

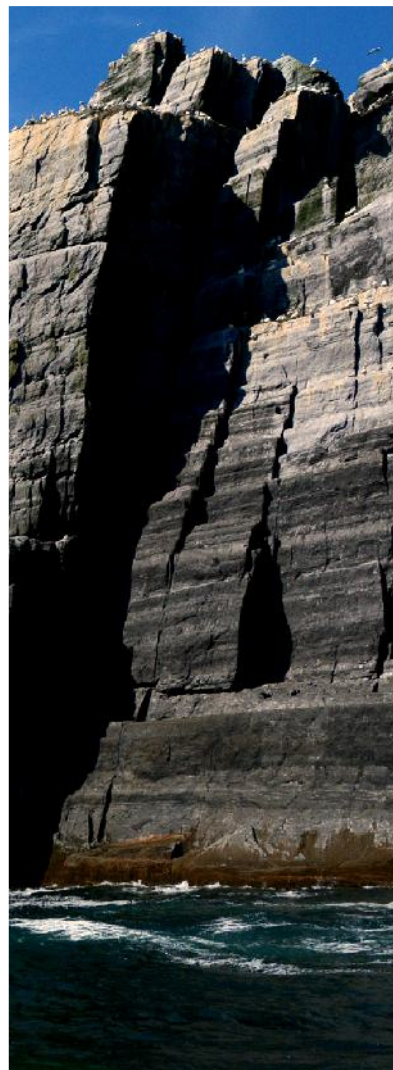
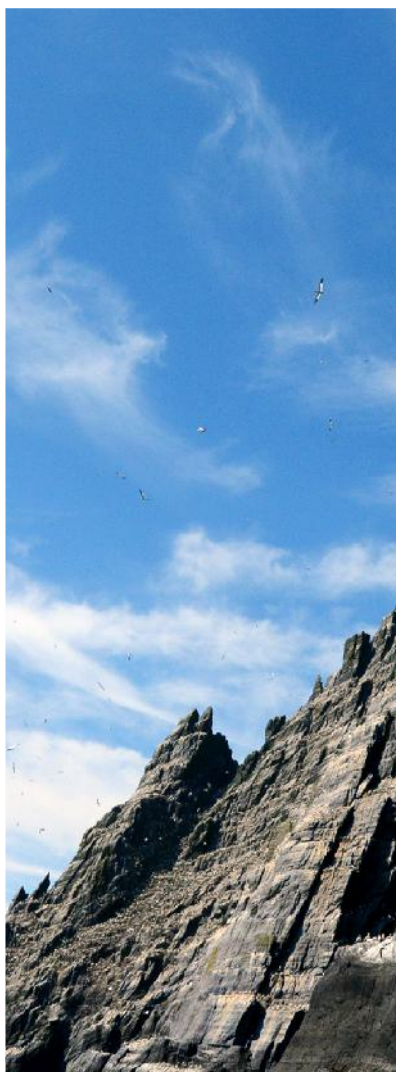


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An assessment of the Impact of the Geological Survey Ireland Research Funding Programme



Prepared by RML Ltd for Geological Survey Ireland, a division of the Department of the Environment, Climate and Communications.



An assessment of the impact of the Geological Survey Ireland Research Funding Programme

This report has been prepared by RML Ltd for Geological Survey Ireland.
The data presented was collected between May and July 2024. Sincere thanks to all researchers and GSI staff who provided input and feedback.

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RML Ltd, December 2024.



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Contents

Glossary	5
Executive Summary.....	7
Introduction	9
Scope and Limitations of this Report	10
Research Programme Background and Research Landscape	12
Structure of the GSI Research Programme	15
GSI Funded Calls	18
GSI Co-funded Calls	19
Total Investment, 2015-2024	20
GSI Funding for Geoscience Research in Ireland	21
Profile of Awardees.....	22
Methodology for Assessing Impact	27
Data and Analysis.....	29
Questionnaire A – Quantitative Analysis	29
Teams and capacity building.....	30
Project outputs.....	30
Dissemination.....	32
Relevance of research to stakeholders	32
Use of GSI data or data products	33
Questionnaire B – Qualitative Analysis.....	35
Physical equipment and infrastructure.....	35
Data and data products	38
Leveraging of additional resources and funding.....	40
Capacity building	42
Relevance of GSI funded research	45
Development of research partnerships.....	47
Comparisons to other national funders	48
Internal feedback from GSI technical units	55
The Role of the GSI Research Programme.....	55
Key Benefits and Strengths of the Research Programme	56

Weaknesses, Limitations and Potential Threats	58
Suitability and Types of Calls	60
Integration of Research Outputs	61
Future Support and Resources	62
Additional Feedback	63
SWOT Analysis	64
Recommendations	65
Conclusions	67
Bibliography	68
Appendix – List of co-funding partners	69

Tables and Figures

Table 1 Summary of GSI-only competitive funding mechanisms.	17
Table 2 Investments in Geological Survey Ireland funded research projects, 2015-2024.....	18
Table 3a Investments in programmes and projects co-funded by Geological Survey Ireland, 2015-2024	19
Table 3b GSI commissioned and managed research on concrete blocks and construction materials	19
Figure 1 Number of projects funded by GSI and co-funded by GSI, 2015-2024.....	20
Figure 2 Total number of projects funded per year 2015-2024.....	20
Figure 3 Number and type of GSI-only funding calls and projects funded, 2015-2024.....	21
Figure 4 Variation in duration of GSI-funded and co-funded projects awarded, 2015-2024.	22
Figure 5 GSI investment and total value of the projects funded per year.	22
Figure 6 Profile of awardees.....	23
Figure 7 Gender balance of male and female applicants to GSI calls, 2015-2024.....	23
Figure 8 Gender balance of male and female successful grantees from GSI funded calls, 2015-2024.....	24
Figure 9 Number of GSI funded and co-funded projects awarded 2015-2024.	25
Figure 10 Response rate for quantitative data (Questionnaire A).	29
Figure 11 Breakdown of the profile of staff funded via GSI funded/co-funded projects.....	30
Figure 12 Summary of total projects outputs to date for projects included in responses. Excludes academic publications.	31
Figure 13 Summary of total projects outputs to date for projects included in responses. Includes academic publications.	31
Figure 14 Summary of dissemination activities for projects included in responses.	32
Figure 15 Relevance of project outputs, as identified by researchers, to stakeholder groups. ..	33
Figure 16 Overview of GSI data and data products used in GSI funded research.....	34
Figure 17 Response rate for qualitative data (Questionnaire B)	35
Figure 18 Number of respondents who received funding to purchase research equipment, or who have accessed GSI equipment to support their research.	36

Figure 19 Number of respondents who have accessed GSI facilities and infrastructure, or who have access GSI physical archives.	36
Figure 20 Types of GSI data and data products used by respondents in their research.	38
Figure 21 Accessibility of GSI digital data.	39
Figure 22 Number of respondents who have used GSI funded projects to leverage additional funding.	41
Figure 23 Number of respondents who have developed capacity and/or expertise via GSI funded research.....	42
Figure 24 Number of respondents whose career development has been supported by GSI funded projects.	44
Figure 25 Relevance of outputs from GSI funded research to geoscience and non-geoscience audiences.	45
Figure 26 Number of respondents who have developed partnership or new collaborations as a result of GSI funded research.....	47
Figure 27 Non-GSI national funding schemes accessed by respondents.....	49
Figure 28 Relevance of themes or topics funded by GSI to respondents' research.	49
Figure 29 Overall comparison of GSI and other national funding programmes.	50
Figure 30 Summary of respondents' feedback.....	52

Glossary

CETP – Clean Energy Transition Partnership

DECC – Department of the Environment, Climate and Communications

DFHERIS – Department of Further and Higher Education, Research Innovation and Science

EPA – Environmental Protection Agency

ERA-MIN – ERA Net for Raw Materials research

Geothermica – ERA Net for Geothermal Energy research

HEA – Higher Education Authority

HEI – Higher Education Institute

iCRAG – SFI Centre in Applied Geoscience

INFOMAR - Integrated Mapping for the Sustainable Development of Ireland's Marine Resource, marine mapping programme

INSN – Irish National Seismic Network

IP – Intellectual Property

IRC – Irish Research Council

OPW – Office of Public Works

R(D)&I – Research (Demonstration/Development) and Innovation

RFO – Research Funding Organisation

RPO – Research Performing Organisation

SEAI – Sustainable Energy Authority of Ireland

SME – Small-Medium Enterprises

SFI – Science Foundation Ireland

Taighde Éireann – Irish research funding agency established in 2024 by the amalgamation of SFI and IRC

Executive Summary

Between 2007 and 2015, Geological Survey Ireland, a division of the Department of the Environment, Climate and Communications, funded geoscience research through the Griffith Geoscience Awards. This programme of funding selected nine geoscience research, education and outreach projects, across the island of Ireland, ranging from €100,000 (1 year) to €3.1m (7years). Following a full review of the programme, in 2015 Geological Survey Ireland launched its new GSI Research Programme. This programme was designed to promote and fund excellent geoscience research across Ireland, and support the objectives of the GSI Research Roadmap published in 2016. The geoscience research landscape in Ireland has seen significant change in the intervening years with increased funding to geoscience and related areas such as environmental and climate research. There have also been changes in numerous national research policies and strategies, and the establishment in 2020 of the new Department of Further and Higher Education, Research Innovation and Science.

The report presented herein examines the impact of the GSI research funding programme and related support for external research activities from 2015-2024. In the last ten years the GSI Research Programme has delivered the recommendations from the review of the Griffith Geoscience Awards (2015) and, through competitive funding calls and collaborative agreements, has supported 226 projects with a total value of over €65million and direct investment from GSI of almost €17million.

The profile of awardee has significantly changed in the last decade and Ireland now has a broad community of active geoscience researchers ranging from early career researchers to senior academic staff. The types and scale of project has also evolved, with GSI now funding small scale pilot projects, Masters by Research projects, medium scale Targeted Projects, larger cofounded projects and co-funding research infrastructure.

The range and scope of geoscience topics funded has built capacity in the Irish geoscience system, supported the activities of Geological Survey Ireland, and supported wider government policies. GSI staff are now actively involved in topic selection and project monitoring, with steering committees recently added to the monitoring processes for larger projects.

This report assesses the impact of the overall GSI Research Programme – the impact of individual projects has not been comprehensively assessed. Qualitative and quantitative data has been collected from funded researchers to capture project outputs, experience of the funding calls, and their feedback on a range of aspects of the programme. The response rate was 60% (quantitative data) and 56% (qualitative data) with several elements of the programme rated and additional text feedback provided. Overall, projects have been very successful with outputs including: maps and datasets, reports, peer reviewed journal articles, training of MSc and PhD students, toolkits, software and educational material, supporting national research infrastructure.

Technical teams from Geological Survey Ireland were also consulted as part of this assessment and have provided feedback on their experience and interaction with the programme over the last ten years. This has been largely positive with some suggestions of areas where GSI staff could increase engagement with external researchers and projects.

Finally, the report includes recommendations for further development and strengthening of the GSI Research Programme.

Dr Aoife Braiden
December 2024

Introduction

The purpose of this review is to assess the activities and impact of the GSI Research Programme 2015-2024. Previous to this, GSI had awarded funding for small scale 'Short Call' projects within the scope of the Tellus and INFOMAR programmes, and larger projects through the Griffith Geoscience Awards. In 2015, RML Ltd was appointed to conduct a full review of the preceding Griffith Geoscience Awards funding programme, and design and implement a new research funding programme for Geological Survey Ireland. The review included the following recommendations for a new funding programme:

1. The GSI funding programme should have clear targets and align with the overall GSI strategy
2. Research management and reporting procedures should be improved with a clear point of contact in GSI
3. Financial reporting and monitoring procedures should be put in place
4. Connections between GSI funded projects and the wider geoscience landscape should be improved
5. Focus should be on thematic research and capacity building, not limited to very narrow scope of project deliverables
6. Funded projects should produce high impact outputs
7. GSI funding programme should complement, but not double fund, projects funded by other national funding schemes and should support both basic and applied research
8. GSI funding should be used to leverage additional support for geoscience research from other funding schemes
9. Review processes should be fair and transparent and avoid bias towards more experienced or senior researchers

A number of funding structures were recommended e.g. Short Calls, teaching buy-out, multi-annual projects etc.

Taking into consideration the outcome of the review, and the changing needs of Geological Survey Ireland, the new GSI Research Funding Programme was established with the first calls launched in 2015. The Programme has delivered all recommendations in the Griffith Geoscience Award review through:

- New procedures developed for designing and implementing research funding calls. This includes call terms and conditions, clear eligibility rules and checks, fully external fair and transparent review processes and projects selection, development of new Grant Agreements in line with best practice across the sector, and clear and efficient financial and technical monitoring of the project throughout the duration of a grant.
- Links between GSI and the research community have been enhanced and improved with an increase in activity and interest from within GSI, and visibility

of GSI activities and programmes externally. This is also supported by e.g. GSI hosting of the Irish Geological Research Meeting (IGRM), Researchers' Nights events, technical posters sessions at Geoscience meetings and Geothermal Summits, and participation in technical workshops, events and conferences with support from Senior Management.

- Co-funding programmes were developed and have successfully leveraged support for geoscience research in Ireland through partnerships with Fulbright Ireland, SFI, IRC, SEAI, EPA, ERA Min, the Marine Institute, the Clean Energy Transition Partnership and Geothermica, plus individual research performing organisations such as TCD, Teagasc and DIAS (see section GSI Co-funded Calls).
- As evident from the responses to the recent questionnaires (see section on Data and Analysis), the research outputs, and activities, have had a significant impact on both the relevant topics and areas of research, and on the capacity and expertise developed in Ireland.
- Several funding mechanisms have been tested since 2015 to determine the most efficient and impactful use of GSI research funding investments (see Table 1 Summary of GSI-only competitive funding mechanisms).

Scope and Limitations of this Report

The review presented herein is limited to projects funded within the 2015-2024 timeframe (data was not accessible for projects funded in previous calls such as Tellus and INFOMAR Short Calls). It also includes feedback from GSI technical teams.

Following the development of new funding procedures and policies for GSI, in 2015, RML developed the GSI Research Roadmap (2016). This framework for the GSI research activities was intended to support the overall GSI strategy and outline the key areas to be developed under the new Research Programme with GSI as a:

- Research Funder
- Research Collaborator
- Researcher Performer

The review presented here assesses only GSI's role as *Research Funder*. It is recommended the remaining roles are assessed in the context of a wider GSI strategic review and stakeholder engagement exercise.

It should be noted that a comprehensive assessment of research impact is extremely difficult to measure objectively. Although some projects and analysis have been undertaken by other Irish and international research funders (e.g. tracking of citations from academic papers referencing their funding), this is complicated and time-consuming and does not accurately represent the range of impacts research projects/funding can generate. For example, it is particularly difficult to capture the impact one project can have on career development of a researcher; there can

be multiple parameters affecting career and employment decisions for both the researcher and employer. Although this report tries to capture some of this information, it is highly subjective and case dependent.

The questionnaires used to collect external data were sent only to GSI funded/co-funded researchers, therefore it does not capture input from other geoscience researchers who have not been funded by GSI (though perhaps use GSI data). Although the response rate was high (60% for Quantitative data and 56% for Qualitative data from funded researchers contacted), this does not represent all funded researchers since 2015. In addition, the responses overly represent researchers who have been funded only once, for small scale projects and/or may not be active in the wider research landscape (e.g. Short Calls delivered by SMEs).

The results only present a snapshot in time and not all outputs from each project will be captured in the data. For example, currently active projects, will not have produced their main outputs yet. Also, completed projects may still be producing outputs, such as academic publications, which can continue years after the project end date.

It should be noted, that the period covered by this review, 2015-2024, has been impacted by both Covid restrictions (impacting external projects and increased levels of working from home/building move which reduced engagement on the GSI side in some cases), and wider impacts of staff losses in GSI. These have all slowed the momentum gained in the initial years of the Programme. However, the increase in focus in the Department of the Environment, Climate and Communications (DECC) on research for policy, including the new DECC Research and Innovation Strategy, and maintenance of the annual GSI research budget, has mitigated the effects to some degree. The recent increase in interest in R&I in DECC should assist GSI in increasing impetus and support to regain lost momentum.

The activities and tasks described herein are primarily delivered by the *Research Team*; this was one RML staff member (Dr Aoife Braidon) from 2015-2021, with an additional staff member from 2021-2024 (Ana Luísa Lavado). A brief comparison with resources available in other thematic funding Agencies is presented below.

Research Programme Background and Research Landscape

Since 2015, the research landscape in general, and for geoscience in particular, has changed significantly. iCRAG, the multi-site SFI funded Irish Centre for Research in Applied Geosciences, was formally established in 2015 with strategic and substantial assistance from Geological Survey Ireland. It brought together a large cohort of researchers across areas such as hydrocarbon exploration, minerals, groundwater, geotechnical engineering and marine geoscience research. These were supported by methodological developments in geophysics, geochemistry, modelling and public perception research. Following the government decision not to issue new licenses for oil and gas in 2021, Phase 2 of iCRAG (2021-2026) focussed on the centre changed to broader areas of Earth System Change, Earth Resources, Earth Science in Society and supporting platform technologies such as geomodelling, geochemistry, geophysics, geodata and geosensing.

At a national level, the new Department of Further and Higher Education, Innovation and Science (DFHERIS) was established in 2020. Subsequently, Science Foundation Ireland (SFI – Department for Business, Enterprise and Innovation), and the Irish Research Council (IRC – Department of Education) were transferred into DFHERIS. The change in host department of the largest funder, SFI, also heralded a change in focus from research to support the economy, job creation and commercial innovation, to include research for policy and a wider range of subject areas.

The national research strategy, Innovation 2020 (published in 2015) was succeeded by the new Impact 2030 (2022) national strategy for research and innovation; this new strategy included the amalgamation of SFI and IRC to form Taighde Éireann, which was legally established in 2024.

