
- (Academia) research assistant
- (non-university research institution) non-leading position
- (non-university research institution) leading position
- (non-university research institution) director or equivalent
- (Industry research and development) non-leading position in an established company
- (Industry research and development) leading position in an established company
- (Industry research and development) employed in a self-founded startup
- (Industry research and development) employed in a non-self-founded startup
- (Industry research and development) employed by an NGO
- (Non-research career) self employed
- (Non-research career) employed in an established company
- (Non-research career) employed in a self-founded startup
- (Non-research career) employed in a non-self-founded startup
- (Non-research career) employed by the state
- (Non-research career) employed by an NGO
- (all answers) none of the above (free text)

19. (Filter: If last question was answered with ‘Academic research and/or education’, ‘Non-university research’, ‘Industry research and development’, ‘Non-research career’, ‘None of the above’.) In order to better understand the carreer development of awardees we kindly ask you to write down your current job title. (Free text)

20. How important was HFSP funding for your career development compared to other funding organizations or other sources of funding? (Single Choice)

- Very important
- Important
- Of minor importance
- Not important

21. Describe in a few words the way in which HFSP funding was important for your career development. (Free Text)

22. How do you rate the contribution of the participation in an HFSP-supported project to the following aspects of your career development? (Matrix questions; Rating: Very high, above average, average, below average, very low, too early to assess, no opinion / not applicable)

- Gaining scientific expertise
- Gaining interdisciplinary collaboration experience
- Gaining international collaboration experience
- Gaining leadership or project management skills

- Improving your network and discovering career advancement opportunities
- Other important contribution (Free Text)

23. (Filter: If answered question 13 'Academic research and/or education', 'Non-university research', 'Industry research and development', 'Non-research career'.) Are the research idea or the results of your HFSP-supported project still relevant to your current research? (Single Choice)

- Yes, it remains a core focus of my work
- Yes, but only as a minor topic
- No

Impact and Unique Value of HFSP

The following section looks at the impact of HFSP and the unique value it provides to its awardees, especially compared with other research funding organizations.

24. How do research projects funded by HFSP differ from projects funded by other support programs regarding the following aspects? (Matrix questions; Rating: much more/higher, slightly more/higher, comparable/average, slightly less/lower, much less/lower, no opinion / not applicable)

- Internationality of participating institutes
- Internationality of participating researchers
- Chance for explorative and risky research
- Remuneration of creativity and innovativeness
- Focus on interdisciplinarity
- Acceptance of researchers without a long-established track record
- Balanced gender representation
- Freedom for the individual researcher in the pursuit of his or her project

25. Did HFSP funding and support lead to an evolution of your original research idea over the course of the project? (Single Choice)

- Yes, significantly
- Yes, to some extent
- No

26. (Filter: If 'Yes, significantly' or 'Yes, to some extent' was answered in the previous questions) What aspect of your project changed due to HFSP funding and support? (Multiple Choice)

- Topic
- Research design
- Methodology
- Interdisciplinary approach
- Institutional setting
- Other (free text)

27. Without HFSP funding would you have been able to fund your project with alternative sources? (Single Choice)

- Yes, easily
- Probably
- Probably not or not with its initial design
- No

28. (Filter: If not 'No' was answered in the previous questions) Where would the alternative funding have come from? (Multiple Choice)

- National program
- International program
- University
- Non-university research institution
- Industry
- Other

29. (Filter: If 'Yes, easily or 'Probably' was answered in the question before the previous one) What is the name or are the names of the alternative funding sources? (Free Text)

30. How would you characterize the success of your funded project in the following categories? For this survey, "success" should refer to the extent to which the project achieved meaningful outcomes. (Matrix Question; Rating: Very Successful, Moderately Successful, Slightly Successful, Not Successful, Too Early to Assess, Not Relevant for My Project.)

- Scientific breakthrough
- Refinement of scientific understanding
- Development of new methodologies or tools
- Falsification of assumptions / methodological approaches
- Contribution to policy or societal impact
- Commercialization or industrial application
- Establishment of new long-term collaboration(s)
- Your career advancement

Way Forward

The following section examines how HFSP should be evaluated and how HFSP can develop its programs further to better meet the needs of researchers and maximize the impact of its funding.

31. How well does HFSP fulfill its own aspirations regarding the following thematic priorities? (Matrix Question; Rating: Excellently, Well, Adequately, Not well, Not at all, No opinion.)

- Interdisciplinarity
- International collaboration
- High-risk / high-reward nature of funded research
- Groundbreaking nature of funded research

32. How do you rate HFSP in the following categories? (Matrix Question; Rating: Excellent, Good, Adequate, In need of improvement, In dire need of improvement, No opinion.)

- Financial scope and structure (e.g. payment cycle) of funding
- Length of funding
- Flexibility of carrying out the research and the use of funds
- Clarity of application guidelines and post-award regulations
- Administrative support and availability of information
- Community-building activities
- Visibility-enhancing activities

33. (Filter: If 'In need of improvement' or 'In dire need of improvement' was answered in the last question) What improvement is needed regarding [relevant category 1 - 7]? (Free Text)

34. If you have any additional comments or suggestions for improving HFSP programs and processes, please share them here. (Free Text)

11.6 HFSP Data Preparation: Curating, Matching and Mapping of the Corpus for quantitative Analysis

The preparation of the HFSP dataset required a multi-stage process combining researcher identification, publication extraction, and grant-level linkage. HFSP provided several raw data files covering awardees, programs, and publications. These required extensive cleaning, standardization, and cross-referencing due to inconsistencies in grant identifiers, acknowledgement formats, and publication metadata. The following section outlines the data sources and methodological steps used to assemble a consolidated, analyzable HFSP corpus.

Data Received From HFSP

HFSP delivered several spreadsheets containing awardee and publication data:

Awardee Data:
- Awards master list: 8,429 awardees (post-1990), across all HFSP schemes. Seven deceased researchers were excluded.
- TeamMemberAwardees_DB_9_April_2024: 4,604 awardees (RGEC, RGP, RGO, RG1, RGEC, RGP, RGY).
- CDA Awardees Dec 2022: 244 awardees of Career Development Awards.
- Fellowship awardees 1990–2025 (May 2025 extract): 3,581 awardees across LTF and CDF programs.

Publication Data:
- All bibliographic references 1990–2024: 32,563 publications, including duplicates, malformed or missing DOIs, and inconsistent HFSP references.
- After selecting only publications from 2000 onward, 24,944 unique publications remained (based on normalized titles).

From these, using DOIs and titles, 19,743 publications (79.1% of delivered publications) could be matched in Dimensions. Of these, 16,058 contained an HFSP acknowledgement.
This means only 68.4% of delivered publications could be reliably linked to awards.

Some HFSP references were invalid or inconsistent (e.g., “RG220094” possibly indicated “RG-0094-2022”).

Publication Identification in Dimensions

To complement and validate the HFSP-delivered publication list, we searched the Dimensions database using acknowledgement fields. We identified 28,354 publications that referenced HFSP support through acknowledgements or funding sections.
Because acknowledgement formats varied substantially, the search included the following name variants:
- “HFSP”
- “H.F.S.P.”
- “HFSPO”
- “Human Frontier” / “Human Frontiers”
- “HSFP” (excluding “HSFPEI” which refers to unrelated entities)

Intersection and Divergence Across Sources

Comparing HFSP-delivered publications with Dimensions-identified publications shows:

- 31,782 total publications across both sources (unique).
- 3,428 publications (10.7%) appear only in HFSP's files.
- 12,039 publications (37.9%) appear only via Dimensions acknowledgements.
- 16,315 publications appear in both sources:
    - 82.6% of HFSP-delivered publications
    - 57.5% of Dimensions-identified publications
    - 51.3% of the total combined corpus

This overlap highlights the value of both sources and the need for triangulation to ensure full coverage.

Researcher Identification and Standardization

The awardee lists included names, nationalities, host institutions, and in some cases email addresses. To construct a reliable HFSP researcher registry:

- Names were standardized and alternative name forms resolved (e.g., formal names used in grant applications vs. abbreviated or familiar names used in publications).
- Host institutions were mapped where possible using standard institutional identifiers.
- Duplicate entries were consolidated and award histories reconciled across multiple HFSP files.

This step was essential due to the international nature of HFSP researchers and the variability in name representation across administrative and scientific outputs.

Linking Publications to HFSP Grants

A major challenge was the lack of consistent grant number formats across HFSP program years. Examples of grant identifiers included:

- LT000537/2015
- LT0042/2022-L
- RG-P5/2023
- CDA00005
- CDA-0039/2019
- LT 0004252014-L
- RGY006S

These variations required a structured approach:

1. Extracting and normalizing grant numbers from:
    a. HFSP-delivered publication metadata
    b. Publication acknowledgements in Dimensions

2. Author-based matching, using HFSP researchers' names to assign publications to grants and applying a temporal filter of 1–5 years post start of award, to avoid misattributing publications resulting from separate later grants.
3. Manual disambiguation of problematic or malformed grant codes.

This hybrid approach maximized accuracy in mapping publications to HFSP award programs despite inconsistent referencing practices.

Identifying Unsuccessful Applicants

HFSP provided lists of unsuccessful applicants at the Letter-of-Intent and Proposal stages, including names, proposed host institutions, nationalities, and ORCID identifiers.

- To locate their publication outputs in Dimensions:
- ORCID IDs were used as the primary and most reliable matching method.
- Where ORCID was unavailable or uninformative, we used:
  - Name + host institution
  - Name + nationality
  - Name + proposed host-country filters
  - Restrictive Field-of-Research (FoR) filters to reduce false positives

Because unsuccessful applicants are not funder-tagged, this multistep triangulation was necessary to construct a valid comparison cohort.
Through these procedures – cleaning, deduplicating, reconciling HFSP and Dimensions publication sources, resolving researcher identities, and normalizing inconsistent grant references – we assembled a comprehensive, researcher-linked HFSP corpus suitable for bibliometric analyses. This rigorously prepared dataset forms the foundation for all program-level, benchmark, interdisciplinarity, and impact assessments presented in the report.

11.7 Fields of Research (FoR)

Fields of Research (FoR) is a classification system that uses the Australian and New Zealand Standard Research Classification to cover all areas of research from Arts and Humanities to Science and Engineering. Assigning FoR codes to publications in Dimensions is done automatically using machine learning emulations of the categorization processes. The Field-Citation Ratio (see below) indicates how a publication has been cited relative to other publications with the same Fields of Research code(s).

In many of the analyses below, we have created a composite of first-level and second-level fields. The second-level field of research was used where the first-level field was Biological Sciences, Biomedical and Clinical Sciences, or Chemical Sciences. For all other fields, the first-level field is used.

Field Citation Ratio (FCR)

The Field Citation Ratio (FCR) is a citation-based measure of scientific influence of one or more articles. It is calculated by dividing the number of citations a paper has received by the average number received by documents published in the same year and in the same Fields of Research (FoR) category.

The FCR is calculated for all publications in Dimensions which are at least 2 years old and were published in 2000 or later. Values are centered around 1.0 so that a publication with an FCR of 1.0 has received exactly the same number of citations as the average, while a paper with an FCR of 2.0 has received twice as many citations as the average for the Fields of Research code(s).