At a departmental level, the Department for Environment, Climate and Communications (DECC) expanded to include the EPA and other research active units (e.g. Cyber Security, Climate). In 2024 DECC published its own Research and Innovation Strategy outlining its aims and objectives in the R&I area over the coming years. Other national research funders, e.g. EPA, Marine Institute, also published organisational or national research strategies that have influenced geoscience research priorities and activities; GSI has proactively provided input into most national and organisational policies and strategies via a range of consultation processes.

Some of the other relevant international and national policies developed in the last ten years include:

- **European Charter for Researchers & Code of Conduct for the Recruitment of Researchers** (European Commission, 2005)¹ The European Charter for Researchers is a set of principles underpinning the development of attractive research careers to support excellence in research and innovation across Europe. The focus of the Charter is the rights and responsibilities of researchers, employers, funders and policymakers.

¹ This was published in 2005 but continues to be implemented across the EU

- **Horizon 2020** (European Commission) This was the EU's research and innovation funding programme from 2014-2020 with a budget of nearly €80billion. Ireland succeeded in drawing down €3.09billion with a success rate of almost 18% across 8,822 projects.
- **Innovation2020** (Department of Business, Enterprise and Innovation, 2015) This is Ireland's research and innovation strategy from 2015-2020.
- **European Code of Conduct for Research Integrity** (European Commission, 2017, updated 2023) The European Code of Conduct for Research Integrity provides a framework for self-regulation across all research settings and is used as a basis for local and national policies and practices relating to research integrity, from collaboration to publishing and communication activities.
- **Enterprise 2025** (Department of Business, Enterprise and Innovation, 2015, renewed 2018) This highlights the need for Government to place a greater emphasis on investments in innovation, in developing talent and in creating attractive places throughout Ireland to fully realise the potential of regions. It places particular focus on investment in training and skills development by enterprises and investment in RD&I.
- **National Intellectual Property (IP) Protocol** (Knowledge Transfer Ireland, 2019) This is Ireland's framework for research commercialisation. It provides for best practice, guiding on the expected norms for research-related engagements between industry and State research performing organisations, and the formation of spin-out companies from State funded research.
- **Assessment of the Economic and Social impact of the Irish universities** (Irish Universities Association, 2019) This report by Indecon represents an evidence-based examination of the impacts of universities in Ireland on the wider Irish economy.
- **Horizon Europe Programmes** (European Commission) This is the current EU funding programme for research and innovation for the period 2021-2027 and with an indicative budget of €93.5billion. Its primary focus areas are climate change, helping to achieve the UN's Sustainable Development Goals, and boosting the EU's competitiveness and growth.
- **National Policy Statement on Ensuring Research Integrity in Ireland** (Irish Universities Association, 2021) This statement follows the European Code of Conduct for Research Integrity and commits the main organisations in Irish research to the highest standards of integrity in carrying out their research, thereby strengthening confidence in the Irish research system.
- **National Development Plan** (NDP) 2021-2030 (Department of Public Expenditure, 2021) As part of Project Ireland 2040, The NDP outlines large scale projects of national importance, including research funding programmes (PEACEPLUS and ERDF) and research infrastructure for Ireland. It also highlights the role research and innovation plays in economic growth priorities (ch.10) and the need for greater investment in strategic R&I.
- **Climate Action Plan** (CAP) (Government of Ireland, plus annual implementation

plans) & subsequent DECC CAP and Research actions. This is a roadmap to halve greenhouse gas emissions by 2030 and reach net zero emissions by 2050 which will require significant input from the R&I sector.

- **National Open Research Forum: Guiding Irish Open Research Policy** (NORF) (Department of Further and Higher Education, Research, Innovation and Science, 2022) This policy statement outlines objectives and actions for Ireland's transition towards open research. It serves as a roadmap for the implementation of open research across Ireland, outlining national goals and coordinated actions to assist the Irish research system as a whole to better support open research practices.
- **National Smart Specialisation Strategy for Innovation** (Department of Enterprise, Trade and Employment, 2022) This strategy builds on the EU Smart Specialisation regions approach and highlights the range and depth of Ireland's research and innovation activities, enabling greater levels of internal collaboration, while also allowing Ireland to present a more comprehensive picture of activities internationally.
- **Impact 2030** (Department of Further and Higher Education, Research, Innovation and Science, 2022) This is Ireland's research and Innovation strategy from 2022-2030.
- **Research Classification Ireland** (RCI) (Department of Further and Higher Education, Research, Innovation and Science, 2023) Research Classification Ireland (RCI) is Ireland's first national classification for public investment in research and experimental development. RCI categorises publicly funded R&D projects according to the Type of Activity (TOA), Field of Research (FOR) and Socio-Economic Objective (SEO).
- **Interoperability, Openness, and Impact – Recommendations and Roadmap for an Irish National PID Strategy** (National Open Research Forum & Higher Education Authority, 2024) This document presents 15 key recommendations and detailed actions aimed at establishing a more efficient, transparent, and open research ecosystem in Ireland through a framework for persistent identifiers, spanning the period 2024-2030.
- **Department of the Environment, Climate and Communications (DECC) Research and Innovation strategy** (DECC, 2024) This sets out a strategic approach to facilitate ambitious engagement in R&I across all areas of DECC.

Structure of the GSI Research Programme

The Research Programme is managed by the **Research Team** (Research Manager, Dr Aoife Braiden, and Research Officer, Ms Ana Luísa Lavado). Topics for research funding calls are proposed by the Research Team based on horizon scanning and stakeholder needs, and solicited from the GSI technical teams through the **GSI Research Group**. The Research Group includes a representative from each technical Unit/Programme within GSI, the Director of GSI, and the Research Team.

The GSI Research Programme and its activities is included in the annual Business Plan for Geological Survey Ireland with related key performance indices set for each year.

The Research Team, and the Programme itself, supports several functions in GSI. The Geological Survey Ireland Research Roadmap (2016) includes three roles outlined for GSI in the research landscape in Ireland:

- A. Geological Survey Ireland's role as a Research Funder;
- B. Geological Survey Ireland's role as a Research Collaborator;
- C. Geological Survey Ireland's role as a Research.

Through its role as a funder, Geological Survey Ireland supports external geoscience research through competitive calls (see Table 1 Summary of GSI-only competitive funding mechanisms and Table 3 Investments in programmes and projects co-funded by GSI, 2015-2024)². These are primarily funded through the Research Programme budget; additional funding calls have been delivered for GSI technical units to address specific research questions. All competitive calls are managed through open competition. Since 2015 a number of research funding schemes have been trialled. In some cases, these did not generate sufficient interest to justify continuation of the funding mechanism. Other mechanisms have been refined and remain in place³.

A series of collaborative Memoranda of Understanding are also managed via the Research Programme. These projects/programmes are of key interest to GSI but where GSI is contributing typically 50% or less of the costs through a direct partnership (Table 3a Investments in programmes and projects co-funded by GSI, 2015-2024).

² This report does not include commissioned research or research undertaken as part of an Service Level Agreement.

³ See <https://www.gsi.ie/en-ie/research/funding/Pages/default.aspx>

Funding Mechanism	Description	Status
GSI Short Calls	These projects are up to 14 months in duration and up to €30,000 in value (these were extended from 12 months to allow for MSc or other projects that must be submitted within an academic year). They are open to Higher Education Institutes (HEIs) and SMEs. These are useful testbeds for new ideas or data collection, many have been further expanded to larger scale projects or innovations. They are also open to anyone with a contract longer than the project, therefore early career researchers are eligible, and important element for capacity building.	Continued, biennial
GSI Griffith Awards	Based on feedback from academic groups, these awards were designed to buyout teaching to allow researchers develop an excellent project or e.g. prepare an ERC grant. These were discontinued due to lack of interest.	Discontinued
GSI Postdoctoral Fellowships	These were awarded directly to Postdoctoral Researchers for 2 or 3 year projects and up to €75,000 per year. Individual projects were very successful and advanced the career of the researchers, however the impact for GSI was limited with a significant investment in mobile individuals rather than establishing a wider research group based in Ireland. Topics were nominated by GSI staff, however in most cases there was little engagement from the researcher once awarded.	Discontinued
GSI Targeted Calls	Targeted Call project topics are nominated by GSI technical units for projects of up to 2 years and up to €200,000. Staffing structures and grades can be determined by the Grantee. Applicants are encouraged to include GSI staff in projects (though this is not essential). Once funded, Steering Committees are required which must include a GSI staff member. Topics are nominated by GSI staff, plus an open topic for projects of up to 1 year and €100,000 to allow for emerging areas of research. (Specific Targeted Calls have also been delivered for Minerals and Groundwater units in GSI.)	Continued, biennial
GSI Masters by Research	Masters by Research projects are 1.5-2 year projects awarded to the supervisor and named Masters student (this may be revised in future iterations). Timing of these awards is critical to ensure the best candidates and allow for the academic year cycle. GSI staff nominate the topics and are part of the project team. Projects are up to €40,000 per year.	Continued, biennial

Funding Mechanism	Description	Status
GSI Equipment Calls	To date, GSI has only had one equipment call (due to budget limitations) for small items of equipment from €5,000-€25,000. Feedback from applicants is that these have been very useful as there are no similar schemes available for this level of investment.	Continued, <i>ad hoc</i>
GSI Travel for Access & Lab Analysis	This call was designed in response to feedback that there were no small travel/lab access grants available for geoscience researchers, including for undergraduate and taught Masters projects. However, the call in 2024 yielded no applicants.	On hold
GSI IODP Call	This call is designed to support research activities resulting from participation as an Irish scientist in research programmes within the International Ocean Discovery Programme. Maximum funding is €25,000.	Continued, <i>ad hoc</i>

Table 1 Summary of GSI-only competitive funding mechanisms.

In addition to the GSI directly funding research projects, a series of partnerships with external funding agencies were developed to leverage additional funding and, importantly, to promote the inclusion of geoscience topics in the calls from other national funding agencies and programmes.

To undertake a full financial analysis of the Research Programme since its inception in 2015, several factors have been taken into consideration (e.g. investment by Geological Survey Ireland, the number of projects funded, the co-funding leveraged from other funders/funding partners etc.). These are presented in sections below.

GSI Funded Calls

Since the implementation of the revised Research Programme in 2015, GSI has launched at least one independent call per year. For all the GSI calls, except for the Equipment Call, the funding available is multi-annual with overall programme budget projections within GSI being monitored and updated monthly. The table below summarises the information for all GSI calls launched and the funding commitments.

Year	GSI Call	# proposals	# projects	Funding
2015	Short Call	77	40	€962,644.02
2016	Groundwater targeted call	1	1	€342,522.00
2017	Short Call	66	26	€616,426.68
	Post-doc Fellowship call	16	4	€818,182.00
	GSI Griffith Award	5	1	€76,419.00
2018	Groundwater targeted call	3	1	€259,626.15
2019	Post-doc Fellowship call	34	2	€299,844.12
2020	Short Call	56	17	€493,324.00
2021	Equipment Call	18	11	€240,557.61
2022	Short Call	31	14	€381,206.00
	IODP Call*	1	1	€29,381
2023	GSI Master Call	17	9	€729,382.25
	GSI Targeted Projects Calls	25	5	€755,872.00
2024	Short Call	27	12	€384,030.00
Total		377	144	€6,389,416.83

Table 2 Investments in Geological Survey Ireland funded research projects, 2015-2024. Calls launched in one year may have been completed and awarded in the following calendar year. * An additional contribution for eligible costs was added to the initial €25,000 budget.

GSI Co-funded Calls

In addition, since 2016 GSI has co-funded projects with external national funding organisations: Science Foundation Ireland (SFI), Sustainable Energy Authority of Ireland (SEAI), Environmental Protection Agency Ireland (EPA), Irish Research Council (IRC) and the Marine Institute, as well as with international organisations or European Union Projects: Fulbright Ireland, ERA-NET ERA-MIN (Raw Materials), ERA-NET GEOTHERMICA (Geothermal Energy), and Clean Energy Transition Partnership. GSI has also developed co-funding research infrastructure and project partnerships with several Higher Education Institutes (DIAS, TCD, UCD (iCRAG) and the Department of Housing, Local Government and Heritage and Office of Public Works.

GSI Call	# projects funded	GSI Funding	Total Project Value
Co-funded under CETP	2	€399,676.23	€10,906,935
Co-funded with EPA	8	€604,661.08	€1,547,622.87
Co-funded under ERA-MIN (EU)	5	€493,803.00	€3,105,421.00
Co-funded with Fulbright	12	€295,250.00	€375,225.00
Co-funded under GEOTHERMICA	8	€788,416.00	€22,345,855.00
Co-funded under iCRAG	6	€630,000.00	€819,000.00
Co-funded with UCD	2	€242,525.00	€465,401.00
Co-funded with DIAS	6	€1,986,221.50	€7,291,397.00
Co-funded with IRC	11	€423,699.33	€968,100.00
Co-funded with SFI	9	€1,490,237.02	€3,063,260.80
Co-funded with SFI & EPA	1	€215,974.00	€647,291.00
Co-funded with SFI & MI	3	€1,262,333.30	€3,546,763.00
Co-funded with SEAI	6	€1,254,036.50	€2,574,351.00
Co-funded with OPW & TCD	2	€328,156.00	€671,586.00
Co-funded with DHLGH	1	0	€50,000
Total	82	€9,899,972.09	€58,168,811.57

Table 3a Investments in programmes and projects co-funded by Geological Survey Ireland, 2015-2024.

Co-funded with DHLGH (commissioned)	1	0	€500,000
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Table 3b GSI commissioned and managed research on behalf of the Department of Housing, Local Government and Heritage to investigate significant issues with concrete blocks and construction materials. This two-year project, completed in 2024, was awarded to the University of Ulster who led a consortium of international experts.

Total Investment, 2015-2024

As a research funder, GSI increased the annual budget in 2020 for externally research funding from €1.25m to €1.6m per annum. Between 2015 and December 2024, a total of 226 projects were funded, of which 82 were co-funded with external funding partners.

Number of projects funded per year

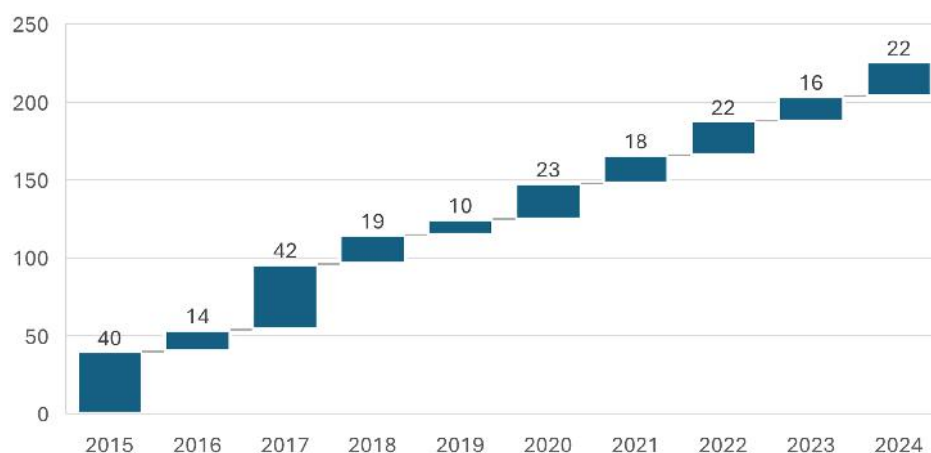


Figure 1 Number of projects funded by GSI and co-funded by GSI, 2015-2024.

The number of projects funded and co-funded per annum varies depending on: (i) the number of calls and (ii) type of GSI calls launched, (iii) funding available for new commitments, and (iv) previously awarded multi-annual commitments. GSI calls fund projects with a duration of up to 24 months, the co-funded projects usually have a duration between 36 to 48 months, an important consideration for co-funding, multi-annual commitments.

Total number of projects and funding sources

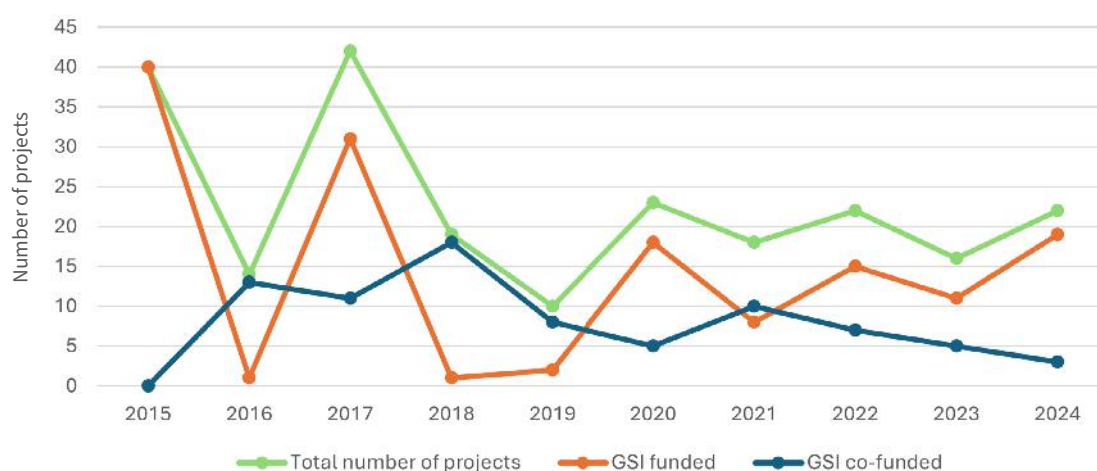


Figure 2 Total number of projects funded per year 2015-2024.

GSI Funding for Geoscience Research in Ireland

In 2015 GSI launched the first edition of the revised GSI Short Call scheme. This funding mechanism is very successful both in terms of applications and of projects funded 2015 (40 out of 77), 2017 (26 out of 66), 2020 (17 out of 56) and 2022 (14 out of 31), 2024 (12 out of 27).

GSI funding awarded, 2015-2024

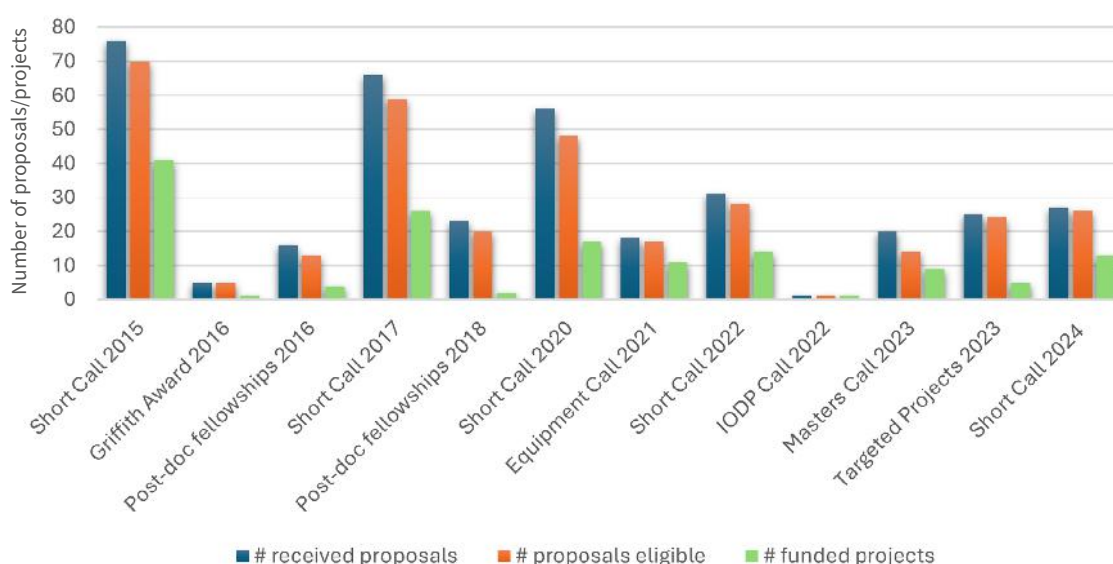


Figure 3 Number and type of GSI-only funding calls and projects funded, 2015-2024.

The duration of project varies depending on the call; for example, Short Calls are limited to 14 months duration. The increase in projects of 13-24 month duration represents the changing needs of GSI technical teams and preference from researchers to undertake MSc projects or medium duration Targeted Projects. This increase in project duration, and related multi-annual funding commitments, results in fewer new projects awarded per year. However, based on feedback these medium-term projects are considered most impactful. Longer duration projects are generally co-funded with funding agencies who have the capacity to monitor and manage projects of this scale, e.g. SFI Frontiers of the Future Programme funding of 48 months.

GSI has been able to further leverage the annual research budget of €1.6m by joining EU funded ERA-NETs and Partnerships, such as ERA-MIN and GEOTHERMICA and the Clean Energy Transition Partnership, and by co-funding with other Irish research funders, mainly SEAI, EPA, IRC and SFI. On average this has yielded approximately 4 times the investment across 10 years of the programme. Larger returns are the result of large scale, transnational projects which have provided Irish researchers with access to data, expertise and/or facilities not otherwise available, e.g. via programmes such as Geothermica. Importantly, GSI participation in these schemes ensures the all data, expertise, facilities and outputs of these projects are available to researchers based in Ireland.

Project duration (months)

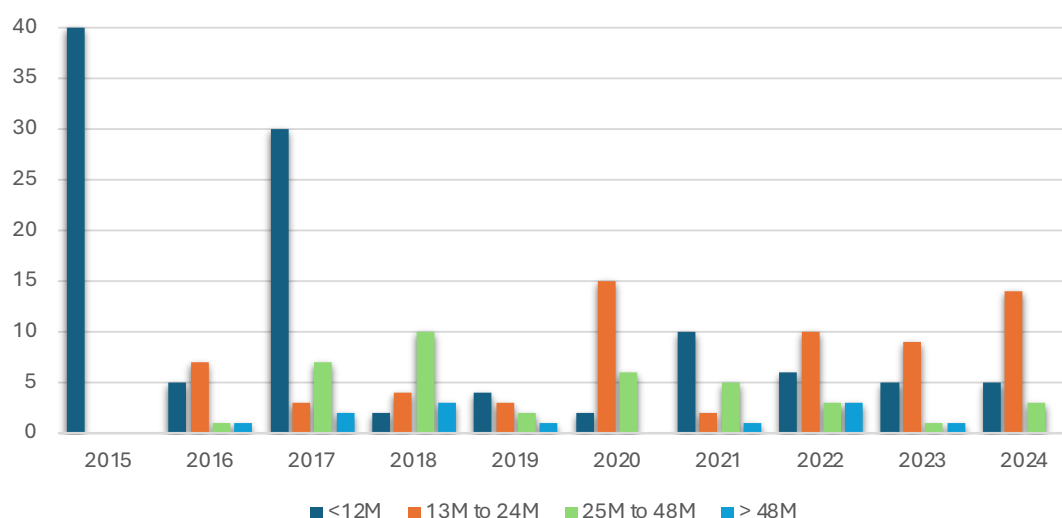


Figure 4 Variation in duration of GSI-funded and co-funded projects awarded, 2015-2024.

Total value of projects vs GSI investment

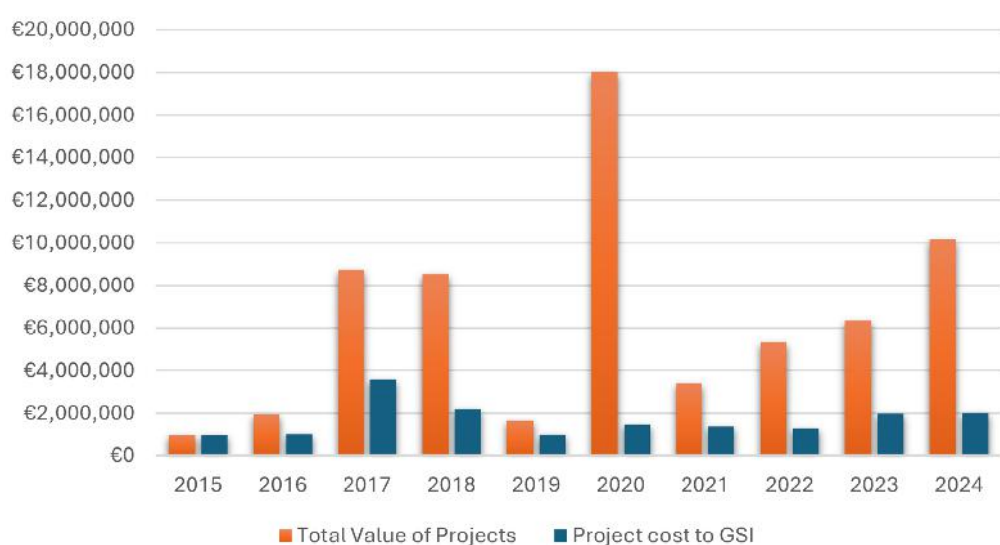


Figure 5 GSI investment and total value of the projects funded per year.

Profile of Awardees

Following one of the recommendations from the Griffith Geoscience Awards review, the design of the GSI Research Programme funding calls and mechanisms has allowed for a more even distribution of grants and projects between professors, lecturers and postdoctoral/other researchers in academia, and awardees in SMEs and consultancies. The Short Call awardees remain most representative of a wide range of researcher types.

Profile of Awardees

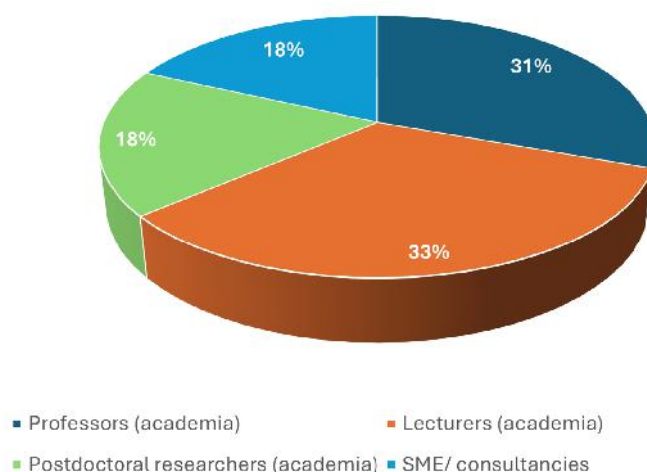


Figure 6 Profile of awardees. This is averaged across all calls, however the terms and conditions, and project duration, generally determines the eligibility of researchers for any particular call.

The statistics collected from each call allow analysis of not only career stage but also other profile data, such as gender and collaborating partners. Data indicates that the number of female applicants is reflected in the success rate, i.e. the number of successful female applicants (average 26%) is proportional to the number of applications from female researchers (average of 22%). This would imply that gender bias at the review stage is minimal

Gender balance of GSI Awardees

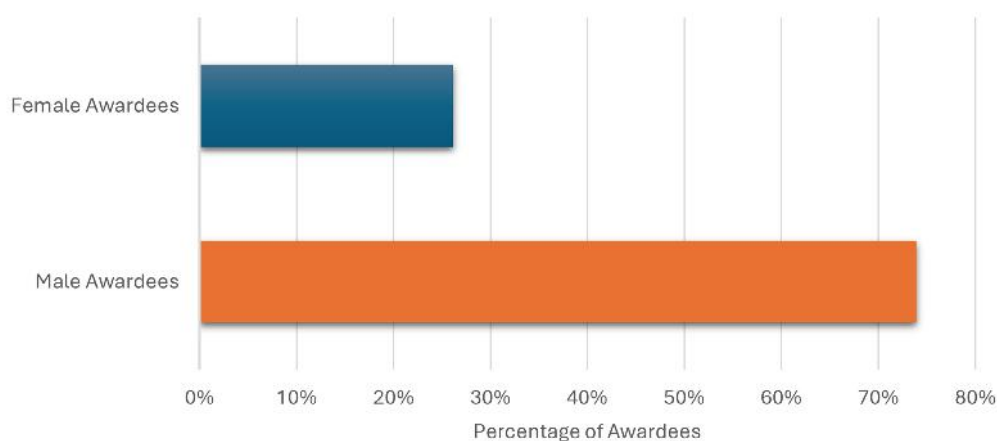


Figure 7 Gender balance of male and female applicants to GSI calls, 2015-2024.

Gender balance of Applicants

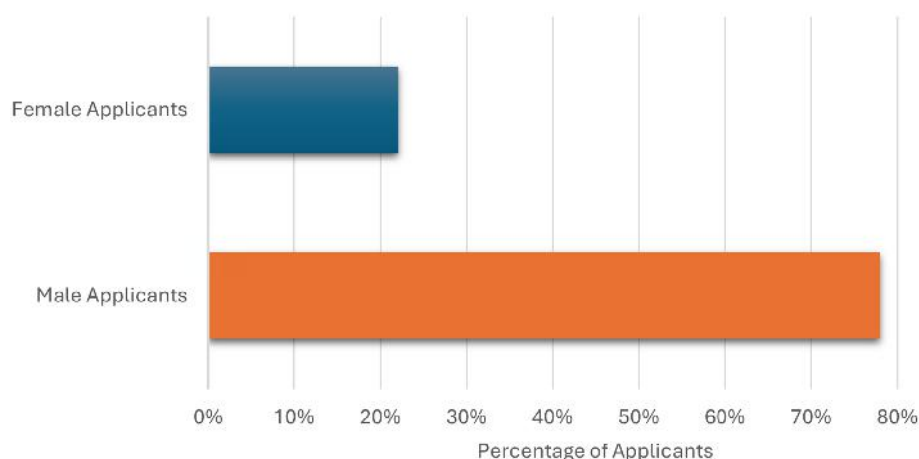


Figure 8 Gender balance of male and female successful grantees from GSI funded calls, 2015-2024.

These data suggest there should be more focus on increasing and encouraging the number of female applicants, and early stage career researchers, to GSI funding calls. This may include, for example, specialist funding supports for researchers returning from maternity leave, webinars regarding the application process highlighting how family-related leave is considered in the assessment, partnership with HR teams in Host Organisations etc.

Analysis also indicates an increase in the number of new applicants. These calls, limited to topics within the realm of geosciences, and are often smaller scale than other national funding schemes and are regularly used by early stage career researchers to build capacity and develop their career profile. This is an important element of the GSI Research Programme.

In recent years, new Host Organisations have started participating in GSI calls, for example the new Technological Universities. It will be important to support the growth of these new research teams and widen the collaboration across emerging areas for geoscience, for example partnering with departments of engineering and the built environment to support the uptake of new energy alternatives such as geothermal energy.

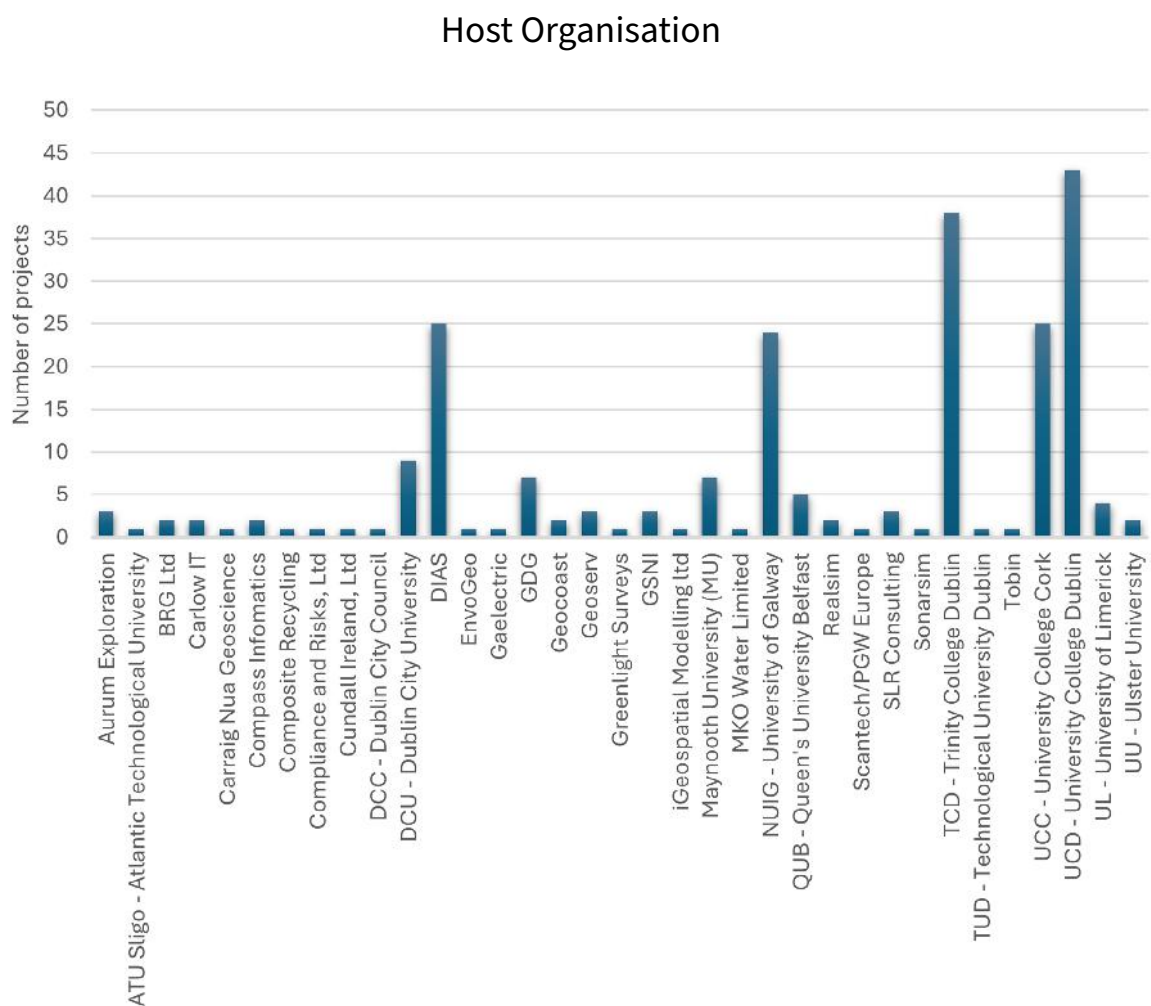


Figure 9 Number of GSI funded and co-funded projects awarded 2015-2024.

As expected, larger organisations (e.g. TCD, UCD, UCC, University of Galway) have a high number of awards. However, smaller/more specialist organisations such as DIAS and GDG have been very successful in comparison to their size and level of activity in their research areas.

Methodology for Assessing Impact

For the purposes of this assessment, two datasets were collected from researchers funded or co-funded by GSI since 2015; as this assessment aims to analyse the impact of GSI funded research, non-GSI funded/funded geoscience researchers were not asked to provide input.

External researchers were contacted and asked to respond to two questionnaires:

- Questionnaire A: Quantitative data regarding the research outputs from each project funded/co-funded by GSI
- Questionnaire B: Qualitative data regarding the perceived impact of the programme on their careers and that of their team members, and also the impact of their research for external stakeholders

In addition, GSI technical teams were asked to provide feedback on their experience of the Programme and how it has evolved since its inception in 2015.

Questionnaire A comprised an excel table detailing each project funded and co-funded since 2015. The aim was to assess the number and type of outputs per project as a measure of successful implementation of the project and indicator of productivity of the project. However, it should be noted that these outputs are only an indication of the project's activities at a point in time and are not a measure of broad impact.

For each project, information was requested about (i) the number and types of staff funded by the project, (ii) the academic reports/publications resulting from the project to date⁴ (including a identifier such as a persistent identified, e.g. doi, if available), (iii) other outputs (e.g. products, datasets, prototypes, patents, trademarks etc), and (iv) dissemination activities (e.g. national and international conference presentations and workshops). Researchers were also asked to provide information on how relevant their research outputs are to external stakeholders (e.g. in policy, education and commercial sectors), and if they used any GSI data or resources, other than funding, during the implementation of their project. Respondents were given the opportunity to provide additional comments for any project, and whether or not it related to any other GSI funded/co-funded project (e.g. where pilot Short Call projects evolved to larger scale projects).