To calculate an FCR score for an article, a minimum number of 500 articles need to be categorized in the applicable FoR category for the year in which the article was published. If an article is categorized in more than one FoR code, then only those codes, which meet the threshold of 500 labelled articles in that year, will be used to calculate the FCR score

FCR Mean is the average Field Citation Ratio (FCR), which indicates the relative citation performance of an article, when compared to similarly-aged articles in its Fields of Research (FoR) category. The values per year are the years in which the publications were published. As with other calculations involving the FCR, the average calculated is the geometric mean, which reduces the effect of outlier publications with extreme citation rates.

To calculate the geometric mean, we use the approach documented in Thelwall & Fairclough.[37]

11.8 Success Rates of different programs and funding schemes

Table 25: Success Rates of different programs and funding schemes

The year refers to the year of the call or competition. FY stands for fiscal year which usually reaches into the previous calendar year.

Funder	Funding Scheme	Year	Success Rate	Source
EMBO (European Molecular Biology Org.)	Postdoctoral Fellowships	2024	**11%**	https://www.embo.org/documents/facts_figures/EMBO_annual_report_2024.pdf
ERC (European Research Council)	Starting Grant	2024	**14.2%**	https://www.cnrs.fr/en/update/winners-2024-erc-starting-grants-cnrs
ERC	Consolidator Grant	2024	**14.2%**	https://www.eubuero.de/en/news-erc-2024-12-11-3981.html
ERC	Advanced Grant	2024	**11%**	https://www.vr.se/english/just-now/news/news-archive/2025-06-17-13-researchers-in-sweden-to-receive-an-erc-advanced-grant-2024.html
CIHR (Can. Inst. of Health Research)	Project Grant – Spring Competition	2024	**15.3%**	https://cihr-irsc.gc.ca/e/53975.html

[37] Thelwall, M., & Fairclough, R. (2015). Geometric journal impact factors correcting for individual highly cited articles. Journal of Informetrics, 9(2), 263–272.

CIHR	Project Grant – Fall Competition	2024	**17.2%**	https://cihr-irsc.gc.ca/e/54191.html
NHMRC (Australia)	Investigator Grants	2024	**13.8%**	https://www.nhmrc.gov.au/sites/default/files/documents/attachments/grant%20documents/2024-Investigator-Grants-Snapshot.pdf
NHMRC	Ideas Grants	2024	**10.1%**	https://www.nhmrc.gov.au/sites/default/files/documents/attachments/grant%20documents/2024-Ideas-Grants-Snapshot.pdf
NIH (USA)	R01-Equivalent Research Grants	FY 2024	**19%**	https://report.nih.gov/nihdatabook/category/3
MSCA (Marie Skłodowska-Curie Actions)	Postdoctoral Fellowships	2024	**16.6%**	https://marie-sklodowska-curie-actions.ec.europa.eu/news/msca-awards-eu417-million-to-postdoctoral-researchers
NSF (USA)	Research Grants (BIO Directorate)	FY 2024	**19%**	https://www.nsf.gov/bio/funding-rates
DFG (German Research Foundation)	Individual Research Grant (Einzelförderung) in the life sciences	2024	**30,3%**	https://www.dfg.de/de/aktuelles/zahlen-fakten/kennzahlen-portal/erfolgsquoten
Wellcome Trust (UK)	All Competitive Funding Schemes (aggregate)	2023/24	**13,6 % - 16,6 %**	https://wellcome.org/research-funding/funding-portfolio/funding-data-2023
NCI (National Cancer Institute, NIH)	Research Project Grants (RPGs)	FY 2024	**14%**	https://www.cancer.gov/about-nci/budget/fact-book/extramural-programs/rpg
BBSRC (UK)	Research Grants (Responsive Mode)	2023	**30%**	https://www.timeshighereducation.com/news/uk-research-council-success-rates-fall-budgets-tighten#:~:text=In%20the%20BBSRC%27s%20case%2C%20this%20was%20up,competitive%20grant%20bids%20were%20approved%20in%202022%2D23%2C
MRC (UK)	Research Grants	2022/23	**24%**	https://www.hinchilla.com/funder-directory/medical-research-council
JSPS (Japan)	KAKENHI	FY 2024	**27.3%**	https://www.jsps.go.jp/file/storage/kaken_award_2025/2-1_r6e.pdf
Canadian Institutes of Health (Canada)	Project Grants	2023	**~17%**	https://www.canada.ca/en/research-coordinating-committee/corporate/annual-progress-summary/annex-2.html
ARC (Australia)	Discovery Projects (Research Grants)	2024	**16.3%**	https://www.arc.gov.au/discovery-projects-selection-report-funding-commencing-2024

11.9 HFSP Top 10 Cluster from 2008 onwards Linked to Publications

Our software retrieves a numerical “fingerprint” for each document (HFSP-acknowledged publication), an embedding that reflects its underlying meaning. Based on these fingerprints, the system decides how many clusters make sense, or it uses the number specified by the user or tests multiple options and selects the one that best separates the documents into distinct groups.

Table 26: Top 10 clusters, publication count, citation count

The number of clusters is set (here set by the system to 10), the algorithm groups documents by similarity, assigning each one to the cluster whose central theme it most closely matches. The system then enriches each cluster by collecting titles and abstracts. Summaries per cluster are AI generated text summaries.

	Cluster	Summary	Publi-cati-ons	Citations
1	Wearable Technology and Material Engineering	The research cluster encompasses advancements in wearable technology, neurostimulation, and polymer engineering, focusing on enhancing human-computer interaction and material applications. Common themes include the development of innovative interfaces for accurate motion tracking and force feedback in virtual environments, as well as the integration of biological signals for real-time kinematic predictions. Methodologies often involve sophisticated modeling techniques, such as Gaussian processes and adaptive rendering frameworks, to improve user experience and device performance. Additionally, the exploration of biocompatible materials for neurostimulation and the evolution of polymer surface engineering in food packaging highlight the interdisciplinary nature of these studies, bridging engineering, neuroscience, and materials science.	1,816	81,704
2	Microbial Evolutionary Metabolic Ecology and Regulation	This research cluster explores the intersection of evolutionary biology, microbial ecology, and systems biology, focusing on the mechanisms driving metabolic strategies and regulatory evolution in microbial communities. Common themes include the use of comparative genomics and genome-scale metabolic models to understand gene regulation, metabolic interactions, and community dynamics. Methodologies such as experimental evolution, computational modeling, and evolutionary game theory are employed to investigate how environmental factors and metabolic interdependencies shape microbial diversity and adaptation. Overall, the studies aim to elucidate the complex relationships between genotype, phenotype, and ecological interactions within microbial ecosystems.	2,282	192,591
3	Cell Morphogenesis and Cytoskeleton Regulation	This research cluster explores the intricate dynamics of cytoskeletal organization and its critical role in cell morphology and function. Central themes include the mechanisms of self-organization within actin and microtubule networks, the interplay between mechanical forces and cellular architecture, and the regulatory pathways that govern these processes. Methodologies often involve experimental manipulation of spatial conditions, in vitro reconstructions, and quantitative analyses to elucidate how cells establish polarity, shape, and mechanical properties during morphogenesis. Overall, the	2,300	184,184

		studies contribute to a deeper understanding of the fundamental principles underlying cellular behavior and tissue development in various biological contexts.		
4	Chromatin Organization and Transcriptional Regulation	This research cluster explores the intricate mechanisms of gene regulation and chromatin organization in eukaryotic organisms, particularly focusing on developmental processes and genome integrity. Common themes include the role of transcription factors and enhancers in modulating transcriptional output, the interplay between chromatin structure and environmental factors, and the collaborative functions of heterochromatin proteins in silencing repetitive elements. Methodologies such as genome-scale binding maps and STARR-seq are employed to investigate enhancer cooperativity and chromatin domain organization. Overall, the studies contribute to a deeper understanding of how genetic and epigenetic factors coordinate to influence development and maintain genomic stability.	2,764	348,454
5	Neuronal Circuit Development and Function	This research cluster explores the intricate mechanisms of neural connectivity and signaling, particularly focusing on GABAergic inhibition and activity-dependent processes in various brain regions. Common themes include the role of sensory inputs and spontaneous activity in shaping neural circuits, the compartmentalization of inhibitory signals within dendritic structures, and the developmental origins of interneuron microcircuits. Methodologies such as two-photon calcium imaging and genetic manipulation are frequently employed to investigate the dynamics of synaptic interactions and the organization of neural networks. Overall, the studies contribute to a deeper understanding of how neural activity influences the formation and refinement of functional brain circuits.	2,317	257,126
6	Membrane Protein Biogenesis and Engineering	This research cluster explores the intricate processes of membrane protein biogenesis, focusing on the mechanisms of insertion, folding, and topology of diverse membrane proteins. Common themes include the role of specific protein complexes, such as the Sec-complex and the ER membrane protein complex, in facilitating the correct assembly of polytopic and nonribosomal peptide proteins. Methodologies employed range from cryo-electron microscopy to genetic screening and structural analysis, revealing dynamic interactions and evolutionary insights that inform our understanding of protein functionality and engineering potential. Overall, the cluster emphasizes the complexity and adaptability of membrane protein systems in cellular environments.	3,030	246,468
7	Evolutionary mechanisms in animal sensory systems	This research cluster explores the intricate relationships between sensory perception, coloration, and cognitive evolution in various insect and avian species. Central themes include the mechanisms of visual and mechanosensory systems, the evolutionary dynamics of coloration and ornamentation, and the neural architecture underlying learning and memory. Methodologies frequently employed involve comparative analyses, visual modeling, and neuroanatomical studies, aiming to understand how sensory adaptations influence behavior and ecological interactions. Overall, the cluster emphasizes the interplay between evolutionary pressures and sensory system development, shedding light on how these factors shape species recognition, communication, and cognitive abilities in diverse taxa.	1,416	58,713
8	Visual Perception and Neural Processing in Primates	This research cluster explores the intricate relationships between sensory processing, cognitive functions, and motor actions in primates, particularly focusing on visual and somatosensory systems. Common themes include the modulation of neural responses by spatial context, attention, and active navigation, highlighting how these factors influence perceptual learning and decision-making. Methodologies often involve single-neuron recordings and behavioral tasks to assess neural dynamics during natural movements. The studies collectively emphasize the importance of integrating sensory evidence over time and the role of top-down influences in shaping perceptual experiences, contributing to a deeper understanding of cognitive neurophysiology.	1,884	158,935

9	Cell Signaling in Stem Cell Regulation	This research cluster explores the intricate signaling pathways that govern stem cell behavior, tissue homeostasis, and immune responses across various biological systems. Central themes include the regulation of stem cell proliferation and differentiation, the role of specific signaling pathways such as Hippo and Toll-like receptors, and the metabolic adaptations of immune cells during activation. Methodologies frequently employed include gene expression profiling, RNA interference screens, and systematic perturbation techniques, which collectively aim to uncover the molecular mechanisms underlying development, regeneration, and tumorigenesis. The findings contribute to a deeper understanding of cellular interactions within their microenvironments and potential therapeutic targets for diseases.	2,046	329,788
10	Super-Resolution Imaging and Biological Visualization	This research cluster focuses on advanced imaging techniques in cellular biology, particularly emphasizing super-resolution microscopy and genetically encoded materials for non-invasive imaging. Common themes include the exploration of molecular interactions, cellular architecture, and dynamic processes within living organisms. The methodologies employed often involve innovative imaging strategies, such as multiplexed super-resolution and proximity-dependent techniques, which enhance spatial resolution and allow for the visualization of multiple targets simultaneously. Overall, the studies aim to deepen our understanding of cellular functions and interactions at the nanoscale, contributing to the broader fields of biophysics and molecular biology.	2,476	242,670

Source: Dimensions database.