The data were collected via email, then compiled and analysed. In total, data was collected for 122 projects of the 205 funded/co-funded from 2015 to 2023, inclusive⁵. This represents a response rate of 60%. The data was not anonymised.

Questionnaire B comprised an anonymous, online survey designed to collect qualitative data from GSI funded or co-funded researchers⁶. A link to an online survey was sent to all such researchers who were asked to give some general information about their experience of the programme, it was not related to any individual project and feedback from individuals represented more than

⁴ These data are only accurate at the date collected, in some cases, projects continue to publish beyond the end date of the project and beyond the date of data collection.

⁵ Projects awarded in 2024 were not included in this analysis as they had not yet yielded outputs or delivered impact.

⁶ At the end of the questionnaire, respondents could provide their contact details for follow up questions, however this was entirely optional.

one project in some cases. The aim was to collect more meaningful information than simple output metrics, and to assess the level of interaction of the researchers with Geological Survey Ireland physical and digital resources, technical expertise, and any broader impact. Seventy-seven (77) responses were received, representing 56% response rate from the 135 researchers contacted⁵.

Researchers were asked if they had received funding for research equipment, had accessed GSI equipment/GSI funded infrastructure (e.g. the Earth Surface Research Lab in TCD), or had accessed GSI physical resources (corestore, drill rig, boats etc) for the purposes of their research. They were also asked how this access impacted their project, if at all. Similar questions were then asked in relation to GSI's digital archives and how this access impacted their project. Respondents were asked to rate the ease of access to digital data, and if the projects supported by GSI were used as a basis for applying for larger scale projects or leveraging additional funding from other programmes.

Respondents were then asked a series of questions relating to capacity building and career progression. These included whether, and how, the GSI funded/co-funded project supported skills and training in their team and if it helped with career development of the funded researcher and/or team lead.

In relation to external stakeholders, researchers were asked if they believed their project outputs were relevant to (a) geoscience audiences and (b) non-geoscience audiences. They were also asked if the research helped to build external collaborations, nationally or internationally.

The final section of the questionnaire examined the accessibility, flexibility, and suitability of the GSI funding programme currently, including the responsiveness of the GSI Research Team and how the Programme compares to other similar funding agencies (e.g. EPA, SEAI, Marine Institute). To conclude the questionnaire, respondents were given the opportunity to provide any additional comments or information.

Where possible, the respondents were asked to give yes/no answers or rank responses from 1 (most negative) to 5 (most positive). For most questions, there was also an opportunity to provide additional comments or clarifications.

The data were collected via online survey tool and analysed.

The final stage of data collection comprised meetings with each technical team (i.e. Unit or Programme) within Geological Survey Ireland. In June–July 2024, the Research Team met with representatives from the Marine and Coastal Unit, Groundwater and Geothermal Unit, Data Management, Outreach and Education, Minerals, Tellus, Mapping Unit and the Geoheritage and Planning team. Each team was provided with questions in advance to guide the discussions. They were encouraged to discuss the topics internally prior to the meetings which could be attended by any staff member (including contractors). Meetings ranged from one hour to over two hours. The same set of questions was sent to the GSI Director and a similar meeting was held to discuss the evolution and impact of the programme since 2015. All sections were strongly encouraged to gather feedback from their wider teams and relevant colleagues. The feedback was collated according to general themes presented below. Feedback has been anonymised and where comments were repeated or very similar, they have only been included once.

Data and Analysis

Questionnaire A – Quantitative Analysis

GSI funded/co-funded researchers were asked to provide quantitative information regarding the outputs of each of their GSI supported projects. In some cases individual respondents provided information on more than one project. The outputs were measured at a single point in time; several projects are still ongoing or still producing additional outputs that are not captured here.

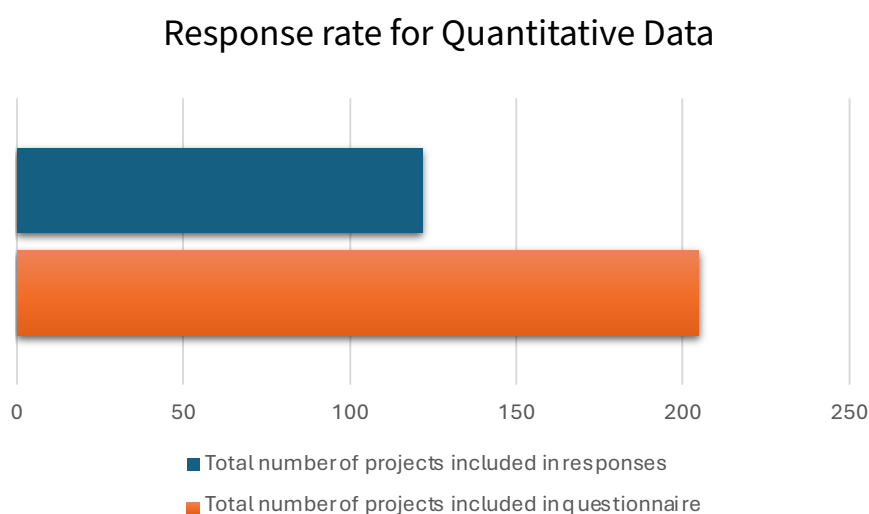


Figure 10 Response rate for quantitative data (Questionnaire A).

Although the metrics are not a direct measure of impact, they do provide information about the quality of the research funded (e.g. peer reviewed publications) and the applied nature of the research activities, e.g. generating datasets, maps, data products etc. that can be used by GSI technical staff and other stakeholders.

Teams and capacity building

Research projects typically fund one or more staff members (either on a part-time or full-time basis). This can include Masters or PhD students receiving scholarships, Research Assistants, Postdoctoral Researchers or the buy-out of permanent staff members' time or other technical staff as appropriate. The local rules of the Host Organisation regarding recruitment and assignment of tasks apply in all cases and must be in line with their existing human resource practices.

Team and Capacity Building – staff funded

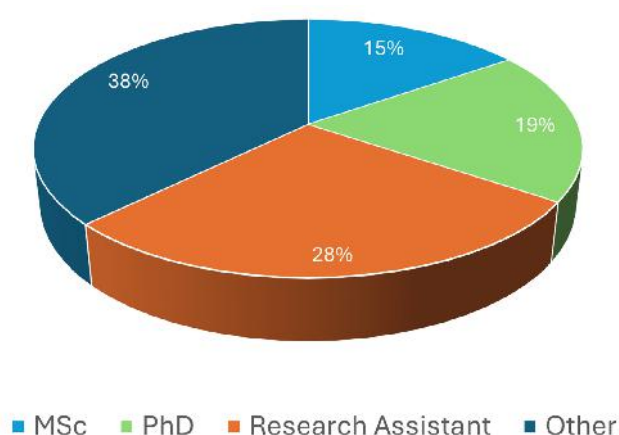


Figure 11 Breakdown of the profile of staff funded via GSI funded/co-funded projects.

Respondents to the survey reported 24 Full Time Equivalent Masters students, 30 FTE PhD students and 44.2 FTE Research Assistants. 58.5 FTE 'Other' staff were funded for tasks on GSI funded/co-funded projects. These typically represent technical staff and Postdoctoral Researchers.

Project outputs

Researchers reported a range of project outputs, which varied depending on the type of project, duration of the research activities, and often the size of the team (e.g. project with a larger number of collaborators have the capacity to produce a greater number of outputs such as publications).

Excluding peer-reviewed publications, and including co-funded projects, funded researchers reported 44 datasets, 22 data products (e.g. maps) 6 prototypes, 2 patents and 25 other types of outputs. 'Other' in this instance includes theses, public display materials (e.g. Stonebuilt Ireland heritage building materials project), websites, open source software/codes etc.

Project Outputs – excluding publications

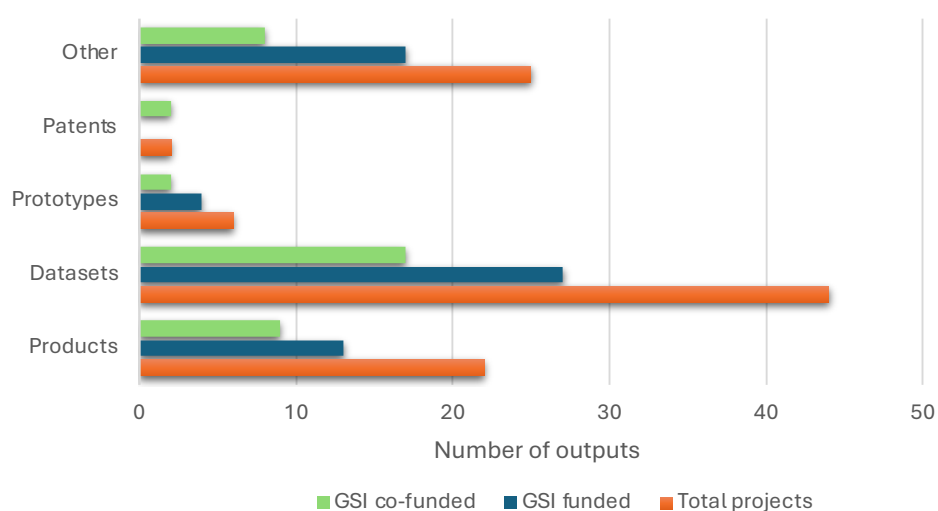


Figure 12 Summary of total projects outputs to date for projects included in responses. Excludes academic publications.

A further 209 peer review publications (academic journals, book chapters and extended abstracts/published conference proceedings) were generated. Given the high number of short projects funded (i.e. less than 14 months for Short Calls), and excluding Equipment grants, which are less likely to generated peer review publications directly, this number is very positive and demonstrates the value and quality of the work funded.

Project Outputs – including publications

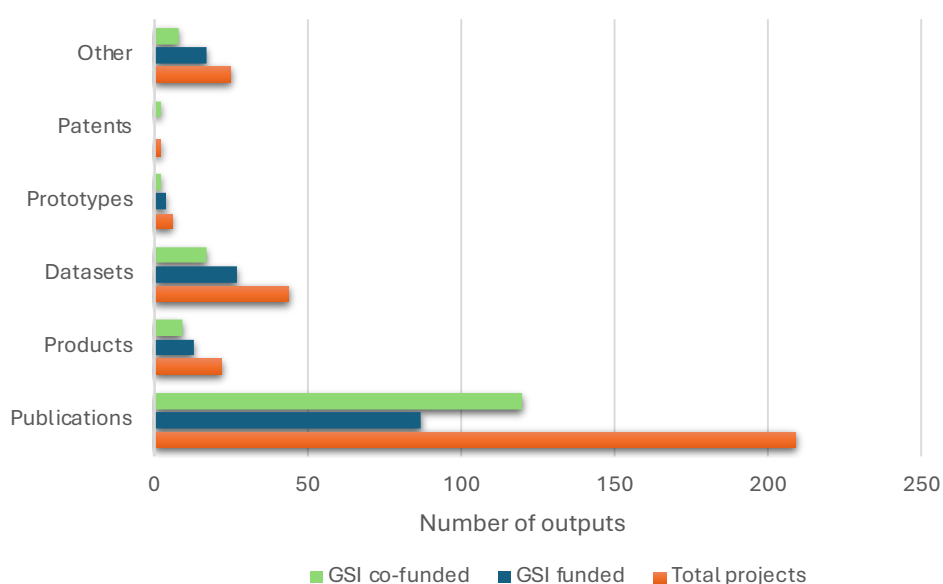


Figure 13 Summary of total projects outputs to date for projects included in responses. Includes academic publications.

Dissemination

Respondents reported a high level of activity in relation to dissemination activities; dissemination activities in this context are largely one-way, i.e. presentations of the project results to an audience. Reported activities vary from presentations at national and international conferences, keynote/invited addresses, participation in technical workshops etc., however other types of dissemination were also undertaken by funded researchers, such as school visits and radio interviews.

Presentations at international conferences represented 302 outputs from the projects supported, with a further 291 presentations at national conferences. This highlighted the level of activity of Irish researchers on the international stage. It should be noted that travel restrictions due to Covid-19 were in place for much of 2020 and 2021, therefore this number would likely be higher in normal circumstances. The lower number of presentations at national conference is likely due to the lower number of relevant events and technical conferences in Ireland. Outputs also included 47 keynote speeches and participation in 64 technical workshops, demonstrating the valuable contribution made by Irish researchers at key events.

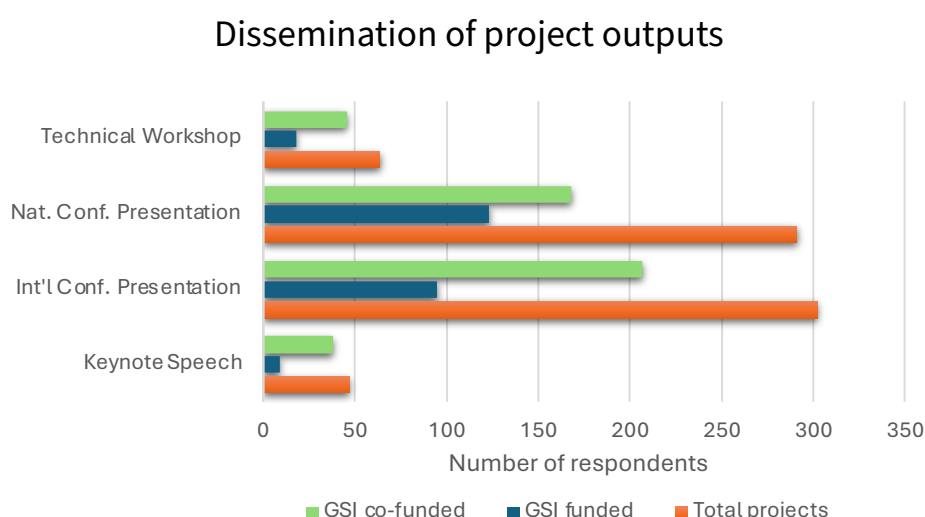


Figure 14 Summary of dissemination activities for projects included in responses.

Relevance of research to stakeholders

When asked if project outputs were relevant to a range of stakeholders, respondents generally considered their work relevant to most sectors of policy, industry, with more significant relevance to education and outreach and basic science/research. Outputs supporting EU regulation was perceived as the least relevant.⁷ GSI-only funded projects were considered more relevant to all sectors compared to co-funded projects. Overall, the responses indicate the important role GSI funded research provides to support departmental and cross-government policies but also in areas that are not prioritised by other funding agencies.

⁷ It may be that outputs are, in fact, used indirectly (e.g. via national agencies) to support EU regulation/policy.

Relevance of project outputs

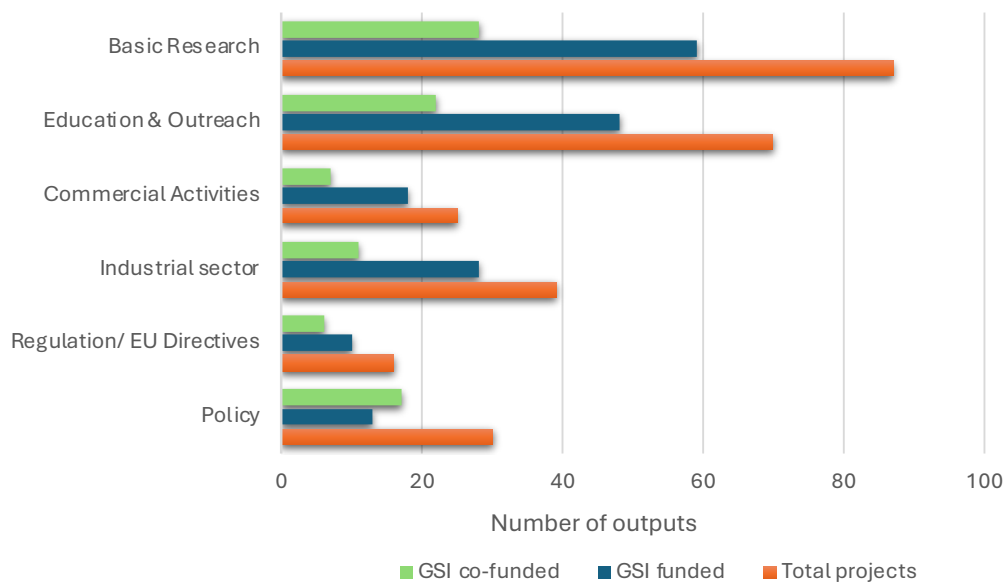


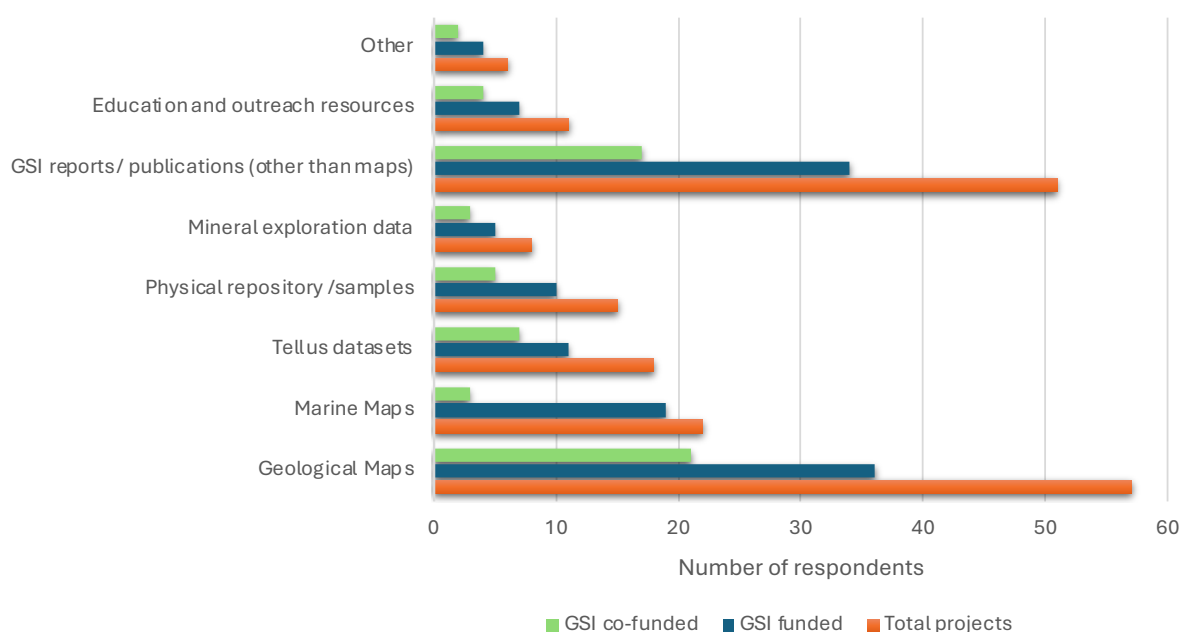
Figure 15 Relevance of project outputs, as identified by researchers, to stakeholder groups.