Figure 42: Heat map – Assignment of disciplines to clusters (numbers represent publications acknowledging HFSP)

	Biological Sciences	Biomedical and Clinical Sciences	Psychology	Chemical Sciences	Engineering	Physical Sciences	Information and Computing Sciences	Health Sciences	Human Society	Environmental Sciences	Earth Sciences	Mathematical Sciences	Agricultural, Veterinary and Food Sciences
Wearable Technology and Material Engineering	185	342	58	350	556	121	292	107	93	38	54	49	33
Visual Perception and Neural Processing in Primates	172	1,007	836	2	43	120	336	112	7	2	1	32	9
Super-Resolution Imaging and Biological Visualization	1,073	303	14	736	582	476	110	10	4	5	36	11	4
Evolutionary mechanisms in animal sensory systems	1,141	231	53	27	77	33	49	32	5	89	38	19	45
Cell Signaling in Stem Cell Regulation	1,106	1,348	29	66	43	4	1	18	1	3	1	21	
Neuronal Circuit Development and Function	719	1,838	376	24	52	65	127	11	1		6	1	
Cell Morphogenesis and Cytoskeleton Regulation	1,920	234	19	73	289	203	16	14	5	5	53	8	2
Microbial Evolutionary Metabolic Ecology and Regulation	2,063	281	6	54	38	42	49	9	14	63	32	42	42
Membrane Protein Biogenesis and Engineering	2,407	355	12	590	87	137	7	7		3	4	9	22
Chromatin Organization and Transcriptional Regulation	2,596	496	19	26	7	25	4	3	1	7	1	4	41

Source: Dimensions database.

11.10 Select Citation Performance of Top 10 Cluster

Table 27: Cluster (10) Super-resolution imaging and biological Visualization

	Discipline (FoR)	Unique Publications	Unique Publications in Top 10% FCR	share per FoR
1	Biological Sciences	1,131	190	16.80%
2	Chemical Sciences	846	107	12.65%
3	Engineering	625	124	19.84%
4	Physical Sciences	485	120	24.74%
5	Biomedical and Clinical Sciences	312	91	29.17%
6	Information and Computing Sciences	113	21	18.58%
7	Mathematical Sciences	41	9	21.95%
8	Psychology	14	9	64.29%

Table 28: Cluster 9 Cell Signalling in Stem Cell

Discipline (FoR)	Unique Publications	Unique Publications in Top 10% FCR	share per FoR
Biomedical and Clinical Sciences	1,618	625	38.63%
Biological Sciences	1,163	438	37.66%
Chemical Sciences	68	18	26.47%
Engineering	44	15	34.09%
Psychology	29	12	41.38%

Source: Dimensions database.

11.11 Novel Concepts: Conceptual Themes in HFSP-funded Frontier Research

While disciplinary mix and cluster structure capture the organization of HFSP-supported research, conceptual analysis reveals how HFSP advances scientific frontiers at the level of explanation. A concept-based analysis of HFSP publications, compared with a large sample of global basic biological and biomedical research, identifies areas where HFSP-supported work diverges in how scientific problems are framed rather than simply which topics are studied.

This analysis is based on:

- Shibayama, S., Yin, D., & Matsumoto, K. (2021). Measuring novelty in science with word embedding. PLOS ONE, 16(7), Article e0254034.

- Yin, D., Wu, Z., Yokota, K., Matsumoto, K., & Shibayama, S. (2023). Identify novel elements of knowledge with word embedding. PLOS ONE, 18(6), Article e0284567.

The main body of the report highlights the concept analysis for recent years (2020-2024). Across the entire span of the evaluation period (2000-2024) four major conceptual frontiers emerge for publications (the text summary for the four main groupings were AI generated): First, precision systems neuroscience reflects a shift from static circuit descriptions toward dynamic, state-dependent models of neural function that integrate physiology, metabolism, and temporal context. Second, physical and developmental morphogenesis highlights work that combines developmental genetics, biophysics, and imaging to explain how tissues and organs form through mechanical and dynamical processes. Third, foundational mechanisms of cellular regulation capture research that re-examines gene regulation, signaling, proteostasis, and cell-cycle control as integrated decision-making systems rather than modular pathways. Finally, adaptive immunity and host–microbial interactions encompass mechanistic studies of immune regulation and host–pathogen dynamics that link molecular processes with system-level behavior.

Table 29: Comparison of individual themes in HFSP publications (by volume) in comparison to a large sample (10%) of global basic biological and biomedical research publications

Theme	HFSP volume	Comparison sample volume
Protein expression & proteostasis	95	312
B-cell differentiation & immune function	162	210
Mesenchymal differentiation & morphogenesis	76	152
Signaling pathways & molecular cascades	918	1,293
Regulatory elements & transcriptional control	1,270	834
Signaling mechanisms	918	1,293
Epithelial morphogenesis & tissue folding	95	106
Stress response mechanisms	482	848
Cell division, growth & surface dynamics	3,100	1,948
Programmed cell death	397	856
Model cell systems & assays	159	685
Cell cycle control	464	336

Source: Dimensions database.

11.12 Multidisciplinary Publication Patterns

Table 30: Research supported by only HFSP and research supported by HFSP and other Funders in multidisciplinary journals

This table compares HFSP's presence in multidisciplinary journals with that of major international funders and examines how HFSP influences publication placement. HFSP-supported basic science displays some of the highest multidisciplinary shares globally, while publications supported by HFSP and other funders show substantially elevated rates compared with the partner funders' stand-alone profiles – highlighting HFSP's distinctive role in driving broad, integrative, and conceptually wide-reaching research.

Funder	HFSP	ERC	NIH	NCI	Wellcome Trust	BBSRC	MRC	DFG	JSPS	NSERC	ARC	CNRS	NHMRC
Nr Publications (2008-2023)	15945	294090	107400	444422	166233	104780	229436	520669	848542	320431	190225	146886	108592
Nr Publications (Basic Science)	8836	48853	38453	183458	60334	43104	69944	95747	135923	32822	16652	27178	33327
Publication (Basic Science) in Multidisciplinary journals	957	4085	2802	15197	5079	3499	5715	7825	12226	2448	1396	2611	2696
multidisp % (Basic Science)	10.83%	8.36%	7.29%	8.28%	8.42%	8.12%	8.17%	8.17%	8.99%	7.46%	8.38%	9.61%	8.09%
Publication (all) in Multidisciplinary journals	1639	13593	4911	23056	11149	7131	13090	20667	31297	8822	6159	6091	5406
Multidisc %	10.28%	4.62%	4.57%	5.19%	6.71%	6.81%	5.71%	3.97%	3.69%	2.75%	3.24%	4.15%	4.98%

Funder with HFSP "co-funding"*	HFSP (only)	HFSP + ERC	HFSP + NIH	HFSP + NCI	HFSP + Wellcome	HFSP + BBSRC	HFSP + MRC	HFSP + DFG	HFSP + JSPS	HFSP + NSERC	HFSP + ARC	HFSP + CNRS	HFSP + NHMRC
Nr Publications (2008-2023)	839	2529	334	950	1053	734	912	1716	1200	457	348	782	340
Nr Publications (Basic Science)	256	1526	231	730	701	420	631	1019	773	218	177	480	241
Publication (Basic Science) in Multidisciplinary journals	19	140	27	89	73	51	74	100	95	13	16	49	27
multidisp % (Basic Science)	7.42%	9.17%	11.69%	12.19%	10.41%	12.14%	11.73%	9.81%	12.29%	5.96%	9.04%	10.21%	11.20%
Publication (all) in Multidisciplinary journals	54	231	41	108	112	92	104	180	146	32	26	79	33
Multidisc %	6.44%	9.13%	12.28%	11.37%	10.64%	12.53%	11.40%	10.49%	12.17%	7.00%	7.47%	10.10%	9.71%

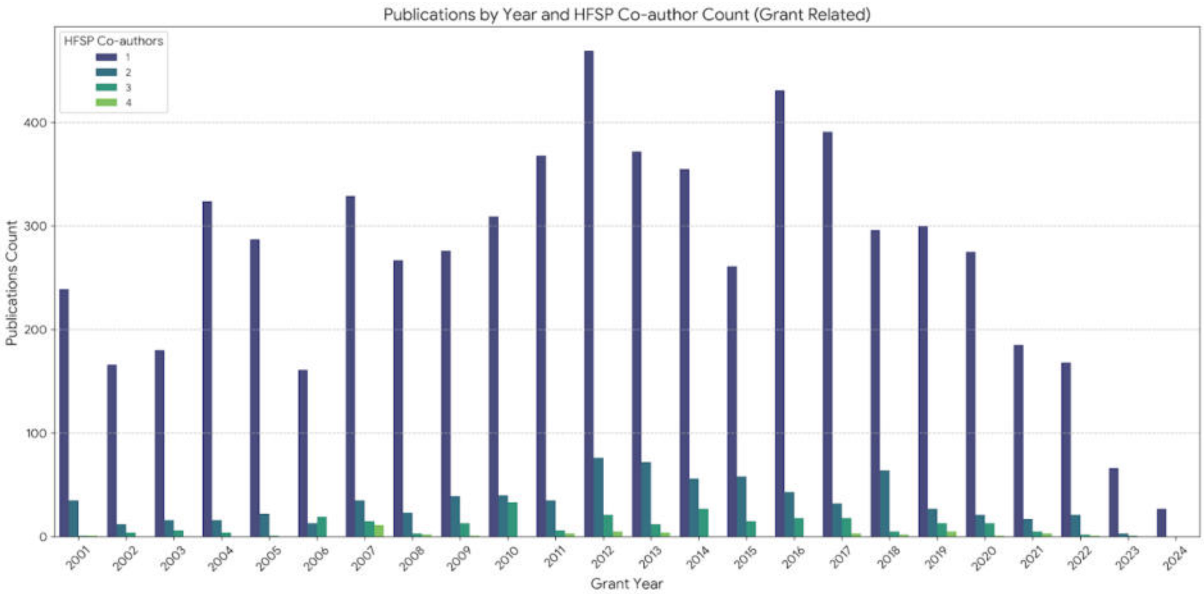
Source: Dimensions Database

*Co-funding in this context means publications that draw on research funded by several funders.

11.13 Collaboration Pattern within the HFSP Community

Figure 43: Grant-related Publications (by year and HFSP co-author count)

Grant-related publications show strong internal collaboration, with outputs involving multiple HFSP co-authors. This indicates cohesive, jointly executed research within HFSP teams throughout the grant period.