Over 71% consider their research relevant to basic and continuing research with over 57% stating it is relevant to Education and Outreach (in this context, this refers largely third level education). Thirty-one percent (31%) consider their research useful for the industrial sector, however, only 20% state it is relevant to commercial activities. Although over 24% stated that their outputs were relevant to policy, only 13% considered this to be in the area of regulation or EU directives.

Use of GSI data or data products

Respondents were asked to comment on the use of GSI data in their research (this question only assessed research funded by GSI, not their wider portfolios or access to GSI data as part of projects funded by other sources). The most commonly used products are maps and reports/ publications from GSI with over 50% of researchers in the study using these in some way. The low use of some datasets (e.g. mineral exploration data) may be due to the raw data being available via other sources (e.g. the DECC Geoscience Regulatory Office or ease of access); this could be further explored through a stakeholder exercise. 'Other' GSI data sources include hyperspectral data, INFOMAR data (some respondents made the distinction between INFOMAR and GSI Marine maps/data) and advice from GSI technical staff.

Project inputs from GSI sources



*Figure 16 Overview of GSI data and data products used in GSI funded research.
This includes only the projects included in the questionnaire responses.*

Forty-seven percent (47%) of respondents have used GSI geological maps for research purposes, with 18% accessing marine maps. Forty-two percent (42%) have accessed GSI reports or publications (other than maps). Fifteen percent (15%) have used Tellus datasets, with 12 % accessing physical samples, including but not limited to Tellus samples. Seven percent (7%) accessed mineral resource data with 9% accessing Education and outreach resources online. Five percent (5%) accessed other digital GSI resources.

Questionnaire B – Qualitative Analysis

The second questionnaire distributed to GSI funded/co-funded researchers focussed on qualitative feedback about the Research Programme. As with Questionnaire A, this was only circulated to researchers who have been funded by the GSI Research Programme directly or indirectly. The following results and analysis are based only on those who responded (between 66 and 77 respondents for each question – not all questions were mandatory). Respondents were also given the opportunity to include additional comments in most sections, some of which have been included to provide context and samples of feedback.

Response rate for Qualitative Data

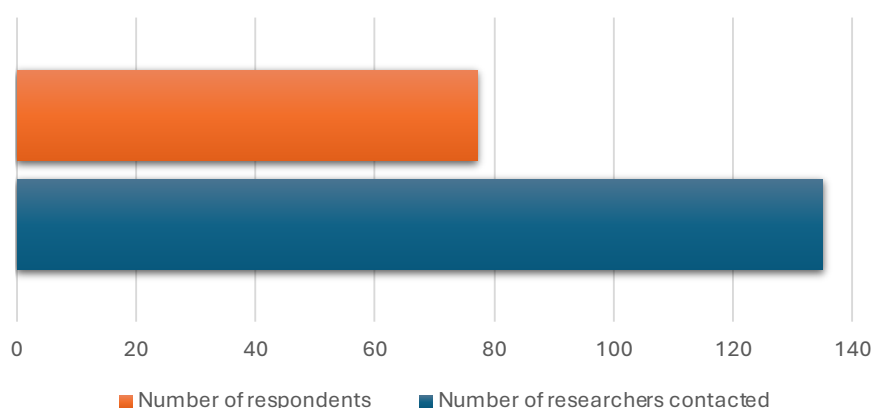


Figure 17 Response rate for qualitative data (Questionnaire B)

Physical equipment and infrastructure

Respondents were asked if they have accessed GSI funded equipment (e.g. in another university) or GSI owned equipment (e.g. handheld XRF, groundwater equipment etc.). This did not include GSI infrastructure or data archives (addressed in later questions). It should be noted that GSI has only concluded one formal Equipment Call for small grants. In addition, GSI has supported some small equipment items through co-funding, e.g. with University of Galway.

Twenty-eight percent (28%) of respondents have received funding from GSI for small equipment. The unexpectedly high response to this question may be due to respondents including small items that have been purchased via non-Equipment specific grants, e.g. Short Calls or where they have classified consumables as equipment. Only 17% of respondents have accessed GSI funded equipment, either hosted by GSI or other GSI funded project hosts. This may be due to a lack of awareness of these resources; it would be beneficial to collect additional data as part of further stakeholder engagement.

Funding for equipment / accessed GSI equipment

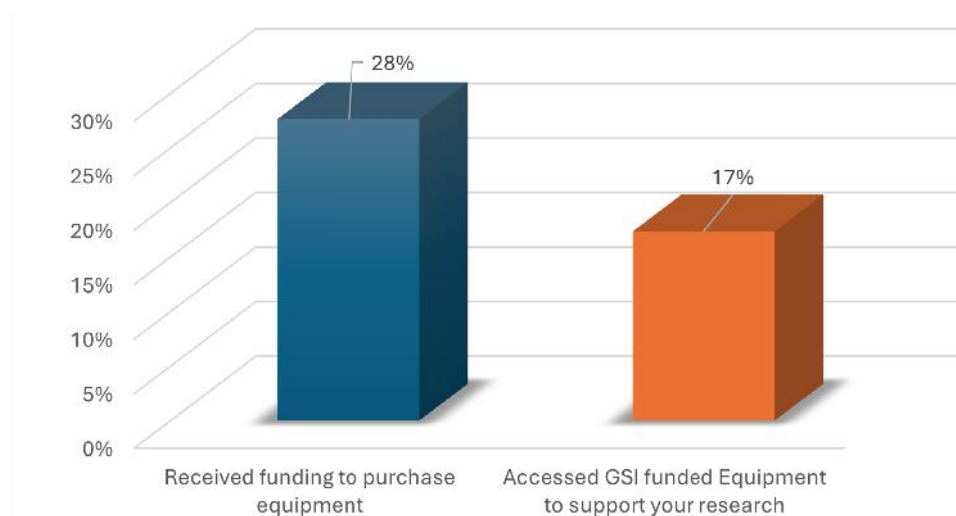


Figure 18 Number of respondents who received funding to purchase research equipment, or who have accessed GSI equipment to support their research.

Have you accessed GSI physical infrastructure?

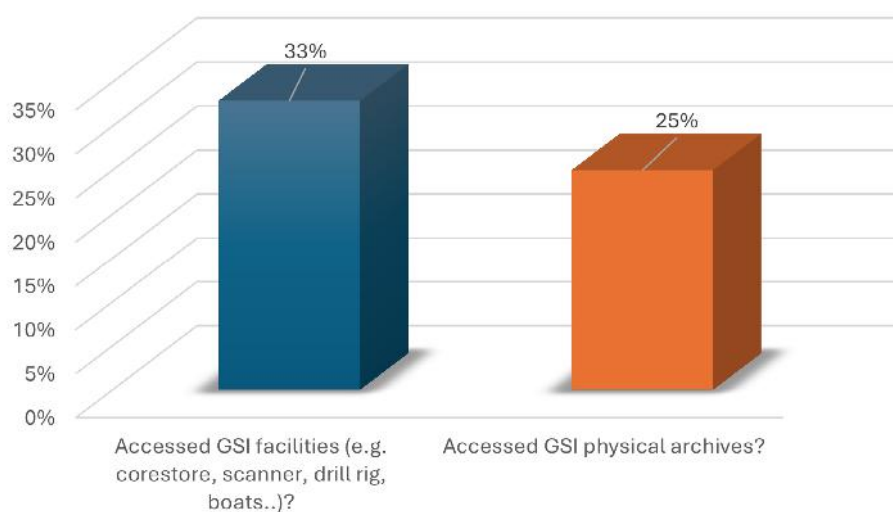


Figure 19 Number of respondents who have accessed GSI facilities and infrastructure, or who have access GSI physical archives.

A higher proportion, 33% of respondents, have accessed GSI physical facilities, for example the core scanner, corestore etc. Respondents were also asked whether they have accessed GSI physical archives (e.g. Tellus soils samples) for their research; 25% did access these, however analysing the additional information indicated that the benefits stated by the researchers varied. These ranged from capacity building locally (though further details were not provided) to using the GSI archives to identify locations for further detailed research. Other examples highlight the advantage of having the data and expertise in Ireland:

“Excellent data quality, access to local expertise and well-archived research materials (e.g. core store). Easy to access without prohibitively expensive travel costs for equivalent research equipment in the UK.”

Comments also included limitations in access. For example, although researchers had received permission to access the core scanner, it was unavailable when required and therefore the researcher had to travel elsewhere.

Other GSI funded resources, for example the Earth Surface Research Laboratory in TCD, were accessed by researchers:

“The GSI facilities accessed above are unique in Ireland. No other lab provides some of the services that the ESRL offers. Similarly, no other archives of drill-core exist to underpin geological research in Ireland. For both of these, there simply are no alternatives. GSI provides unique offerings/services in an Irish context. The level of support provided by the core-store personnel was excellent.”

As indicated by the above statement, not only are the facilities unique in Ireland, but the expertise offered by GSI staff and GSI funded staff in Host Organisations (e.g. at the ESRL and corestore) are perceived as exceptional.

“The high level of engagement and openness when dealing with the GSI, compared to commercial and often academic partners, meant that field data collection could be much more carefully thought through, tested and iteratively improved than otherwise would be possible. This lead [sic] to much better data quality, a more comprehensive monitoring programme and lower costs compared to the alternative”.

Researchers also used GSI funded equipment/infrastructure to leverage additional funding and create long term national equipment pools and infrastructure. They stated that this supported capacity building and training locally for the wider team and national expertise.

“The GSI equipment funding model has been of critical importance. In particular the co-funding model has allow us to leverage additional sums in excess of €4 Million from other bodies, for Geophysical Infrastructure. In all cases the equipment forms part of a National pool. Without the GSI seed funding we would not have been able to participate in these programmes, and so the National infrastructure would not exist.”

When asked to provide details about how the access benefited their research, respondents listed: (i) The quality of data (which allowed improved research outputs), (ii) the development of new methodologies, (iii) flexible access, (iv) reduced travel costs, and (v) the building of local capacity. Feedback also focused on the unique datasets available in GSI, including samples from areas that have been mined out or are no longer accessible. The significant benefit to education and third level training, e.g. of laboratory techniques, was also highlighted.

Data and data products

Respondents were asked which GSI datasets/data products they used for their research⁸. The majority of data types accessed were reports and publications (excluding maps) 74% and geological maps and map related products, 73%. Marine maps (47%), Tellus data (60%), physical samples, and education and outreach material (37%) were also rated. Minerals data was lower (25%) however this is likely due to the fact that minerals data may be access via the Geoscience Regulatory Office or may be included in the Tellus and physical samples/corestore access.

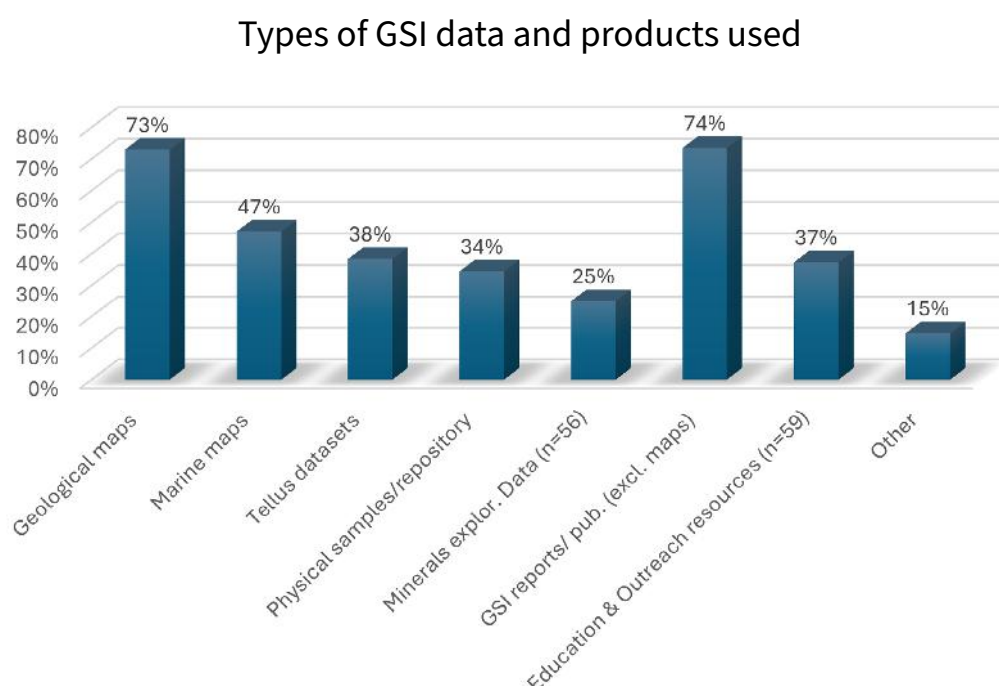


Figure 20 Types of GSI data and data products used by respondents in their research.

Although data are vital to much of the geoscience research conducted in Ireland, the accessibility of this data is equally important. Respondents were therefore asked to rate the accessibility of the GSI data and data products that used, physical or digital. This ranged from the inclusion of high quality data in analysis, to the use of GSI data for project planning, field location identification and comparisons against data collected by other organisations. Feedback included:

“The baseline data provided by GSI maps and datasets forms an important background for more specific academic questions and is invaluable. Generating such datasets is both too time and cost intensive for an academic research group, thus they provide crucial data to support research.”

“GSI has a well archived collection of digital data which provides a foundation for several of my research projects. Specifically, maps, reports and Tellus data provide

⁸ Respondents to Questionnaire A were asked a similar question, but in relation to specific projects only.

important preliminary information which helps the development of research questions and targeting initial research work.”

“The digital products provided by the GSI have been instrumental in many areas of my research the GSI [sic] and are used on a weekly basis for my research and teaching.”

“Access to geological maps and Tellus datasets provides the fundamental underpinnings of much Geological and Earth Sciences research and associated economic activities in Ireland. It is hard to imagine where one would start without access to these excellent and admirably accessible datasets”.

Data and related products have facilitated new collaborations, for example in the area of artificial intelligence/machine learning. Digital data has been used by respondents for applications in marine mapping, geological studies, geothermal energy, mineral exploration, education and training (including outside Ireland by a research fellow previously funded by GSI), and methodological development (e.g. geophysical studies and geochemical studies).

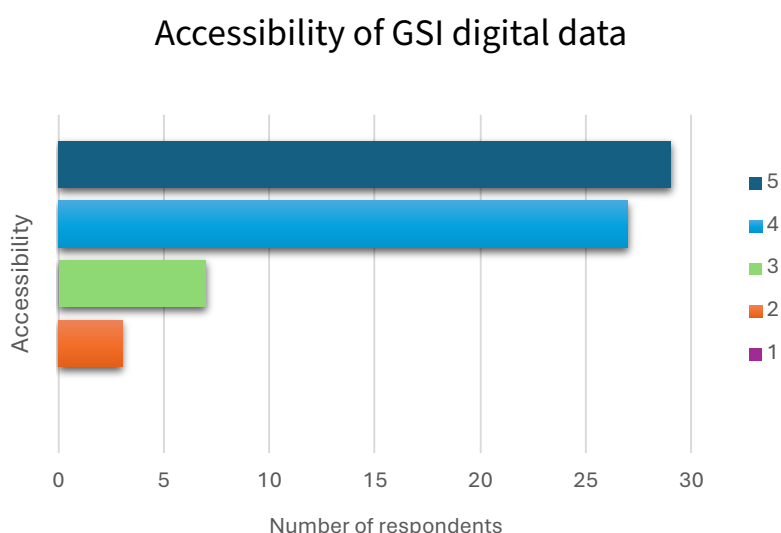


Figure 21 Accessibility of GSI digital data. 1= very negative, 5= very positive.

Over 45% of respondents considered GSI data accessible or very accessible. As reflected in the general comments, the level of accessibility of the data for research activities has greatly improved the impact and increased widespread usage of data.

Respondents highlighted the value to education and training, public engagement, economic activities and research. Researchers also stated the value of GSI data to other, non-GSI funded/co-funded research.

“Access to the Tellus data has been a massive step change in being able to look at geochemistry in Ireland, both as a science resource and as a public facing window for the geological sciences in Ireland. For my own research, it has supported

new collaborations involving machine learning applications as well as providing baseline data for exploring potential projects for the future.”

GSI data are also used for projects beyond the scope of the GSI funding Programme and accessibility allows significant impact through other activities.

“All aspects of the research that I’m currently involved with is underpinned by accessing the various GSI products.”

However, some concerns were included:

“Except for the Mineral exploration data, which took a very long time and was through email request, all the other data was simple to access. The system for accessing core samples could be improved because it is very informal and it lacks transparency on the queue and priorities.”

Leveraging of additional resources and funding

This question aimed to identify research activities that used GSI funded research as a baseline to further develop portfolios of research by the teams funded. One of the goals of the GSI Research Programme was to fund pilot projects that would allow researchers to test theories or methods in small-medium scale projects which could then be up-scaled. However, responses suggest that the question was interpreted by some respondents to relate to the mixing of GSI and other funding in an individual project; this model is used by the SFI iCRAG centre where SFI funding is ‘leveraged’ against industry funds secured. The responses for this question may need further investigation to determine if the percentage of researchers who did not use GSI funding to leverage further projects or funding (65%) is accurate.

[Additional projects] “represent €400,000+ leverage with SFI. Several other industry-funded projects outside of Ireland have been funded, in large part due to the people and skills development on Irish geology. The results of that were seen by industry, who now want to avail of these skills and people, developed within Ireland, for projects outside Ireland... [and a further] leveraging of €450,000+ in the last 3 years” from minerals companies.

For some researchers, GSI funding provided capacity to secure further GSI co-funded, larger scale projects:

“GSI funding allowed leveraging additional funds from other Government agencies (i.e. co-funding arrangement).”

“We used a... model developed as part of a GSI funded project as the basis for a number of work packages in a larger SEAI funded project looking at sediment mobilisation and scour”.

Have you used GSI funded projects to leverage additional funding?

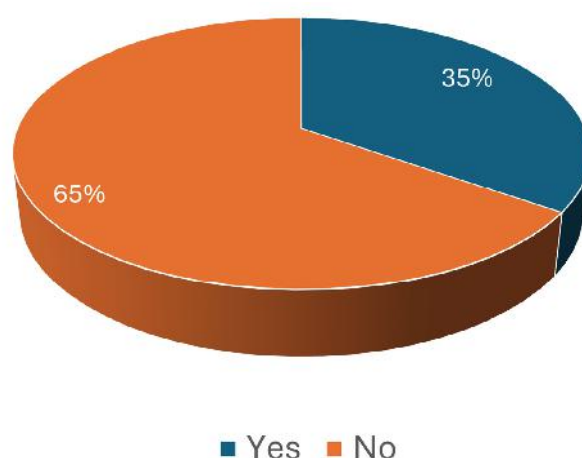


Figure 22 Number of respondents who have used GSI funded projects to leverage additional funding.

“I used results from a GSI Short Call to ‘seed’ commercial interest. After some additional funding via an Enterprise Ireland Innovation Voucher, this led to the new start-up company ‘spinning into’ NovaUCD. A direct benefit for my research is that this resulted in 2 year funding for a post-doctoral researcher, co-funded by SFI/ iCRAG and industry partner.”

“We have used GSI funding to leverage physical infrastructure funded through SFI”.

In other cases, GSI projects, such as Short Calls, provided the baseline data and proof of concept to apply for non-GSI funds and in some cases for international programmes. In-kind or non-cash contributions (e.g. Marine Institute shiptime) have also been leveraged:

“GSI Short Call outputs [were] used (successfully) as a proof of concept study to demonstrate feasibility and potential of a proposed larger-scale project. The Short Call scheme was essential to this process. I do not believe it would have been possible to leverage the latter monies otherwise. The latter now comprises two tranches of funding and payment-in-kind totalling circa 300,000 euros.”

“[U]sing GSI funded projects to secure funding from NSF/NERC to study climate change in deep time.”

“I have used it to lever in kind contributions from academic institutions, e.g. iCRAG, analytical labs, for equipment and staff time, top up funds”.

Capacity building

As per the GSI Research Roadmap, one aim of the GSI Research Programme was to build capacity in the wider geoscience sector in Ireland. As the time of publication, the Roadmap was intended to target areas not addressed by the SFI iCRAG applied research centre or other funders, as well as developing skills and expertise in areas relevant to GSI.

For the purposes of this assessment, the skills and training theme included a broad range of skills developed through the term of the research projects funded. For example, this could include a range of formal and informal training from the use of specialised equipment (e.g. days to weeks working at the ESRL), to supporting full PhD projects. It was also intended that the programme supported the career progression of not only the staff employed, but also the principal investigator (who may not have been directly funded by the project but was responsible for concept, delivery and management).

Have GSI funded projects supported skills and training and/or helped to develop new expertise in your team?

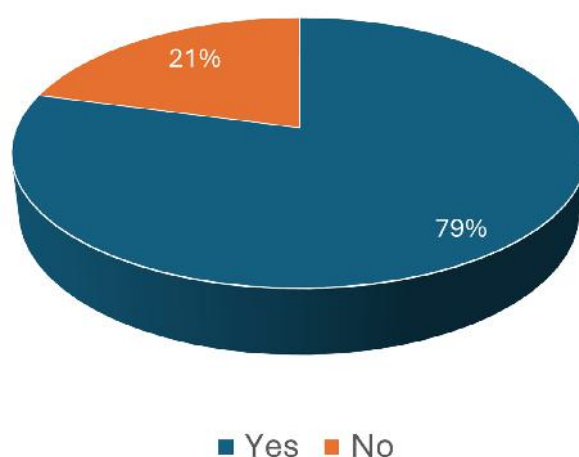


Figure 23 Number of respondents who have developed capacity and/or expertise via GSI funded research.

Seventy nine percent (79%) of respondents agreed that GSI funding and support has helped develop new expertise in their team. This is across a range of team members, from Research Assistants and students, to senior research fellows. The skills development varied from training through research and through the use of e.g. new equipment, to formal training courses funded/co-funded by GSI. For example, skills training included “*analytical laboratory skills for my PhD student and undergraduate research assistant*”. Other specific skills developed and provided in feedback included GIS, modelling (across a range of datasets and topics and including AI), laboratory techniques and methodologies, creative ways to engage with public, and international training modules/workshops.

“Several high-quality, highly trained postgraduate students have benefited from GSI support”

Training types varied but the value of hands-on experience is evident. The development and enhancement of technical skills included:

“training of researchers in CFD modelling and use of GIS”,

“we have developed considerable capacity in a new technical area that was otherwise not possible”,

“Equipping master’s students with machine learning modeling skills to investigate the impact of climate change on groundwater levels.”

“Mine waste expertise”

“These projects have helped our team develop and understanding of new geophysical and geotechnical equipment and to develop new geophysical skills”

“They are building analytical expertise and capacity in our geochemistry lab. We are using our GSI project to train geologists/geochemists in proper database management”.

Although in some cases project topics funded by GSI can be very specific, the training and skills gained have been widely transferable;

“During my Scholarship I learned expertise in a specific method for dating rocks (high-precision U-Pb zircon dating by CA-ID-TIMS), which I have added to my toolbox and has helped me design projects with others and for students.”

In some cases, respondents have tracked team members through their career; one example highlighted a GSI funded Research Assistant who progressed to a PhD and is now working with a campus spin-off company. Other postdoctoral researchers funded by GSI have secured tenured positions in academia.

Respondents were also asked to comment on the impact on their own career development. A significant majority of them (89%) agreed that the GSI funding had a positive impact on their own career. The career impacts for lead researchers ranged from developing knowledge and skills, to the ability to build a team, to facilitating engagement with international groups. In particular GSI calls have supported early career researchers and have provided opportunities to not only build their research portfolio, but also gain experience in writing proposals and managing research projects.

Examples of feedback from researchers, whose career has benefitted directly from GSI grants, include:

“The project that GSI funded helped propel my career in data and project management, allowing me to move to a new department within my organization that better showcases my skills and interests”.

Has GSI funding helped your own career development or those of your team?

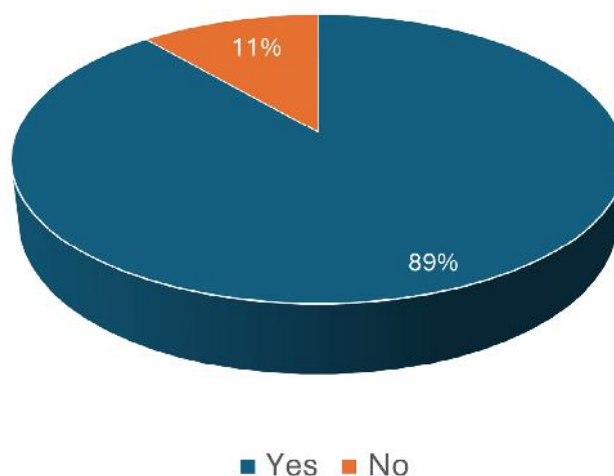


Figure 24 Number of respondents whose career development has been supported by GSI funded projects.

"I was invited to [a] European Map Group (leading by the EU-JCR). Thanks to that I published the first Pan-European map".

"I've grown my own reputation as well as my reseach [sic] network as a results of my GSI work".

"GSI funding has allowed me to expand my research team and target new research topics which are relevant to Ireland/the Irish economy. It has also benefitted the careers of several students and postdocs who have moved through my research group and on to successful careers elsewhere".

"Has provided me a foothold in obtaining grants, which begets more grants. Also highlights that innovative ideas are actually appreciated in Ireland."

"Our relationship with INFOMAR has been very fruitful and enjoyable. Great examples of unforeseen outputs that would otherwise not have been funded. Resulting publications have helped me personally and also former PhD students who have pursued very good academic careers including a recent ERC award".

"I have recently cited my activities associated with the GSI Funded research project as part of a competency assessment in support of an application for professional accreditation (CMarTech) with the Institute of Marine Engineering, Science and Technology."

"Thanks to GSI funding, I have established a new geochemistry lab facility, embarked upon an entirely new research direction (thus expanding my collaborative network), and won a large grant with which I can contribute to international climate adaptation efforts. The long-term impact of GSI short call funding is way above the financial scale of those awards themselves."

“Yes, without question. The funding secured my second postdoctoral position at UCD, and the research was presented internationally at a number of conferences raising my profile. Following this project I then secured a lectureship [in the UK]. The project also allowed further collaborations for my PhD student at the time and has facilitated a number of papers and abstracts.”

The feedback was overwhelmingly positive in terms of career support from Geological Survey Ireland research funding programmes.

Relevance of GSI funded research

In recent years there has been an increasing focus nationally on research and evidence to support policy⁹. Geoscience is relevant to a broad range of policies and is often part of baseline data used for policy or regulatory recommendations and implementation, for example offshore renewable energy, drinking water source management and geothermal energy. Respondents were asked if the research outputs from their projects were useful to wider academic, industry and/or policy geoscience audiences; 99% of respondents agreed. Slightly fewer, 84%, agreed their research outputs were useful to non-geoscience audiences.

Do you feel the products and outputs from GSI funded projects are useful for wider academic/industry/policy...?

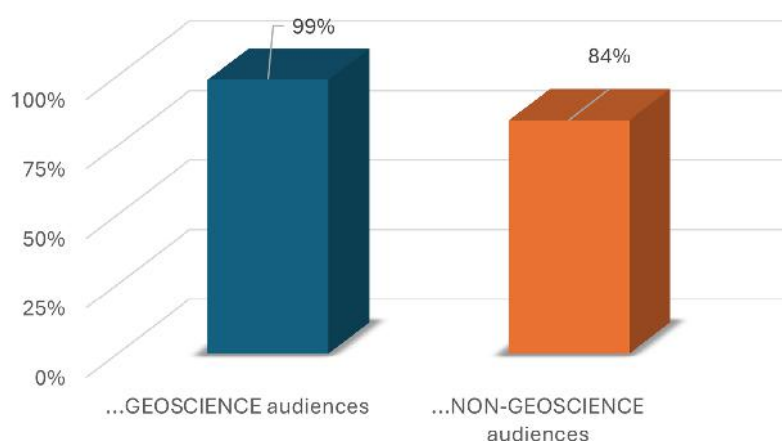


Figure 25 Relevance of outputs from GSI funded research to geoscience and non-geoscience audiences.

It is worth investigating further the reasons for the very high positive response to this question. The intention of the question was to gauge relevance beyond the researchers' own academic research area/sector. This question would benefit from further breakdown across the academic, industry and policy areas rather than geoscience or non-geoscience audiences.

⁹ <https://www.gov.ie/en/press-release/25965-minister-harris-launches-consultation-with-researchers-on-maximising-the-impact-of-research-in-policy-development>

When free text from this question was assessed, responses included generalised statements, e.g. *“foundational geoscience knowledge is fundamental to informed policy decisions”*. Some responses referred to the broader programme rather than specific project outputs:

“GSI funds high quality research which is of broad use to the geoscience community. This is in part through supporting work in established areas but IMPORTANTLY also seeding research in novel areas and providing a springboard to larger academic grants or new industry exploration efforts.”

Whereas, some responses specifically referred to key sectors:

“My own experience is with industry primarily, where it allows us the space and time to properly develop methodologies and approaches to differing analysis, which ultimately industry can utilise.”

“Yes. In my case, the reason I was approached by the start-up company to collaborate was that the founder (a non-geologist) had read my EGU abstract.”

“.. the products and outputs of GSI funded projects are vital for a wide range of audiences. In may [sic] case it was picked up by a commercial entity, but in other cases the academic or policy aspects may be equally important.”

Policy specific feedback included:

“Yes, in my case, research outcome of geothermal distribution and production will inform policy marker for district heating and cooling urban planning.”

“For example, the aempy and AEMpyX (aempy-extended version) is an open source Python toolbox and used by the academics and GSI Tellus team. The products from this toolbox, i.e., shallow subsurface electrical resistivity models are also used by wider academic /industry GEO SCIENCE audiences.”

For relevance to non-geoscience audiences, these ranged from areas such as environmental science, health, outreach:

“I was able to give public presentations a few times as well as attend various national and GSI-sponsored activities (youth science fair in the RDS for example) that would not have been likely otherwise”.

“Yes as we have seen with the UAV feasibility study, the primary impact of the resulting capacity build was that it supported the outputs of the CHERISH programme which were inherently tailored towards general outreach and a wider audience than the Geo-science community.”

“My project, for example, helped to update the national indoor radon of Ireland, used by the EPA in the National Action Plan”.

“There is a considerable overlap with other branches of science (astrophysics/ space weather, oceanography/meteorology, physical chemistry. This also applies to industry (aggregates, solid-state physics). Geosciences are also connected to cultural traditions and in formulating environmental policy.”

Based on text feedback, respondents broadly did not distinguish between geoscience and non-geoscience audiences. This may suggest that investment in outreach and dissemination activities promoting the relevance of geoscience across key policy areas such as health, construction, education, climate, environment, public engagement and energy is worthwhile.

Development of research partnerships

Overall, the quantity and quality of research collaborations is very positive with 83% of respondents stating that the GSI funded projects helped to either further strengthen existing partnerships or develop new collaborations, nationally and internationally. Importantly, researchers also stated that the funding programme helped to develop new partnerships with GSI technical teams and with industry and SMEs.

Has your GSI funded research supported partnerships with other research groups or led to new partnerships?

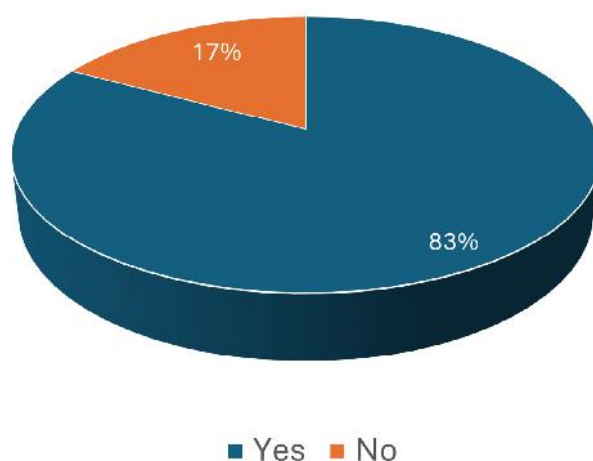


Figure 26 Number of respondents who have developed partnership or new collaborations as a result of GSI funded research.

“The skills developed resulted in an industry collaboration between [two SMEs] and [a UK] University which resulted in a MSc and a paid internship ... for a Masters student”

Many respondents referred to international partnerships, helping to increase the quality and quantity of research activities in Ireland.

“New collaborations are mainly international. As a result of the GSI-funded project I was asked to do an assessment of weathering potential of the Paleogene basalts in Northern Ireland. New collaborations in the enhanced weathering field have also arisen with Northwestern University (Illinois), University of Sheffield, Heriot-Watt (Edinburgh) and the University of Hamburg”.

“My recent Short Call helped me create new international partnerships in Spain, Portugal and Germany.”

Some partnerships were developed across (i) disciplines:

“Both [national and international]. Thanks to my first GSI Short Call award, I built collaborations with researchers in Sweden and Germany, Northern Ireland and the Republic. That project also helped bridge the Geography-Geology divide effectively and gain an IRC postdoc in the process. My second Short Call award has added two valuable Irish researchers to my network and two US-based researchers. Finally, my SFI-GSI funded project includes new collaborators based in the UK and US”

And (ii) with the new technological universities:

“Helped build national collaboration between SETU and TCD, which led to recently EPA-GSI funded award on groundwater recharge mapping”.

In several cases researchers continued the collaboration with further joint funding applications, however some did refer to the need for funding streams to sustain the links.

“It did help for a short time. More funding chains are needed to sustain the connections and collaborations.”

“Initially yes, but momentum lost when PhD student left to take up employment”.

Comparisons to other national funders

Researchers were asked a series of questions to assess how the GSI Research Programme and calls compared to other national funders, e.g. EPA, SEAI, the Marine Institute, Enterprise Ireland, SFI and IRC etc. These questions also aimed to assess the areas of the programme or calls that could be improved.

Most respondents applied to one or more other funding agencies. ‘Other’ included tenders/ procurement for contract research, DAFM thematic calls and Teagasc. SFI and IRC (now amalgamated to Taighde Éireann) fund science across all disciplines, all other funders fund thematic research in areas such as marine science, environmental science, renewable energy etc. Each organisation also has either an organisational strategy, or in some cases are responsible for delivering significant elements of national research strategies, for example, SFI (Impact 2030) or the Marine Institute (Ocean Knowledge 2030). These strategies guide the

research themes and activities funded. In addition, the organisational structures usually include an executive or non-executive board responsible for decisions on research budgets allocations.

Which other national funding agencies do you typically apply to?