Source: Dimension Database

11.14 Performance of HFSP funded Publications (2008 -2023) by Discipline (Field of Research).

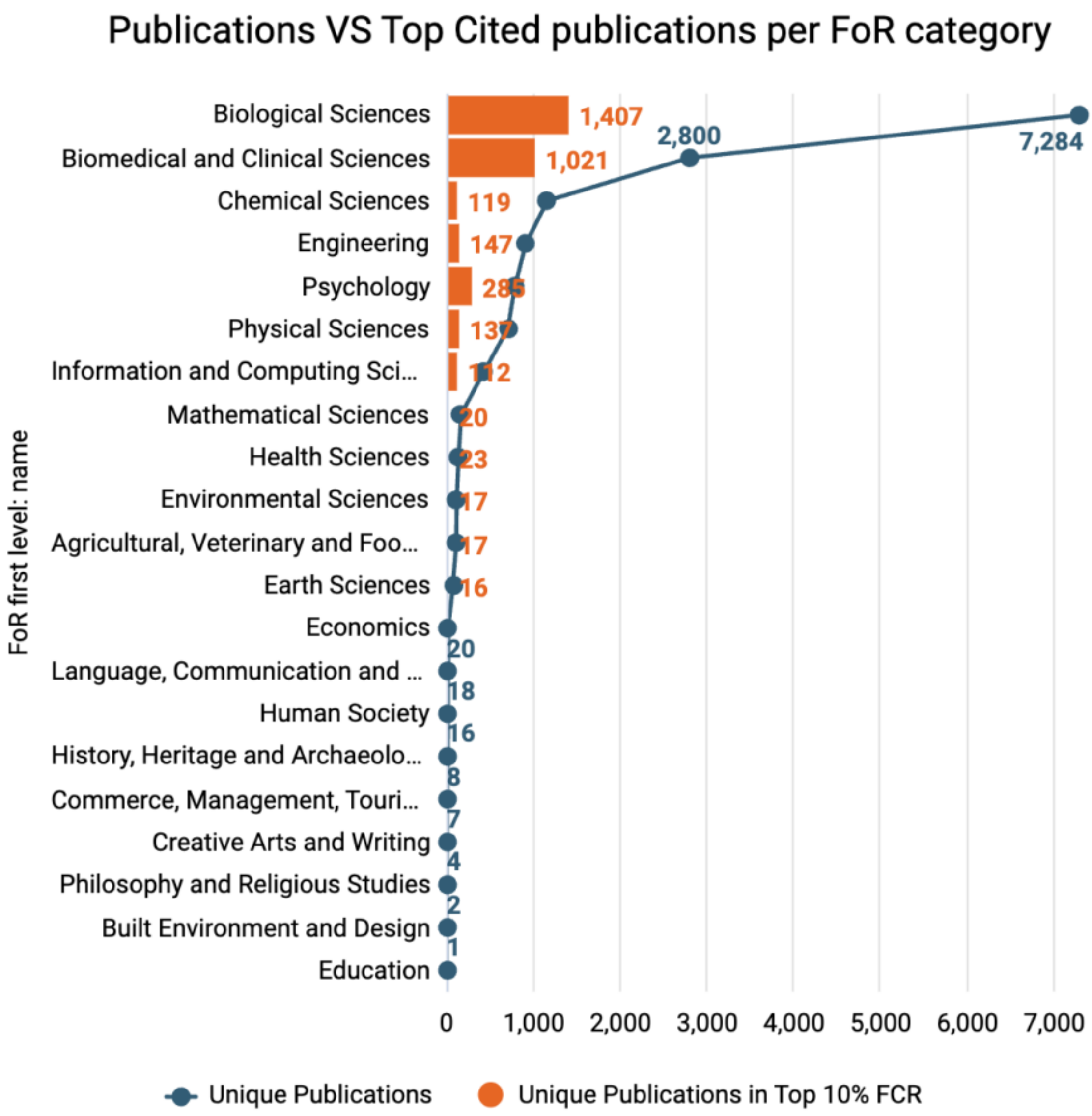
The citation performances of individual HFSP award programs

Table 31: Performance by discipline for Research Grant Program (RGP and RGEC)

	FoR first level: name	Unique Publications	Unique Publications in Top 10% FCR
1	Biological Sciences	7,286	1,409
2	Biomedical and Clinical Sciences	2,802	1,021
3	Chemical Sciences	1,165	122
4	Engineering	917	145
5	Psychology	790	285
6	Physical Sciences	707	137
7	Information and Computing Sciences	432	112
8	Mathematical Sciences	169	19
9	Health Sciences	139	24
10	Environmental Sciences	119	18
11	Agricultural, Veterinary and Food Sciences	112	17
12	Earth Sciences	74	17
13	Economics	21	8
14	Language, Communication and Culture	20	10
15	Human Society	18	6
16	History, Heritage and Archaeology	16	6
17	Commerce, Management, Tourism and Services	8	5
18	Creative Arts and Writing	7	3
19	Philosophy and Religious Studies	4	1
20	Built Environment and Design	2	1
21	Education	1	1

Source: Dimension Database

Figure 44: Performance by discipline for Research Grant Program (RGP and RGEC)



Source: Dimensions Database.

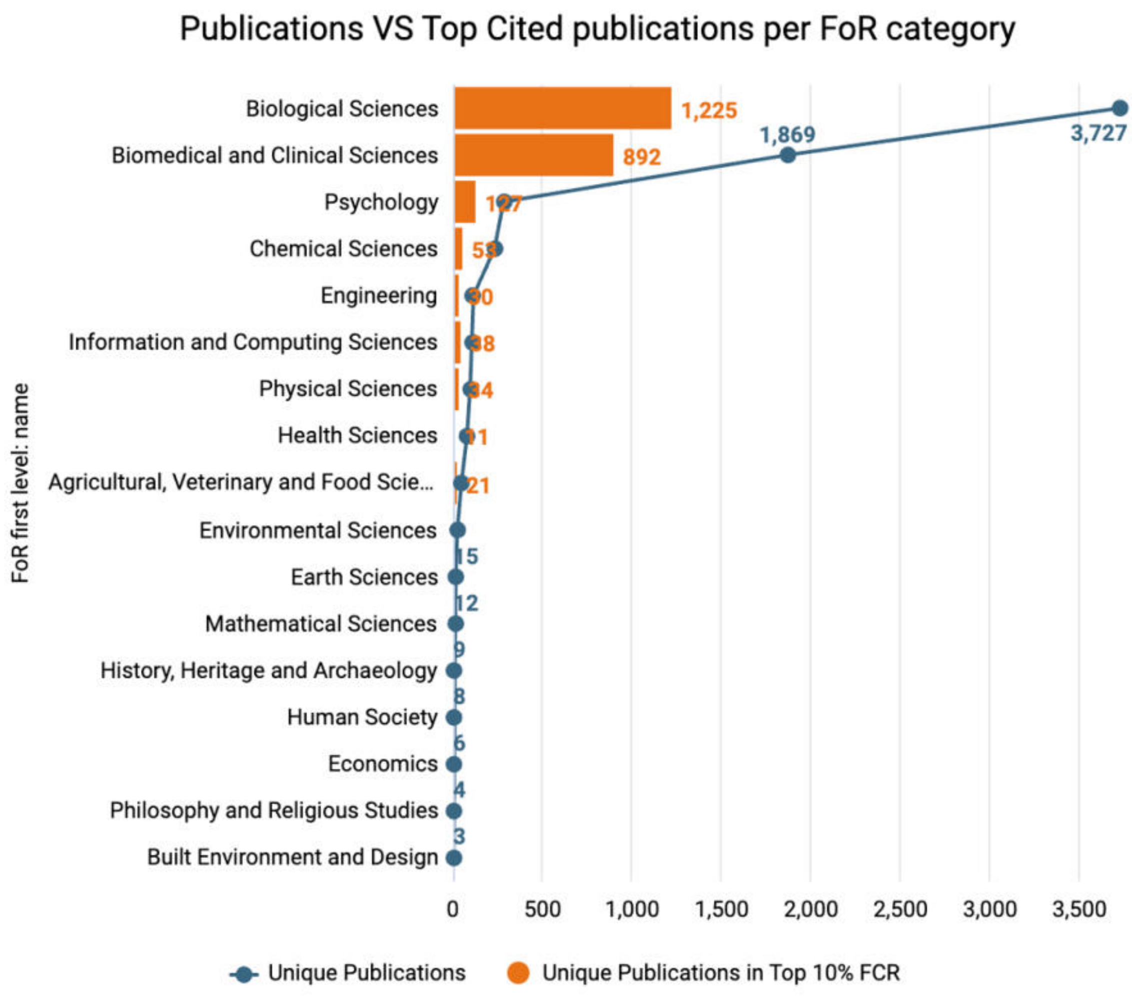
Table 32: Performance by discipline for Long-Term Fellowships

	FoR first level: name	Unique Publications	Unique Publications in Top 10% FCR
1	Biological Sciences	3,727	1,225
2	Biomedical and Clinical Sciences	1,869	892
3	Psychology	282	127
4	Chemical Sciences	232	53

5	Engineering	114	30
6	Information and Computing Sciences	105	38
7	Physical Sciences	95	34
8	Health Sciences	78	11
9	Agricultural, Veterinary and Food Sciences	47	21
10	Environmental Sciences	24	2
11	Earth Sciences	15	5
12	Mathematical Sciences	12	2
13	History, Heritage and Archaeology	9	4
14	Human Society	8	5
15	Economics	6	2
16	Philosophy and Religious Studies	4	1
17	Built Environment and Design	3	2

Source: Dimension Database

Figure 45: Performance by discipline for Longterm Fellowships



Source: Dimensions Database.