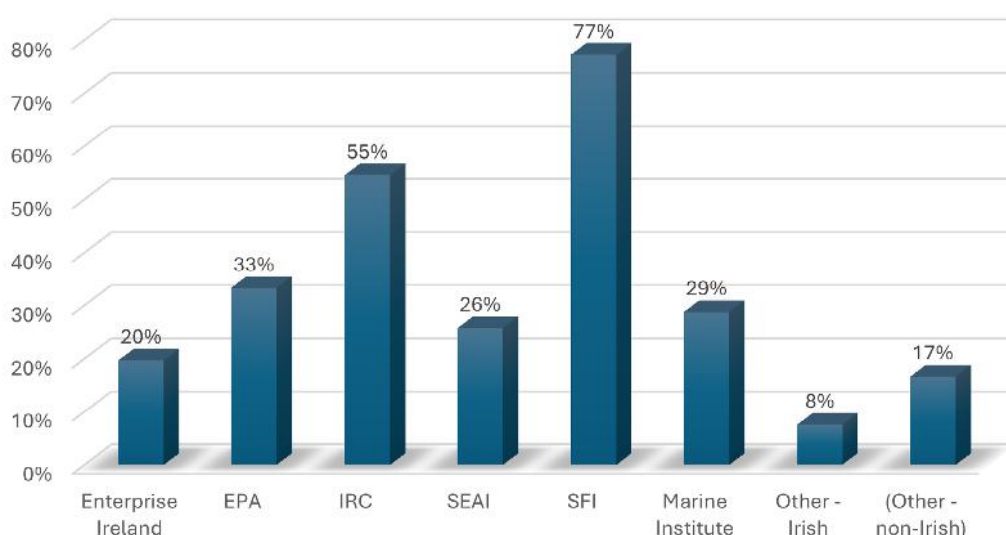


Figure 27 Non-GSI national funding schemes accessed by respondents.

Respondents were asked to rate the GSI Research Programme from 1 to 5, with 1 being very negative and 5 being very positive. Eighty-eight percent (88%) of respondents stated that the GSI funding themes and topics are relevant to their research area compared to the other main funders. Twelve percent (12%) stated it was neither negative nor positive.

Relevance of Themes / Topics

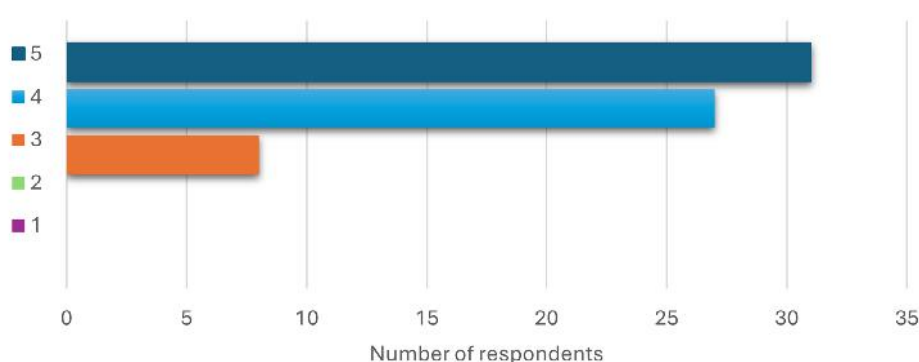


Figure 28 Relevance of themes or topics funded by GSI to respondents' research.
1= very negative, 5=very positive

Comments provided by respondents included positive aspects such as GSI funding available to 'non-faculty' (i.e. non-permanent staff) positions, short review times, efficient and transparent review process, clear expectations in call documents and constructive feedback from reviewers. However, some respondents made suggestions for improvements, including:

- More scope for fundamental or basic research
- Higher number of projects funded under each call (increased funding, though not necessarily number of calls or size of projects)
- Increase funding for some calls/medium scale projects
- Improve timelines for calls (longer time to prepare proposals)
- Scheduled calls in advance (multi-annual/ringfenced funding for calls)
- More flexibility in topics funded

Overall, the comments provided for this section were mixed, often with contradictory statements regarding, for example, review times, review quality, scale of projects funded and topics funded.

How does GSI Research Programme compare to other funders?

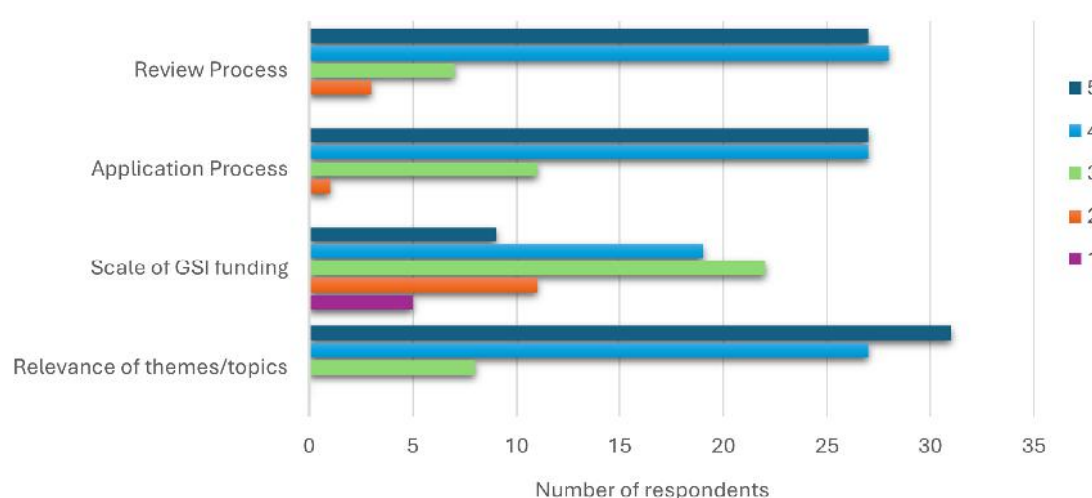


Figure 29 Overall comparison of GSI and other national funding programmes.
1=very negative, 5=very positive

Over 88% of respondents considered the relevance of themes/topics of GSI calls to be positive or very positive, with 12% rating topics as neither positive nor negative. Forty-three percent (43%) rated the scale of funding as positive or very positive with over 33% rating it as neither positive nor negative. Twenty-four percent (24%) considered the scale of project funding to be negative or very negative.

Almost 82% rated the application process (i.e. call documents, templates etc) as very positive or positive with almost 17% stating it was neither positive nor negative. Similarly, almost 84% considered the review process (i.e. timing, feedback etc.) as positive or very positive with almost 11% stating it was neither positive nor negative and just over 4% stating it was negative.

Positive aspects of the GSI funding programmes compare to other funders included:

“I think that one excellent aspect of the GSI Research Programme is the range of funding schemes available - from small, short grants for specific targeted [sic] grants to larger fellowships. This really supports a range of projects and academics at different career stages (critically including ECRs [Early Career Researchers]).”

“Funding is still relatively restricted to faculty positions. GSI is better than other agencies (e.g. SFI) with short calls. Lack of new/innovative equipment and restrictions on existing equipment is an issue (note this is not just for GSI but all of geoscience research in Ireland).”

“The Short Call and Equipment Call templates are clear and the process relatively straightforward. Obviously, the amounts offered by other agencies can be considerably higher, but that only highlights the uniqueness of the Short Call funding mechanism. Without this more moderate competition, many bigger awards would not be successful owing to a lack of pilot data/proof of concept.”

“(1) Short Call + MSc are plugging a gap in the funding streams that allow novel research to be brought onstream in low-risk manner via servicing proof of concept studies. (2) Infrastructure and equipment calls are servicing the geoscience community.”

Negative aspects and potential areas of improvement included:

“One thing which I think could be improved is having some scope for non-applied research. Ireland has an excellent R&D sector but limiting research to projects with a clear short-term applied/economic benefit stifles innovation.”

“Proposal writing is becoming more and more time consuming. There is no need for the volume and all the sections. Yes, it is tax payers money but spending weeks on proposals that should only take days does not make sense.”

“There could be more scope for funding in the topic of Earth system science and paleoclimatology to strengthen Irish researchers’ ability to carry out research in this field and be competitive among international researchers, given the ever increasing number of Irish researchers in this field.”

“Scale of funding seems small compared to other agencies.”

It should be noted that the time required for both proposal preparation and reviewing varies depending on the funding call (e.g. Short Calls versus larger scale Targeted Projects). The primary limiting factor is resources in the Research Team; pre-award activities and call schedules must be organised around other duties and activities.

Respondents were asked to rate the Research Programme service which is coordinated and delivered by the Research Team. Access to information about calls was viewed as positive or very positive (almost 75%), with over 24% stating it was neither negative nor positive. The range and types of funding were considered positive or very positive (75%) with 21% stating it was neither negative nor positive. The call schedule was considered broadly positive with over 70% considering it positive or very positive and just under 29% stating it was neither positive nor negative.

Over 89% stated the responsiveness of the Research Team to queries was positive or very positive, with over 10% considering it neither positive nor negative. Over 70% considered the programme to be positive or very positive in terms of flexibility with over 18% stating it was neither positive nor negative in terms of flexibility in emerging areas. Just over 6% considered it negative.

Rate the following elements of the GSI Research Programme

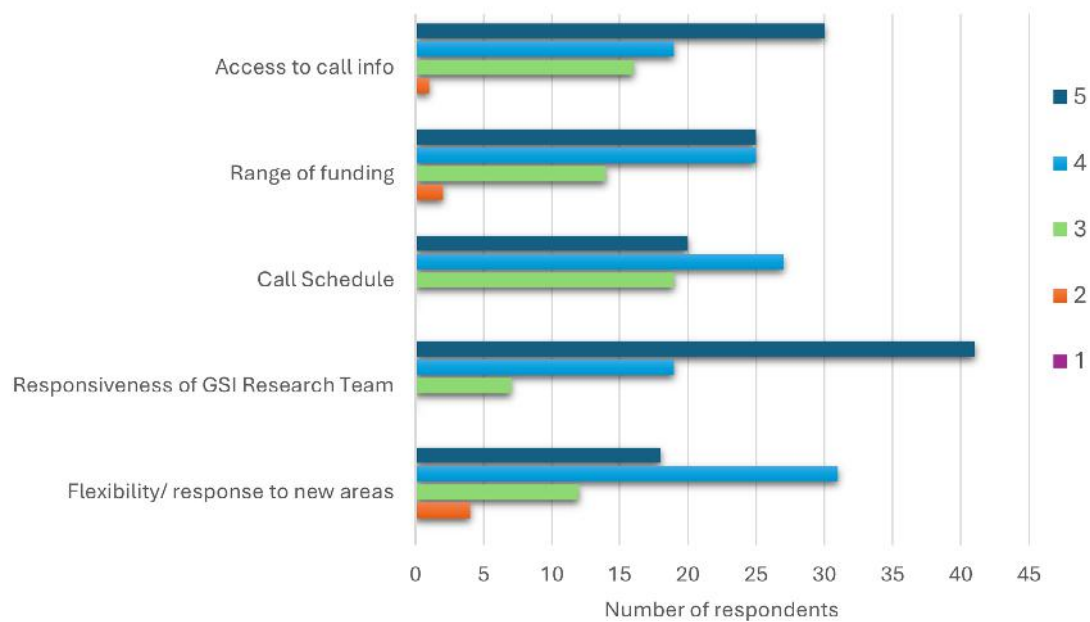


Figure 30 Summary of respondents' feedback regarding access to call information, range of funding types, call schedule, responsiveness of GSI Research Office and flexibility of the programme to new areas of interest. 1=very negative, 5=very positive

Examples of feedback in relation to these questions include:

"The funding calls are great, and application process is relatively smooth."

"The GSI Research Programme is excellent."

"The quick turn around and relatively simple templates of GSI calls is very useful and very welcome".

"I felt the GSI Research funding was clear and straightforward in its requirements. The review process was very fair and the funding provided allows for large research projects to be established."

"The review process is also more time-efficient, which allows to develop pilot project that would lead to major projects."

"Part of my positive assessment of the GSI process would also be the good communication from the GSI itself regards the merits of the project and what was expected."

"The GSI Research Programme is a pro-active and effective initiative which opens the door for the development of new knowledge and partnerships within the Geoscience community."

“Hallmarks of the program have been (1) the way the GSI has been highly proactive in seeking to be as diverse as possible re scope - including responding to new areas of national need re research. (2) exemplary management in terms of the helpfulness of the research officers administrating the program. (3) good communication re funding opportunities (4) imaginative re different funding opportunities - do NOT lose those Short Call and MSc programs.”

“The research team are always available to answer queries and provide help to ensure that all documentation is included and correctly submitted. They give regular feedback on the process and are hugely helpful. Their help and the lessons learned from the process in applying for GSI funding has been invaluable in seeking funding from other funding bodies.”

“I really appreciate the support from Aoife and the team at GSI and thank you for listening to my views and experience.”

Areas which merit further investigation or improvement include:

“The process could be more automated instead of through emails”.

“GSI does fund projects without direct industry links (in contrast with, for example, iCRAG) which does facilitate exciting, innovative research in novel areas. However, I would like to see more flexibility in funding blue skies research without a immediate, short-term applied focus - this isn't uniquely a GSI issue and is common in a range of Irish research funding - however, I do think that short-termism stifles major longer-term innovation”.

“More communication/advertisement on calls is always appreciated”.

*“It would be great to have more scope from the GSI funding themes on fundamental research rather than more applied topics.
It would also be beneficial to have annual calls on existing funding streams to enable geoscientists more access to funding”.*

“Some GSI staff don't appear aligned with their own funding calls.”

“I feel that by restricting the calls to researchers based only in Ireland, the GSI is limiting itself to research from a handful of departments. There are several calls to which we could have contributed (based in the UK), but were not eligible to apply. This also applies to several other research groups who are working on Irish geology”.

“You guys need to embrace space”.

Internal feedback from GSI technical units

The Research Programme has been adapted over the last ten years to increase engagement between external researchers and staff in GSI technical teams. Currently, all funding applications processed by the Research Team are allocated to a technical staff member or nominated person with the relevant technical competencies. This is part of a basic eligibility check to ensure projects are not double funded and are within the remit of the GSI Research Programme. It also provides the technical teams with oversight of the themes and topics submitted. This eligibility check is not part of the assessment. Therefore, it is possible for GSI staff to participate in projects as formal, unfunded, collaborators.

For larger scale/longer projects (MSc, Targeted projects), successful researchers are required to include GSI staff as part of a supervisory or steering group for the project. This ensures that GSI staff are up to date on the research being undertaken, but can also steer and advise the researchers as the work progresses; GSI staff are required to assess the interim and final technical reports for projects. Again, this provides an opportunity to highlight any issues or request any clarifications before the project is finally completed and reports are accepted.

As part of the review presented herein it was important to gather feedback from GSI staff carrying out these tasks. The Research Team met with each Unit/Programme to collect feedback on a range of topics, and any other matters arising. To guide the discussion, and to allow for the technical teams to prepare and gather input from their wider group, questions were circulated in advance of the meetings.

Feedback has been collated and presented below on behalf of the Marine and Coastal Unit, the Groundwater and Geothermal Unit, the Tellus Programme, Minerals programme, Mapping Unit, Data Management, Geoheritage and Planning Programme.

The Role of the GSI Research Programme

Overall, GSI technical teams recognised that the role of the Research Programme has evolved and become more coherent. The operational aspects, rules and structures are clearer with fairer and more transparent processes in place. This includes mechanisms for external collaborations and advisory services and how GSI staff can work with other departments, e.g. the Department of Housing, Local Government and Heritage, and research activities within GSI can complement projects developed with external academic research groups.

With respect to the type of funding available, the ideal scenario identified is that GSI would fund both fundamental and applied geoscience research activities. Some teams emphasised that the role of geoscience research should be strategic, for example focussed on national priority areas, such as climate change.

The Research Programme is seen to have a higher level, and broader overview, of geoscience activities (internationally in some areas) compared to the limited scope of any individual

GSI unit. This has been useful to the technical teams who can be referred to international programmes or projects that can support GSI activities.

The main role of the Research Programme as perceived by most teams to be facilitation and funding calls, promote research and development in geoscience in GSI and to keep links between the GSI technical units and external research. This was viewed as not just outputs and operational activities, but also how information is used and collaborations with external expertise via research projects. The research links are also a useful way to identify gaps in GSI and develop best practice as well as an access route to external expertise.

An important role of the GSI Research Programme (and included in the Research Roadmap, 2016) is to fill gaps and fund key topics that other funders do not support or are not priority areas. This can help to develop emerging areas of research and supports research questions relevant to GSI now or in the future. Maintaining a Research Programme is deemed essential to the technical units. It is important to add value to the other GSI Programmes and collaborate with external groups. GSI staff can also add value to external projects, e.g. as data collectors and custodians, by being involved (for example the offshore geology project. It was also stated that if GSI does not have a research presence, it will miss opportunities for developing expertise as well as visibility and return on investment for national programmes (e.g. data collection supporting policy and industry).

Key Benefits and Strengths of the Research Programme

When asked about the benefits and strengths of the Research Programme, technical teams overall viewed it as dynamic, well organised and stable with good visibility and good processes. The format of the programme is perceived as positive, including in the interaction with GSI staff, and staff being to nominate and develop projects.

A key benefit is that the Research Programme is a discrete and separate operational unit, i.e. centralised and removed from technical units and programmes, thereby providing objective, consistent and fair support structures. The management and monitoring aspects of the programme are perceived as positive with strong research outputs in most cases. The expertise provided by the Research Team in organising robust reviews and ensuring good governance is deemed as very positive. The review and monitoring processes mean that GSI staff do not influence which projects will be funded.

The level of activity across the geoscience research community has been evident from the project presentations at Geoscience and the Geothermal Summit and several staff commented that these poster sessions should continue and are very valuable.

The Research Programme has allowed GSI staff to stay connected to the wider geoscience community in Ireland and in particular academic organisations who are developing the relevant capacity. The Programme is essential to fund and support research which, in turn, can support the work of GSI and other sectors. This includes opportunities to partner with other organisations and groups; activities within the GSI technical teams tend to be limited in scope

and/or resources (time and personnel), the Research Programme provides wider scope to with longer term links and development of new ideas and knowledge.

It was acknowledged that the programme significantly promotes the GSI brand and profile with now wide recognition across more organisations via research funding programmes and projects. The Research Programme is recognised as significantly improving visibility of GSI not just among researchers but also, for example, among other funding agencies and colleagues at national and international level.