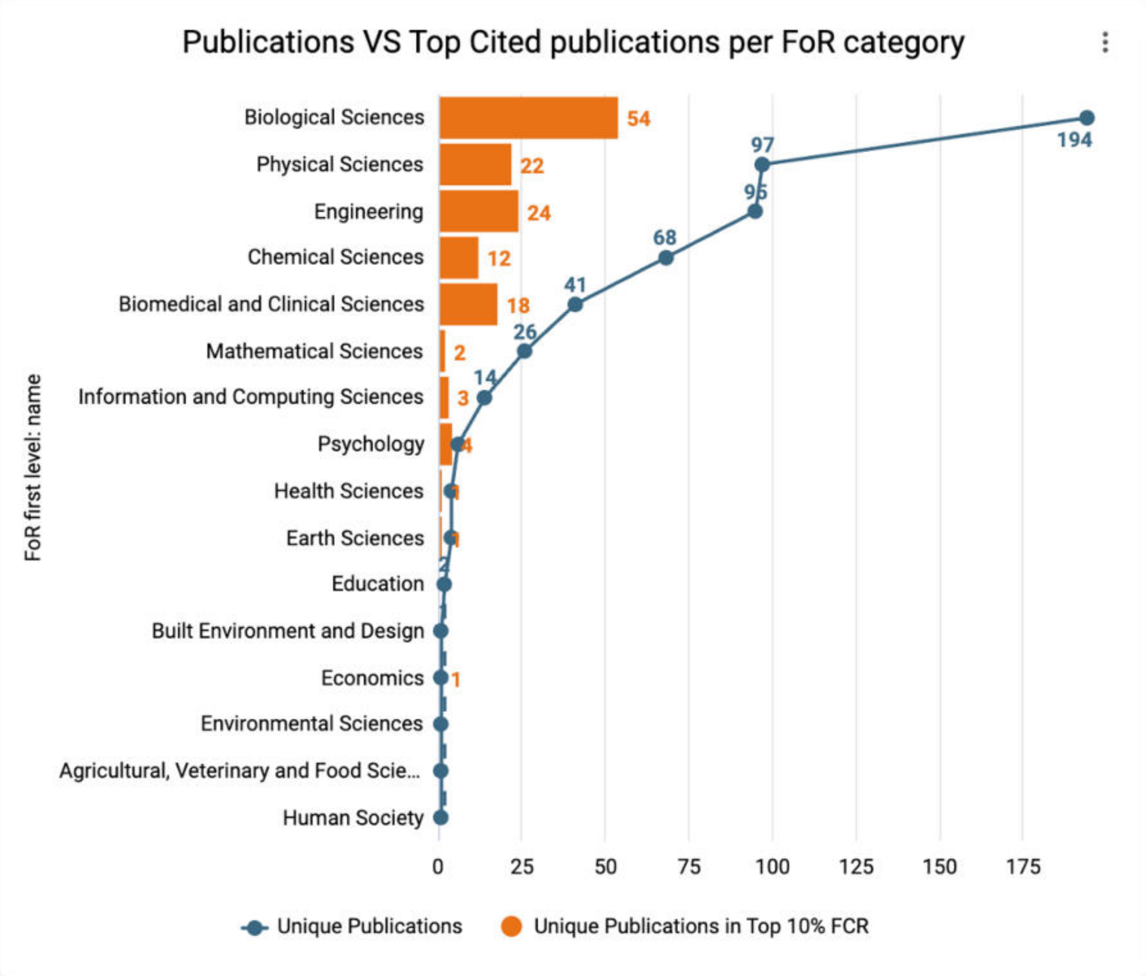
Table 33: Performance by discipline for Cross-Disciplinary Fellowships

	FoR first level: name	Unique Publications	Unique Publications in Top 10% FCR
1	Biological Sciences	194	54
2	Physical Sciences	97	22
3	Engineering	95	24
4	Chemical Sciences	68	12
5	Biomedical and Clinical Sciences	41	18
6	Mathematical Sciences	26	2
7	Information and Computing Sciences	14	3

8	Psychology	6	4
9	Health Sciences	4	1
10	Earth Sciences	4	1
11	Education	2	0
12	Built Environment and Design	1	0
13	Economics	1	1
14	Environmental Sciences	1	0
15	Agricultural, Veterinary and Food Sciences	1	0
16	Human Society	1	0

Source: Dimension Database

Figure 46: Performance by discipline for Cross-Disciplinary Fellowships



Source: Dimensions Database.

11.15 Retraction Patterns for HFSP Programs

To complement the portfolio-level analysis of retractions, this annex examines retraction patterns within HFSP award programs using researcher-linked publication data. The analysis compares retraction rates across award types and distinguishes between retractions occurring before and after receiving HFSP support.

Across publications directly linked to HFSP-supported researchers (11,474 outputs), only one retraction was identified (0.01%), substantially lower than the retraction rate observed in the broader HFSP-acknowledged publication set (0.05%) and below commonly reported global benchmarks. This difference suggests that researcher-linked data provides a more precise signal of HFSP-associated research outputs than acknowledgement-based attribution, which may include publications where HFSP support was indirect or peripheral.

Table 34: Retraction rates of different HFSP programs

Retracted publications per Award type (indicated 'linked' in each case) from 2001-2024.

	Publication Years 2001-2024				
Funder	Re-tracted	Publications	share	Pre-Award retractions	Post-Award retractions
HFSP Acknowledged	11	22028	0.05%	n.a.	n.a.
HFSP (Researcher Linked)	1	11474	0.01%	0.05%	0.04%
Long-term Fellowship	0	2663	0.00%	2.29%	0.12%
Cross-Disciplinary Fellowship	0	448	0.00%	0.14%	0.02%
Research Grant Program	1	5585	0.02%	0.04%	0.04%
Research Grant Early Career	0	2131	0.00%	0.05%	0.02%
Career Development Award	0	647	0.00%	0.22%	0.08%

Source: Dimensions database

Across all HFSP programs, no increase in retraction rates is observed following receipt of HFSP funding. Post-award retraction rates remain stable or decline across funding streams, with fellowship programs in particular showing lower post-award retraction rates compared with pre-award periods. Taken together, these patterns indicate that HFSP support does not amplify integrity risks associated with high-risk or frontier research and may be associated with stable or improved research integrity outcomes, especially among early-career researchers.

11.16 Top 10 assignee organizations sorted by number of citing patents for CDF, LTF and RG

Table 35: Top 10 assignee organizations sorted by number of citing patents for CDF

Name	Citing patents	Cited Publications
10X Genomics Inc	189	2
Arvinas Operations Inc	58	1
Harvard University	50	4
Bio Rad Laboratories Inc	36	1
C4 Therapeutics Inc	32	1
California Institute of Technology	25	12
Yale University	24	2
Dana Farber Cancer Institute Inc	24	2
Miroculus Inc	21	1

Source: Dimensions database.

Table 36: Top 10 assignee organizations sorted by number of citing patents for LTF

Name	Citing patents	Cited Publications
Massachusetts Institute of Technology	494	143
Harvard University	462	105
Broad Institute	418	103
University of California, San Diego	292	118
10X Genomics Inc	250	16
Stanford University	244	83
Massachusetts General Hospital	202	82
Inserm	157	110
French National Centre for Scientific Research	107	86

Source: Dimensions database.

Table 37: Top 10 assignee organizations sorted by number of citing patents for Research Grants

Name	Citing patents	Cited Publications
10X Genomics Inc	286	16
Harvard University	275	70
Massachusetts Institute of Technology	213	103

University of California, San Diego	192	86
Stanford University	166	47
California Institute of Technology	163	59
French National Centre for Scientific Research	135	65
Bio Rad Laboratories Inc	120	6
Inserm	105	63

Source: Dimensions database.

11.17 International Collaborations – Methodology: Relative Collaboration Benefit Index

The analysis of international collaboration patterns uses HFSP awardee and publication data. Each publication linked to an HFSP Grantee or Fellow was classified by phase relative to the award start year: five years before, during, and after funding. All collaborations were treated as multilateral networks rather than pairwise links, meaning that each publication contributed one hyperedge connecting all participating countries.

From this structure we derived, for each country:

1. Total collaboration participation: number of publications involving that country.
2. Average team size: average number of countries per collaboration.
3. Global share: that country's share of total HFSP-linked collaborations.
4. Relative Collaboration Benefit Index (RCBI): proportional growth in participation (post vs. pre).
5. Benefit Index: a composite metric combining proportional (RCBI) and absolute (share) growth, expressing each country's overall collaboration gain.

Countries were grouped into six geographic regions based on HFSP membership (Africa, Asia-Pacific, Europe, Latin America, and North America). We focus on HFSP member states.

Table 38: International collaboration by HFSP research program per award year. Pre, during, post award avg numbers of collaborating countries (by linked publication to award)

	Career Development Award			Cross-Disciplinary Fellowship			Long-Term Fellowship			Research Grant (Early Career)			Research Grant (Program)		
Grant Year	pre-grant	grant-related	post-grant unrelated	pre-grant	grant-related	post-grant unrelated	pre-grant	grant-related	post-grant unrelated	pre-grant	grant-related	post-grant unrelated	pre-grant	grant-related	post-grant unrelated
2001							1.26	1.94	1.93	1.28	2.16	1.89	1.28	2.13	1.84
2002							1.3	2.08	1.81	1.27	2.73	1.96	1.34	2.04	1.81
2003	1.43	2.14	1.27				1.39	1.98	1.8	1.43	1.83	1.8	1.28	2.08	1.71

2004	1.34	1.46	1.93				1.39	1.74	1.97	1.43	2.02	1.53	1.36	1.94	1.72
2005	1.26	2.04	1.68	1.2	1.66	1.57	1.37	1.83	1.91	1.4	2.04	1.73	1.36	2.05	1.81
2006	1.58	2.03	1.96	1.22	1.57	1.59	1.29	1.75	1.9	1.37	1.83	1.74	1.39	2.09	2.14
2007	1.4	1.75	1.93	1.41	1.6	1.9	1.41	1.85	1.98	1.46	2.38	1.9	1.37	2.12	1.87
2008	1.49	1.92	1.86	1.29	1.71	1.88	1.48	1.82	2.13	1.35	1.88	1.98	1.36	2.09	1.94
2009	1.31	1.66	1.72	1.56	1.21	1.47	1.55	1.79	1.94	1.49	2.24	1.74	1.35	1.91	1.66
2010	1.42	1.78	1.97	1.42	1.57	1.56	1.46	2.01	2.03	1.48	2.12	1.8	1.36	1.95	1.78
2011	1.36	1.83	2.06	1.47	2.09	1.92	1.63	2	2.15	1.61	2.36	2.04	1.38	2.06	2
2012	1.77	1.94	2.38	1.13	2	1.68	1.64	1.94	2.12	1.64	2.55	2.08	1.52	2.07	2.03
2013	1.64	1.64	2.96	1.56	2.15	2.08	1.49	1.84	1.81	1.41	2.26	1.76	1.48	2.13	1.93
2014	1.55	1.61	2.04	1.27	1.95	1.86	1.77	2.35	2.15	1.55	2.19	2.26	1.51	2.24	2
2015	1.66	2.09	2.07	1.25	1.94	1.76	1.58	1.85	2.06	1.63	2.08	1.75	1.51	2.21	2.1
2016	1.64	1.59	1.72	1.65	1.82	2.38	1.92	2.09	2.5	1.6	2	2	1.49	2.2	2.23
2017	1.54	1.93	1.85	1.41	1.73	1.67	1.65	2.12	2.06	1.95	2.32	2.31	1.55	2.31	1.94
2018	1.65	1.78	2.52	1.58	2.08	1.74	1.77	1.99	2.2	1.81	1.83	2.06	1.61	2.02	2.13
2019	1.8	1.82	1.97	1.55	2.38	2.08	1.91	2.05	2.17	1.87	2.28	2.15	1.68	2.78	2.17
2020				31.91	2.01	2.45	1.76	2.01	2.08	1.77	2.02	2.02	1.62	2.71	2.17
2021				1.58	1.76	2.04	2.2	2.08	2.37	1.98	2.38	2.06	1.73	2.48	2.08
2022				1.82	1.92	1.9	2	2.4	2.56				1.9	2.34	2.43
2023				2.33	1.6	2.33	1.79	2.61	2.19	1.87	2.75	2.14	1.8	2.31	2.26

2024	1.47	1.38	1.9	1.83	2.5	2.8	2	3.19	1.97	2.19	2.41

Source: Dimension Database

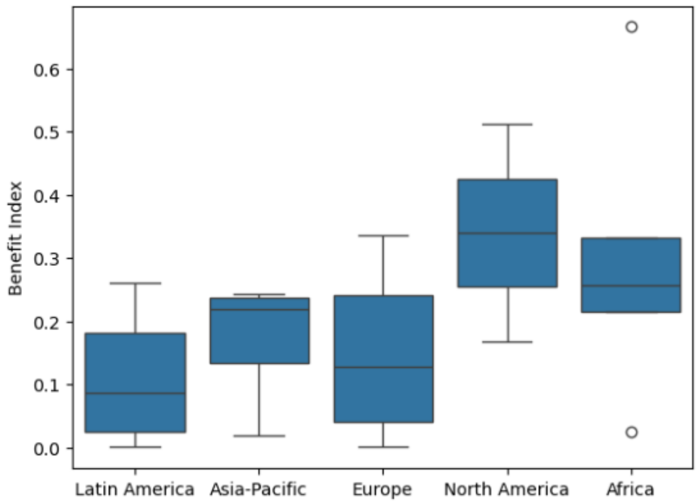
This analysis examines the evolution of interdisciplinary research (IDR) across the various HFSP Fellowship schemes. Unlike earlier quantitative analyses that were focused and limited to HFSP-acknowledged outputs, this study incorporates all publications by HFSP-affiliated researchers – both before and after the award – to capture the broader trajectory of their interdisciplinary engagement.

11.18 Benefit Index

This index combines two complementary dimensions of change in a country's HFSP-linked collaboration activity: proportional growth relative to its own pre-award baseline, and absolute growth in the total number of collaborative publications. This approach captures both the scale and the sustainability of network expansion. A high value can therefore indicate either (or both) a significant relative increase for countries with initially small collaborative footprints, or a substantial real increase in volume for countries already well embedded in global networks.

In practical terms, a Benefit Index of 0.51 – as observed for United States – means that HFSP involvement led to a dramatic expansion in that country's international research engagement. Collaboration activity increased strongly relative to its starting point and remained elevated after the funding period, indicating a durable integration into HFSP-supported global research networks. Lower but still notable values (e.g., 0.30–0.50) reflect meaningful growth either in relative or absolute terms, depending on the country's baseline. The Benefit Index therefore provides a robust summary measure of how much HFSP participation enhances a country's international scientific connectivity over time.

Figure 47: Distribution of Benefit Index by Region



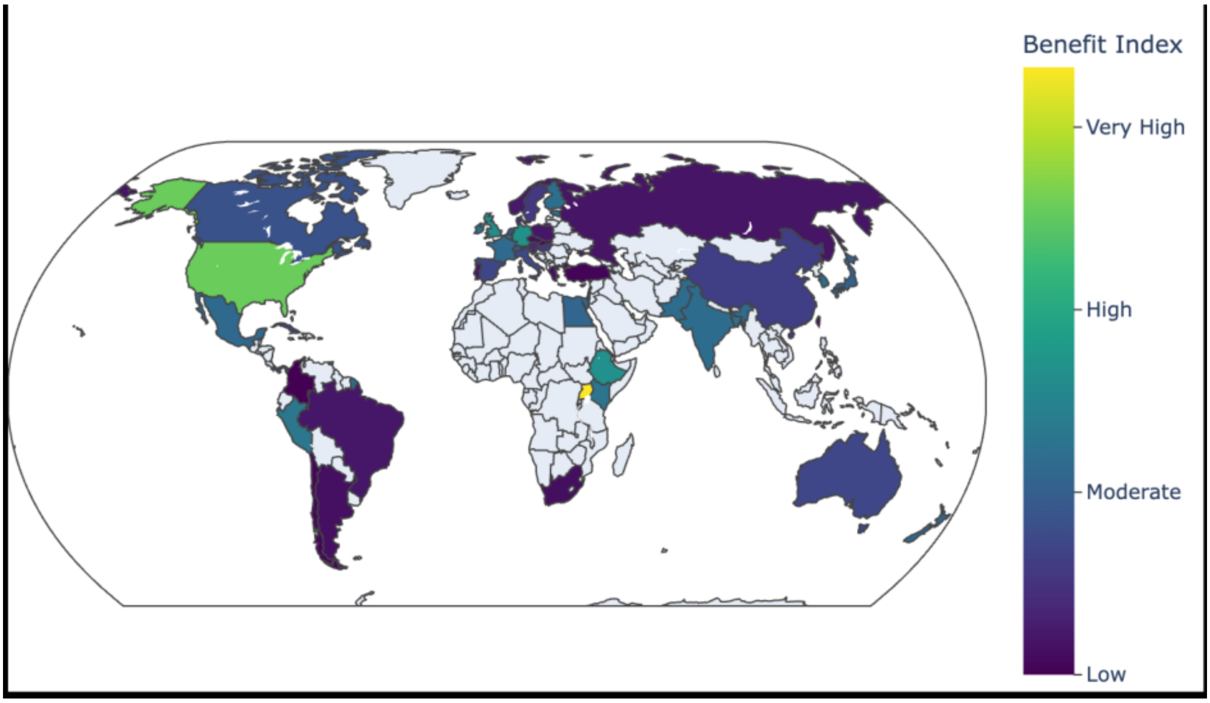
Source: Digital Science based on Dimensions database and HFSP data.

This figure illustrates regional differences in collaboration gains under HFSP. North America shows the strongest absolute increases, while Africa demonstrates the highest proportional growth driven by emerging participants. Europe and the Asia–Pacific region reflect steady, mature engagement, and Latin America shows limited but developing integration. Taken together, these patterns confirm HFSP's dual achievement: reinforcing established scientific hubs while broadening participation among smaller or emerging research systems. This balance of excellence and inclusivity underpins HFSP's unique value proposition, sustaining the global research core while extending access to frontier science across regions.

The following geomap visualizes the Benefit Index for HFSP-linked international collaborations, highlighting where countries experience the strongest proportional and absolute gains based on HFSP funding.

Figure 48: Visualization of the HFSP Collaboration Benefit Index by Country

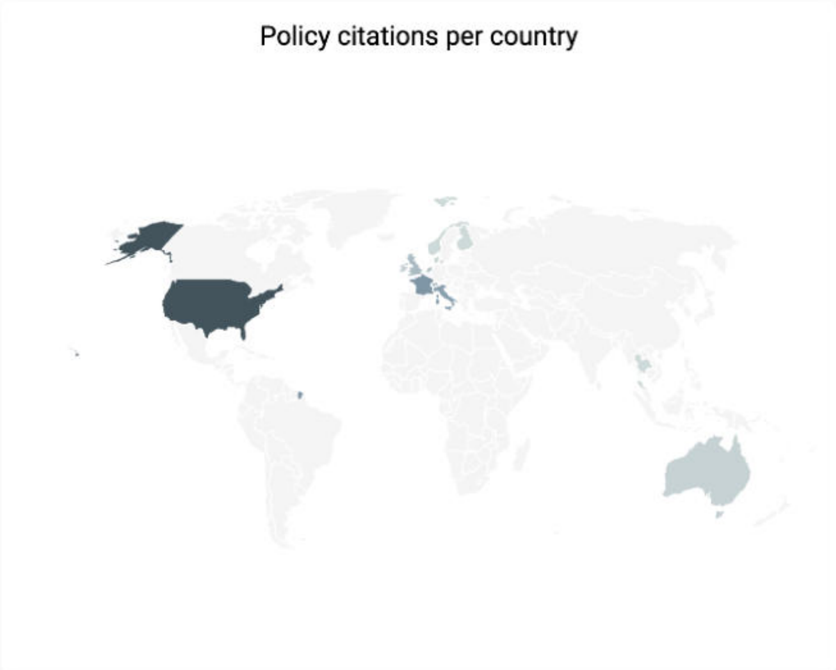
The geomap visualizes the Benefit Index for HFSP-linked international collaborations, highlighting where countries experience the strongest proportional and absolute gains based on HFSP funding. Lighter (greenish/yellow) shades indicate deeper integration into HFSP's global research network, with notable concentrations of benefit in North America, emerging African research systems, and selected large and mid-sized European and Asia–Pacific countries. The map illustrates how HFSP strengthens established scientific hubs while simultaneously enabling newer or smaller systems to enter and participate in frontier research collaborations.



Source: Digital Science based on dimensions database and HFSP data.

11.19 Policy Citation Data for Publications by the Long-term Fellowships

Figure 49: Policy citation data (2008 onwards) for publications by the Long-term Fellowships. Geographic spread, country details, top publishing organizations and type of organization in an overview



Country details

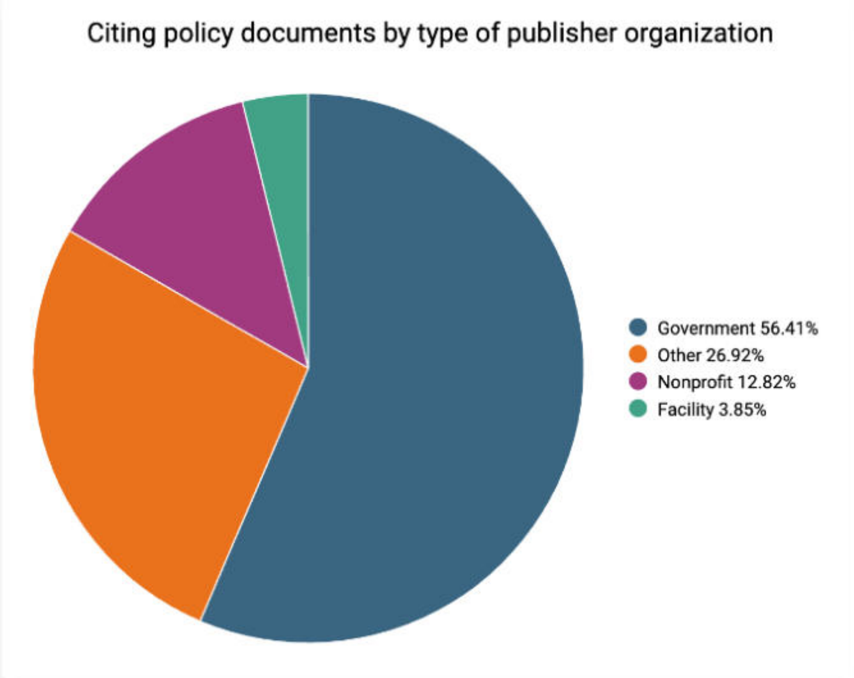
	Publisher country	Policy documents	Cited publications	Researchers
1	United States	26	28	298
2	France	13	7	52
3	Italy	10	8	120
4	Luxembourg	7	5	43
5	Switzerland	5	6	73
6	United Kingdom	5	5	92
7	Netherlands	4	4	45
8	Australia	2	2	81
9	Ireland	2	1	2
10	Thailand	1	1	20
11	Finland	1	1	13
12	Denmark	1	1	2
13	Norway	1	1	18

Policy citations per country. The map shows the number of policy documents citing publications by country of the document's publishing organization.

Country details. The table provides additional details on cited publications and researchers at the country level.

Top publishing organizations

	Organization	Policy documents	Cited publications
1	**National Academies Press** United States	18	21
2	**Organisation For Economic Co-Operation and Development** France	13	7
3	**Food and Agriculture Organization of the United Nations** Italy	9	7
4	**Publications Office of the European Union** Luxembourg	7	5
5	**World Health Organization** Switzerland	4	4
6	**UK Government** United Kingdom	3	3
7	**National Institute for Public**	3	3



Top publishing organizations by citing policy documents. The table provides an overview of the top organizations that have published policy documents citing the publications in the result set.

Citing policy documents by type of publisher organization. The pie chart shows the percentage of resulting policy documents published by the type of organization.

Source: Dimensions database.

11.20 Follow-on Funding

An analysis of HFSP awardees' subsequent funding trajectories reveals a strong pattern of continued research success and sustained international engagement. 1,450 HFSP-supported researchers (Fellows and Grantees) were identified in the Dimensions database with follow-on funding and each recipient secured, on average, 1.5 follow-on grants (full award metadata in the Dimensions database, hence excluding publication based on funding acknowledgements). This demonstrates that success in HFSP awards serves as a catalyst for further competitive funding. This multiplier effect highlights the program's effectiveness in strengthening research capacity and credibility that translates into long-term sustainability.

The follow-on ecosystem spans 136 distinct funders, dominated by national and international public research agencies. The top five include the Japan Society for the Promotion of Science (JSPS), Deutsche Forschungsgemeinschaft (DFG), the International Human Frontier Science Program Organization (HFSPO) itself, the Directorate for Biological Sciences (US NSF), and the Canadian Institutes of Health Research (CIHR) reflecting both the global reach and reputation of HFSP as well as past HFSP awardees can claim success in winning HFSP follow-on funding.

11.21 ERC Success among HFSP-supported Researchers

Table 39: ERC grant success among HFSP-supported researchers.

The table reports HFSP alumni who later secured ERC Advanced, Consolidator, or Synergy Grants. In total, 64 HFSP-supported researchers obtained ERC support, with Program Grants contributing the largest share. Long-Term Fellowships and Early-Career Grants also show strong conversion rates, and even smaller schemes yield ERC awardees – highlighting HFSP's effectiveness in cultivating high-potential scientific leaders.

SUM of n_erc_pis	**erc_program**			
Grant Program	Advanced grant	Consolidator Grant	Synergy Grant	Grand Total
Career Development Award	5	5	2	12
Cross-Disciplinary Fellowship		1		1
Long-Term Fellowship	1	7	7	15
Research Grant (Early Career)		4	6	10
Research Grant (Program)		2	24	26
Grand Total	6	19	39	64

Data: Dimensions and HFSP data

Table 40: Time elapsed from HFSP award to ERC success

This table shows the distribution of years between receiving HFSP awards and subsequently securing an ERC Advanced, (ADV) Consolidator (COG), or Synergy Grant (SYG). Two pathways emerge: rapid ERC success within 1–7 years for Program Grant and Early-Career awardees, and a mature trajectory in which Long-Term Fellows (and Career Development Awardees typically reach ERC competitiveness 7–13 years post-award. ERC outcomes continue up to 20–28 years post HFSP award, demonstrating HFSP's long-term impact in cultivating scientific leaders whose achievements unfold over entire careers.

Count of researcher	**Elapsed years until ERC success**																						
HFSP	**1**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**17**	**18**	**19**	**20**	**21**	**22**	**24**	**28**	(blank)	Total
HFSP: Career Development Awardee							1	2	2		5				1			1					12
ERC Advanced											5												5
Consolidator							1	2	2														5
Synergy Grant															1			1					2
HFSP: CDF										1													1
Consolidator										1													1
HFSP: LTF							2	1	3	3		1		1			2				2		15
ERC Advanced							1																1
Consolidator							1	1	2	3													7
Synergy Grant									1			1		1			2				2		7
Research Grant (Early Career)				3	2	2		1									1	1					10
Consolidator				1	2													1					4
Synergy Grant				2		2		1									1						6
Research Grant (Program)	1	1	1		4	2			3		3	4	3	1		1			1	1			26
Consolidator			1		1																		2
Synergy Grant	1	1			3	2			3		3	4	3	1		1			1	1			24

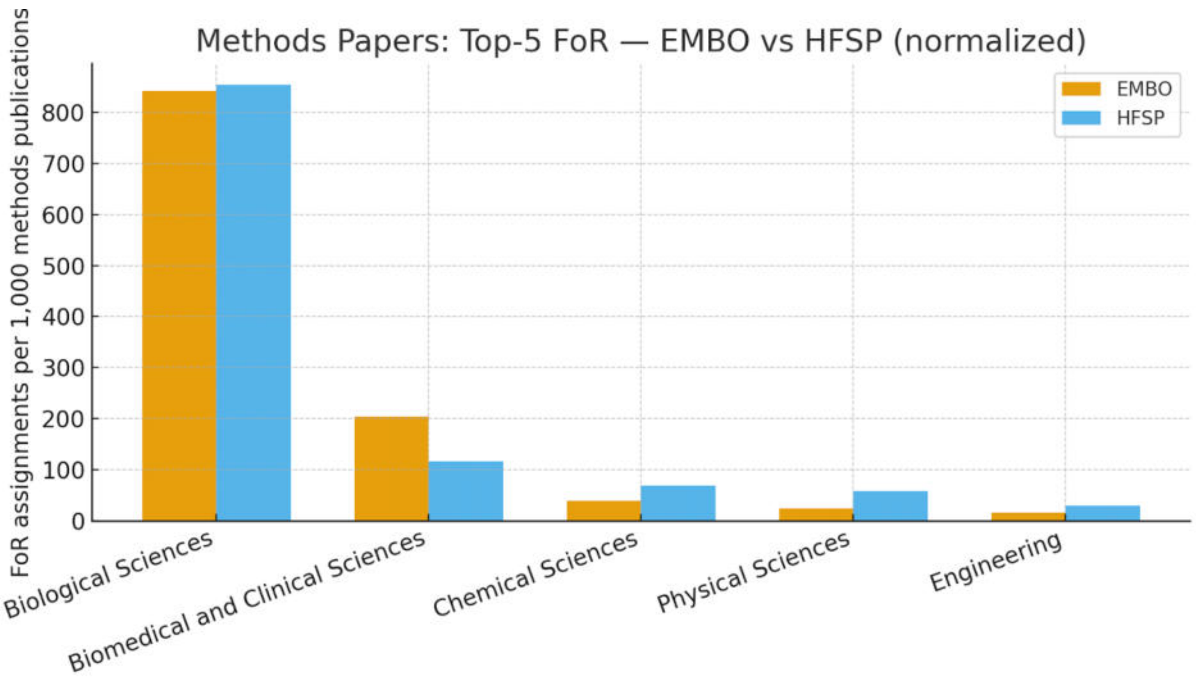
Total	1	1	1	3	6	4	3	4	8	4	8	5	3	2	1	1	3	2	1	1	2	64

Data: Dimensions, ERC publication and HFSP data

11.22 Comparison of methodological Papers with EMBO by FoR

Although the numbers for methodology papers are small, we analyzed the disciplinary profile of methods outputs. The analysis normalizing FoR categories shows that methods papers for both funders are overwhelmingly anchored in Biological Sciences (EMBO ≈74.8% of FoR assignments; HFSP ≈75.9%).

Figure 50: Methods papers – Top-5 Fields of Research (FoR), EMBO vs HFSP (normalized)

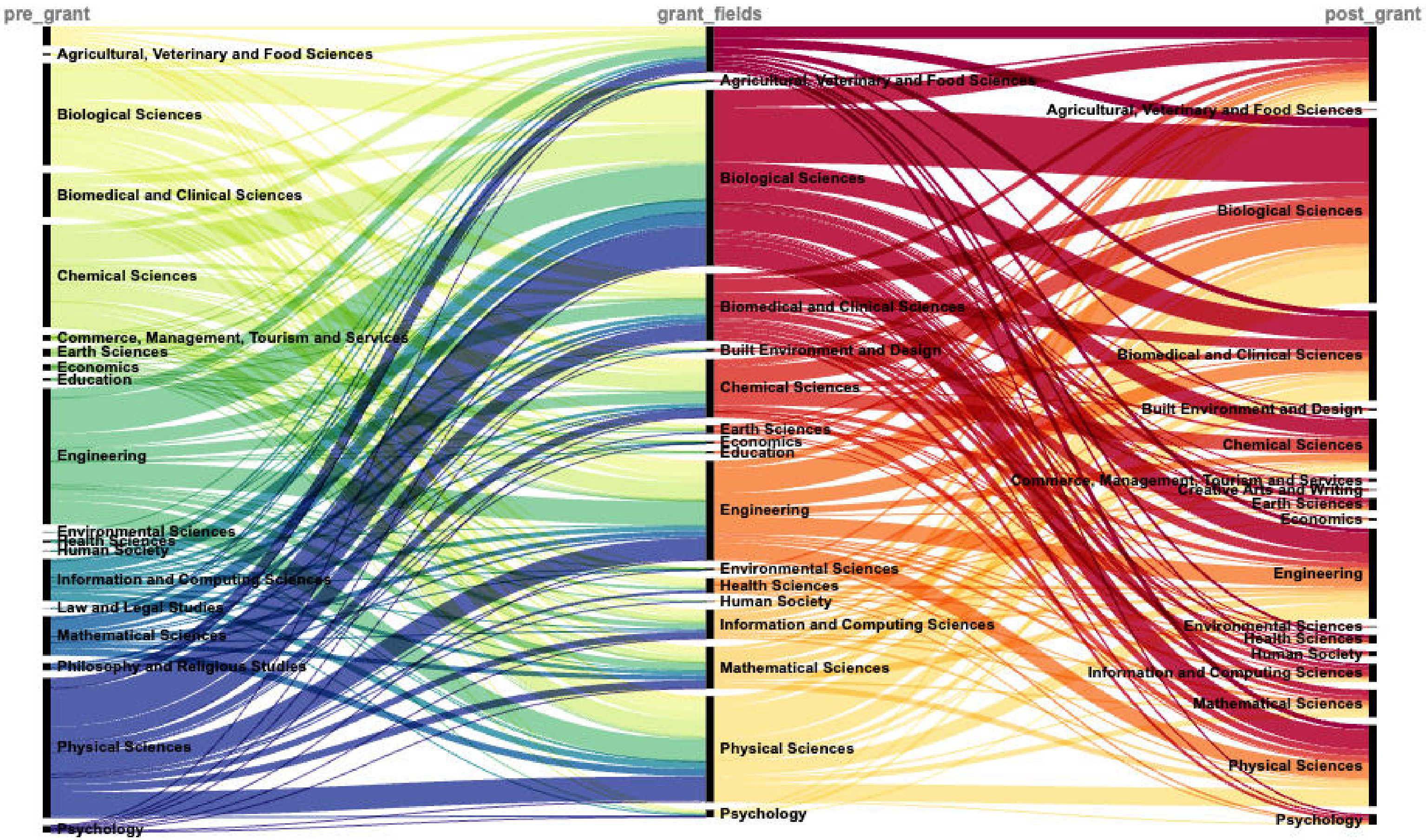


Bar chart shows FoR assignments per 1,000 methods publications for EMBO (n=127) and HFSP (n=103). Biological Sciences dominate both portfolios; EMBO has a higher Biomedical & Clinical share, while HFSP shows greater cross-disciplinary breadth with relatively larger shares in Chemical Sciences, Physical Sciences, and Engineering.
Source: Dimensions database.

The key difference is in the secondary mix: EMBO allocates a larger share to Biomedical & Clinical Sciences (18.2% vs HFSP 10.3%), whereas HFSP shows a broader physical/engineering footprint with Chemical Sciences (6.0% vs 3.5%), Physical Sciences (5.2% vs 2.1%), and Engineering (2.6% vs 1.4%). This wider cross-disciplinary base aligns with the higher patent-citation rate for HFSP methods (41.75% vs 37.01%) and their greater reuse across patent families (4.2 vs 3.85), suggesting that HFSP-backed methods are particularly likely to propagate into tools, platforms, and analytical pipelines beyond academia.

11.23 Sankey-Diagrams Wide Format

Figure 51: Interdisciplinary Pathways of HFSP Cross Disciplinary Fellowship researchers: A visual overview of disciplinary shifts based on FoR of the Fellows' publications before, during, and after funding.



Source: Dimensions database, HFSP data.

Figure 52: Researcher mobility of Long-Term Fellowship (LTF, top) and Cross-Disciplinary Fellowship (CDF, bottom)

Figure 53: Fellow nationality or earliest affiliation (by region), Applicant region (by publication affiliation), Host (HFSP member state region) and the most recent destination (known by affiliation). LTF and CDF originate predominantly from Europe, reflecting th

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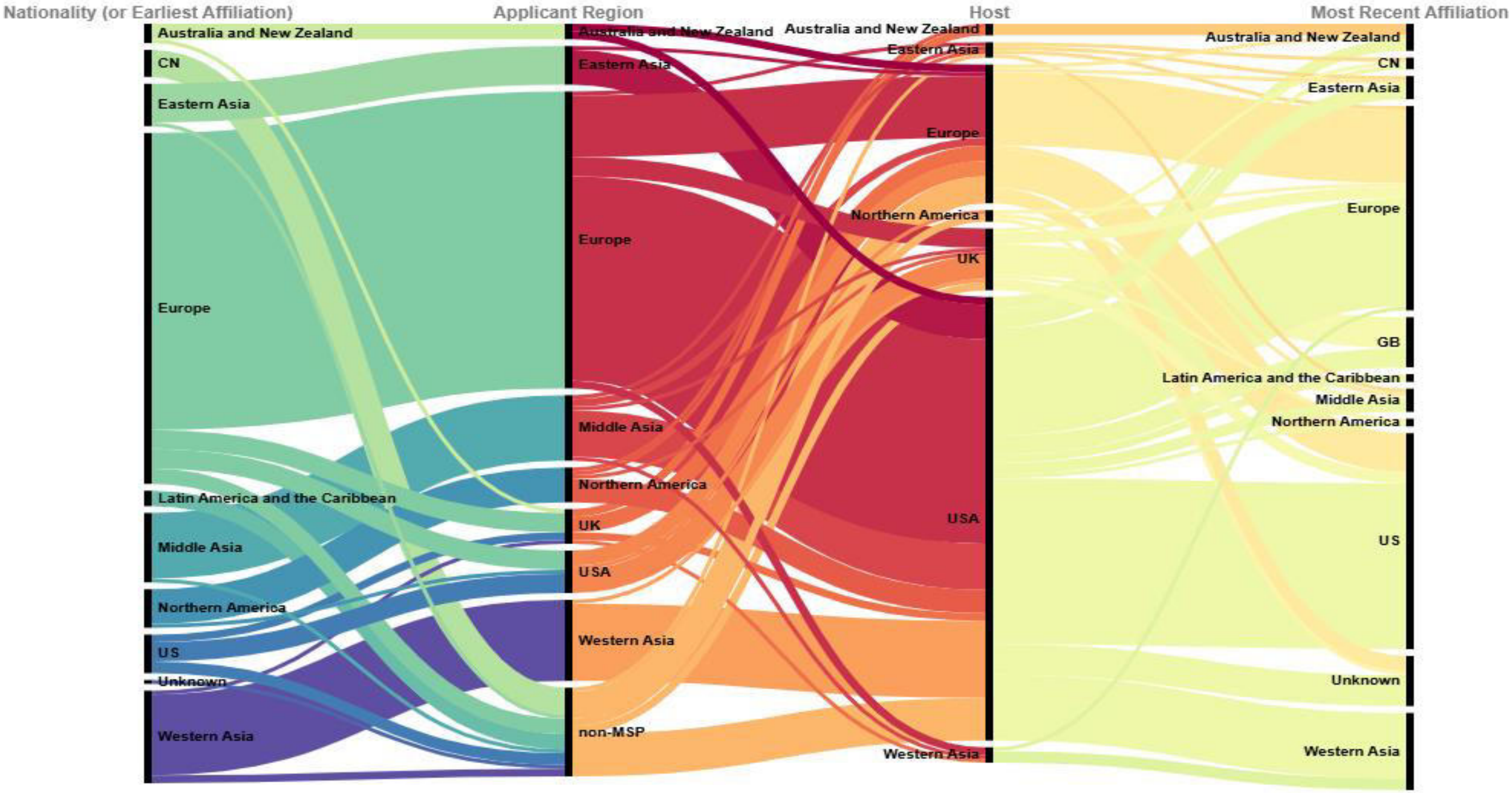
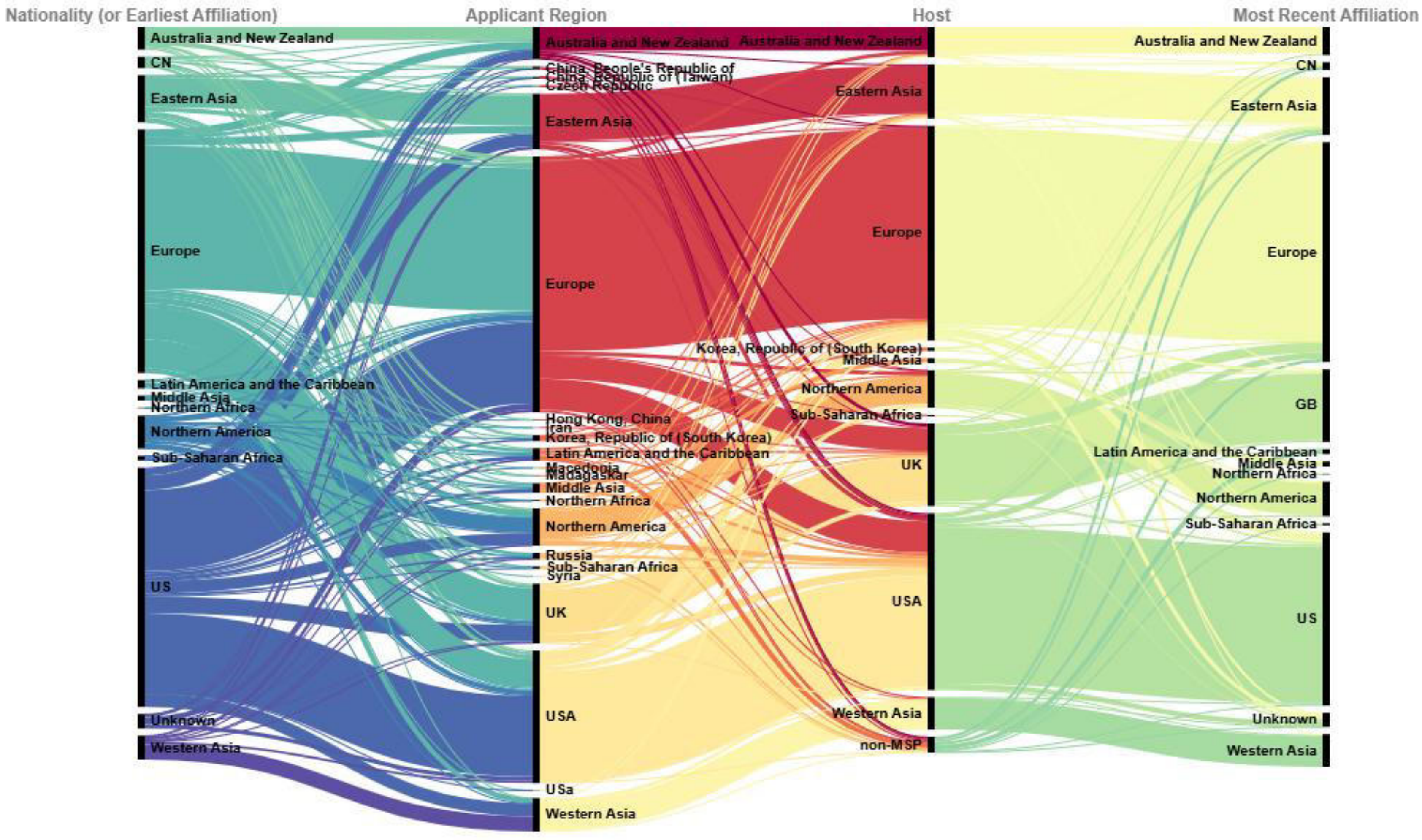


Source: Dimensions database, HFSP data.

Figure 54: Researcher mobility of Research Grant Awardees

From left to right in this sankey diagram: Grantee nationality or earliest affiliation (by region), Applicant region (by publication affiliation), Host (HFSP member state region) and the most recent destination (known by affiliation).



Source: Dimensions database, HFSP data.

12 List of Abbreviations

AMED	Japan Agency for Medical Research and Development
ARC	Australian Research Council
BBSRC	Biotechnology and Biological Sciences Research Council (UK)
CDF	Cross-Disciplinary Fellowship
CIHR	Canadian Institutes of Health Research
CNRS	French National Centre for Scientific Research
DFG	Deutsche Forschungsgemeinschaft (German Research Foundation)
EMBO	European Molecular Biology Organization
ERC	European Research Council
FoR	Fields of Research
FCR	Field Citation Ratio (FCR)
HFSP	Human Frontier Science Program
HFSPO	Human Frontier Science Program Organization
IMF	International Monetary Fund
JSPS	Japan Society for the Promotion of Science
LoI	Letter of Intent
LTF	Long-Term Fellowship (HFSP fellowship scheme)
MRC	Medical Research Council (UK)
MSCA	Marie Skłodowska-Curie Actions
n	Sample size (number of observations/respondents), as used in survey reporting

NCI	National Cancer Institute (US)
NHMRC	National Health and Medical Research Council (Australia)
NIH	National Institutes of Health (US)
NSERC	Natural Sciences and Engineering Research Council of Canada
NSF	National Science Foundation (US)
PNAS	Proceedings of the National Academy of Sciences (journal)
RCDC	Research, Condition, and Disease Categorization
R&D	Research and Development
RG	Research Grant(s) (including Program Grants and Early Career Research Grants)
RGEC	Early Career Research Grant(s) (formerly Young Investigators)
RGP	Program Grant(s)
SNSF	Swiss National Science Foundation
ToC	Theory of Change
UKRI	UK Research and Innovation

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