An advantage of the Programme is that it can support longer term research collaborations and can keep GSI work relevant and current. This also means that work ongoing in GSI is relevant to industry and policy. It serves as a validation tool for work GSI is doing and helps keeps the interest of GSI staff for further development. Having external research parallel to GSI activities gives the GSI work visibility and credit while keeping communications channels open in both directions. The Research Programme also helps to highlight the expertise in GSI and strengthens it while allowing for further development of technical teams.

The Research Programme has been very beneficial to help translate and interpret GSI data and project results to applied tools, e.g. researchers developed new methods for analysing Tellus geophysics data, which in turn supported the development of a new national radon risk map. In some cases, these have then been directly used for national health and safety or environmental or economic applications such as the radon maps, minerals prospectivity mapping etc. GSI does not always have the capacity to develop these in-house.

The Research Programme offers support on key topics and provides pilot studies that can be forward looking, particularly when GSI staff do not have the time or capacity and where collaborative work can be more suitable. An example is the ability to overlap funded projects with using GSI data or projects that are of interest to GSI but not core priorities. These are very valuable projects that can help groundtruth data or trial new methods that GSI does not yet have the capacity to do, e.g. machine learning methods on hyperspectral data. This also builds capacity externally providing a cohort of experts in the event GSI chooses to do more in these areas in future. Another example is coastal erosion by county (work undertaken as PhD projects) which now needs to be incorporated into GSI operational programmes and rolled out. These projects often benefit more stakeholders beyond GSI, e.g. OPW, Local Authorities etc.

Research activities were highlighted as one area that offers career development and training. GSI staff have learned new information and skills from being involved in projects, particularly during development stages; it can be beneficial to be in the room with researchers gaining new knowledge about the topic but also project development. This can help identify gaps in e.g. data streams. GSI is positioned as the bridge between policy and academia. To support this, it needs to benefit from, and be directly involved in, research activities; it is not sufficient to be data providers, GSI also requires the expertise to interpret the results. Inclusion in external projects can help in maturing their scientific expertise, in particular where promotions internally in GSI are not available.

Since it was established, the GSI Research Programme has also contributed to the improvement in the quality of geoscience research in Ireland generally and it is viewed as positive to have

geoscience specific funding. Externally funded research provides an opportunity for GSI staff to see the application of their work and data and to get feedback on ways to improve e.g. accessibility or data quality. One staff member commented: “GSI gets more from the research when staff are actively involved”

The European agenda was identified as very important and historically GSI has been well connected with most EU funded projects being classified internally as research activities. However, this requires additional support from the Research Team, and visibility, to be able to compete, collaborate on and deliver these projects. Ensuring GSI benefits from EU and international projects (e.g. generating and managing new, interoperable databases that require the latest methods and standards) requires GSI to be ‘at the table’ and using the latest methodologies. For example, hydrographic work has traditionally focussed on water depth but GSI has been successful in adding and utilising backscatter data. GSI can connect both research and operational work which advances the state of the art.

Another vital aspect of the research activities is to support procurement. For example, without work undertaken by external research groups, the technical aspects of writing and assessing tenders for operational work would be significantly more difficult. GSI staff need to be aware of the latest technology and methods available to the market.

There have also been good examples of GSI involved in national and international research infrastructure projects, and developing national monitoring networks, which helps maintain international standards, develops capacity on the island and gives GSI visibility, e.g. the Irish National Seismic Network, magnetotelluric equipment pool, the Earth Surface Research Laboratory, magnetic network, databases etc. These are perceived to be good value for money for the commitment required from GSI.

Weaknesses, Limitations and Potential Threats

Technical teams were asked what they considered were the weaknesses or limitations of the Research Programme. The discussion also included potential threats to either maintaining the programme or developing it further.

One perceived disadvantage of the existing system is the low level of control in research projects, e.g. there are few options between a tender for contract research (where the specifications are detailed and comprehensive) and an open research call (where project delivery is proposed by the researcher). External projects do not always offer exactly what is needed to support internal programmes or projects cannot be redirected during the terms in responses to changing needs from GSI¹⁰. There is also potentially a lack of capacity building within GSI where projects are delivered by external researchers who may/may not remain in the system long term.

¹⁰ It should be noted that this is not the only objective of the Programme.

There is a risk of losing technical expertise in-house and building this up in external contractors/ research groups instead, therefore not building GSI's capacity and increasing risk. There is also a risk that if the Research Programme is not maintained, GSI could lose connections to the wider geoscience community and development of geoscience programmes in the universities, particularly if the technical units do not have the time or capacity to work closely with these groups. The use of a temporary external contract for research management is a significant risk, however in the current climate this was also seen as potentially more secure in the short term (i.e. this is better than the research coordination work being reassigned to permanent staff/ other units or divisions in GSI or DECC). Having a temporarily contracted Research Team was identified as risky by most units in terms of the potential loss of knowledge and expertise.

A potential weakness of the Research Programme is that it is operating in isolation strategically, i.e. lack of scientific strategy in GSI and could divert from GSI's main focus areas.

The lack of mechanism to absorb data into GSI programmes was recognised. In the short term it was suggested that data should be stored in a dedicated part of the system until the fully operational National Geoscience Data Centre is available and fully resourced.

Although research projects can help support activities in-house, this is seen as largely gap filling due to shortage of staff. Lack of capacity also means that there is not much time for technical staff to absorb the details of projects or project reports that they are being asked to review.

Some teams recognised that there is a danger of the Research Programme being used to 'get around' recruitment or procurement issues¹¹. Some teams acknowledged that the topics nominated for the last Targeted Call were the result of not having staff in-house to undertake the work and essentially 'farming it out' to the research community. Some of this work would be better and more effective if it could be done in-house by a postdoctoral level researcher, with additional support or specific expertise being provided by external groups through collaboration. Several units highlighted the recent loss of skills in GSI and further risk of GSI losing capacity, including in the Research Team.

A key threat is the lack of funding and insufficient time for GSI staff to engage; additional resources are urgently required. Staff would prefer to have more time available to guide and contribute to research projects (this is also allowing other organisations to fill the gaps and offer to take on the role that perhaps should be offered by GSI)¹². Some GSI projects have not fully engaged with EU programmes due to lack of capacity. There are opportunities that have not been taken, e.g. there are no EU-scale projects including the Tellus team or outputs, however given the EU focus on soils, including the Soils Mission, this is an active area that the Tellus programme could participate in using Tellus data/expertise. Similarly, resulting from the new Critical Raw Materials Act and associated national requirements, there will be a significant number of high quality and relevant research projects funded by the European Commission; however, GSI does not currently have the capacity to participate.

¹¹ This is carefully monitored by the Research Team.

¹² Currently there are approximately 16 technical staff involved in research activities ranging from 5-30% (*pers. comm.* GSI Director).

Suitability and Types of Calls

Applied topics were viewed as more useful, however it was recognised that there needs to be room for more open research and emerging areas with unknown outcomes. For less applied research, it was suggested that reports with potential applications were useful, including e.g. how it could be developed into an applied tool with further investment.

Overall the value of the range of funding and projects scale was positive. Some projects have been identified as useful for follow on work using data collected, e.g. Tellus and work on the data collected from geoheritage sites to select future Natural Heritage Areas. This work is more suited to research activities or in-house researchers rather than consultancy contracts.

Some staff stated that the most useful type of project was a very specific, co-created targeted projects with one academic institute. This highlights the benefits of co-creation however, the most beneficial type of research activity for this team is to have additional postdoctoral level researchers in-house, as was the case in previous projects.

Short Calls are preferred by several teams as the results are received 12-18 months from the start of the project (longer research projects can be riskier and more time consuming, however they can include staged reporting). Smaller and shorter projects are easier to handle but these are increasingly an issue due to lack of GSI technical staff. One team would prefer not have Short Calls and to focus on longer term projects with technical team members involved in projects, however they did state they do not have time to fully engage.

Masters and Targeted Projects allow for more in depth work and closer engagement with researchers. It is useful to have slightly longer projects (e.g. MSc) that pilot projects (e.g. Short Calls) can develop further.

Some teams find PhD/Postdoc programmes less useful as they are longer and with greater unknowns. For other teams the IRC-type or individual fellowships are most beneficial and are good for linking and maintaining collaborations with external groups, including enterprise partners. Most teams do see more benefit from researchers funded by those projects physically working in GSI.

In general, the view is that co-funding programmes are positive, however as GSI staff do not have a lot of time to engage, there are concerns that GSI is not making the most of some of these.

For some teams, e.g. Education & Outreach, research is considered to be useful (e.g. research on curricula, public perception etc) but not a priority given current demands and resources.

Integration of Research Outputs

Technical teams were asked how best to integrate the research outputs from external projects into GSI programmes.

The Research Programme and projects can help to connect technical aspects of GSI's work, for example links to academia. Several staff commented that the difficulties of integrating results from research is more related to insufficient time to integrate them into GSI activities or data products. However, the advantage is that expertise is developed which is accessible to GSI. GSI staff also commented that they would prefer time to attend conferences, including those where GSI funded projects are presenting (Irish Geoscience Research Meeting).

There is a need for high quality data to be available and build on existing databases. However, there is a threat that GSI will not have the capacity to accept, curate and publish research outputs from projects, e.g. minerals/Geoscience Regulatory Office data, geochemistry data, geophysics data, models etc. There needs to be some assurance that datasets generated by research projects can be integrated into GSI databases and not conflict with cyber security rules. Direct use of the data by GSI is good for co-creation/co-ownership of projects. Datafiles and databases are useful for not only GSI, but to submit to international databases. However to be impactful, the Information Management Team will need further resources.

Several units acknowledged that research data and results may not always be integrated into GSI operational activities, however it is still useful to have the related outputs such as reports, publications etc.

Feedback across all units confirmed that all types of outputs are positive but peer-reviewed publications are preferred and allow GSI staff to refer to them as independent, expert publications in high quality international journals. Where possible, these would ideally be accompanied by technical reports, workshops, databases, synthesis reports etc.

Steering committees in projects were generally viewed as positive, with the extra opportunity to increase the level of engagement, especially for longer projects. The lack of engagement in other projects (which do not have steering committees) is more to do with the limited time available rather than a lack of interest. Steering Committees offer a useful way for staff to get involved in the project and bring more knowledge back to GSI. If there are other external members these can be more effective and increase visibility for GSI and GSI data.

The ideal scenario is that projects can develop new ideas but still answer relevant questions for GSI. Some sections have research and data to publish (e.g. in peer-reviewed journal articles) but insufficient time to publish; there were useful discussions with several units who agreed it would be very useful to have in-house researchers who could support this. Some research positions could also support several units, e.g. working on remotely sensed data, AI methods, data analytics etc.

Some staff highlighted useful projects that were never converted to products, e.g. software to convert electromagnetic inversions. DIAS completed this research however it was never converted by GSI to a full software tool. ESRL work is similar whereby, in the near future, there could be a relevant license developed. However it was noted that GSI will be missing the expertise by then.

Future Support and Resources

GSI technical teams were asked to suggest additional supports that could be provided and which could support GSI objectives.

There are additional opportunities for GSI to fill the gap between policy and applied research directly. It was recognised that the Research Programme is currently being used to identify projects that can help fill gaps in staffing (i.e. external groups undertaking project that should be done by GSI teams). However, several team members agreed it could not be either/or; **more technical staff are needed but alongside continued support for external, open calls.**

Teams also said it is useful to be able to tease out research topics in advance of launching calls. For example, guidance to identify the research question, potential impact and most suitable funding mechanism.

Additional Research Team capacity could potentially deliver:

- A more comprehensive publication list on the website¹³
- More support for development of EU and other projects. This was identified as particularly important if GSI is to become an independent agency and to maintain connections. This would also need require administrative support to manage successful applications.
- More work with other surveys/expert groups/task forces
- Building competencies with other surveys and teams
- Supporting Coordination and Support Actions funding from the EU (e.g. drilling centre of excellence, aggregate work, urban/cities and resources)
- Online tutorials for using data or tools developed as part of projects.
- Addition of data research to the National Geoscience Data Centre
- Continued communication of activities, calls and decisions
- Broader and deeper relationships and collaborations could be developed and GSI remain up to date on latest research
- Horizon scanning for emerging areas of interest and relevance to GSI
- Advice on rules, terms and conditions for calls and during applications perhaps including ways to engage directly with projects, e.g. Letters of support etc.
- Attendance of Research Team at section meetings may help gain an overview of ongoing needs.
- Workshops on academic writing and reviewing
- More cross cutting projects between units in GSI where capacity allows, late afternoon/more informal events may help with brainstorming.
- More communication between sections on previous and ongoing projects and increased buy-in from all units.
- Identifying new opportunities to apply data collected under long term projects, e.g. INFOMAR and Tellus
- Additional reporting for Senior Management

¹³ There is a publications section for the website but it is not comprehensive and not kept up to date by all programmes. Programme webpages also need regular updating, including new publications.

Additional Feedback

Technical teams were given the opportunity to include any other feedback.

By collaborating with external research group, GSI has an opportunity to influence research projects (e.g. EU funded) as an associated partner and therefore increase their relevance and impact.

The challenge is to balance current, applied projects with forward-looking activities supported by GSI, e.g. results from a 2017 mine waste project are now relevant to the CRM Act, similarly with the geothermal energy research projects funded since 2016.

Technical teams feel it is important to be involved in external projects, however they feel they do not have sufficient time to engage. All teams agreed that they would, and would like to, engage more if the time or capacity was available. Even attending relevant meetings or steering meetings is taking time from operational work that other teams or stakeholders require.

Involvement in EU projects is positive with good links and expertise developed with international organisations. This allows GSI to keep up to date on new developments. A positive move would be to have dedicated staff (possibly fixed term contract staff) to work on time-bound, focussed EU projects. Also, EU and LIFE projects are good and very useful for networking, however the administration is very burdensome and support is required if GSI is to remain involved in these. Having support for EU projects from the Research Team, even if it is a small scale involvement or an advisory role, is very useful. In some cases, involvement in EU projects and networks is also an obligation, e.g. EMODNET is a gateway for commitments to deliver data to the EU. It would be better if GSI could be more involved in these projects and scale up activities as well as improving visibility both in Ireland and internationally. This also helps maintain skills and standards and avoid falling behind international colleagues.

It would be good to be able to get involved in more, and broader, projects, e.g. multidisciplinary projects including in the social science and education areas, to support specific technical programmes. This would also provide opportunities to collect robust data and move away from anecdotal evidence.

Technical teams would like to see a commitment from GSI management to defining the role of the Research Programme. Several teams acknowledged that a higher level GSI strategy would benefit the Research Programme in identifying priority areas (topics) as well as other targets (e.g. building capacity). There needs to be a longer term view of the research area and integration into a GSI overall strategy. This should include identification of the key areas to support (e.g. climate) and how (types of projects, capacity building, new skills etc).

GSI has been very good at engaging at both DECC and national level research groups and influencing and informing policy; this should be maintained and supported, e.g. research policy, national climate report, geothermal energy etc.

SWOT Analysis

Following analysis of the feedback from funded researchers, and internal unit in Geological Survey Ireland, a SWOT analysis was carried out. This is based on the current structure of GSI as a division of DECC and the limitations in staffing.

Strengths • Flexibility • Responsiveness • Forward looking • Collaborative partnerships with external groups • Strong Research Team	Weaknesses • Ad hoc calls/inconsistency of timelines • Lack of multi annual funding • Lack of long term planning • Slow & inefficient DECC administrative processes
Opportunities • More EU projects & funding • Stronger international and national funding partnerships • Relevance in key policy areas (climate, Environment, CRM..) • Support from the DECC R&I strategy • Further capacity building in GSI & wider geoscience community • Potential funding from e.g. Just Transition, Climate, CRM etc. • Better integration of Research Programme in the new GSI strategy	Threats • Insufficient staff resources/expertise in technical teams to participate appropriately in research activities • Insufficient time for existing staff to participate • Non-permanent staff/resourcing of Research Programme Team • Potential future funding cuts

Recommendations

Based on the feedback from external respondents to the questionnaires, and internal teams in GSI, 15 recommendations are proposed. Some recommendations will require interaction with Department level units (e.g. R&I unit, HR, Finance etc), however, several can be implemented within GSI (e.g. reporting to Senior Management, allocating time and incentives to allow staff to more fully engage with external research activities).

1. Integration of the Research Programme in the overall GSI strategy development
2. Increase the Research Programme budget and resources for Research Team
3. Implement an online portal and grants management system, with persistent identifiers for grants
4. Develop an annual schedule for calls including multi annual funding commitment
5. Maintain flexibility in programme to be able to respond to external opportunities (e.g. international schemes such as fellowships, travel grants etc.)
6. Maintain international links with e.g. ERANets and Partnerships
7. Maintain co-funding programmes but improve engagement and impact e.g. Taighde Éireann
8. Maintain fully external (international) scientific and technical reviews, however an additional stage could be added to the process to assess relevance and impact for national policy areas and GSI Programmes. Any such element must be fair and transparent.
9. Incentivise GSI staff to engage with research activities, e.g. funding of research conference or workshops, participation and presentations at technical workshops, hosting of events
10. Quarterly reports for Senior Management (including e.g. monitoring annual KPIs, activities etc)
11. Development of fixed term/purpose contracts for research staff in-house. These must not aim to replace staff or deliver operational support, but should focus on *additional* research activities and novel solutions and developing external partnerships for GSI programmes. These positions could include e.g. researcher(s) based in the data management section who could work on development of methods across GSI for in-house data analysis and delivery.
12. Analysis of GSI's role as a Research Collaborator and Research Performer, i.e. as part of overall GSI strategy and stakeholder engagement
13. Develop stronger links with DECC technical units and support of DECC R&I strategy. The DECC R&I team can also support GSI through e.g. improved access to academic journals and other supports.
14. Continued investment in national infrastructures, ESRL, INSN, GSI Corestore, including developing in-house expertise to maximise impact for GSI (geochemists, geophysicists, geologists)
15. Allocation of resources to support national initiatives e.g. Research classification Ireland, roll-out Persistent Identifiers, NORF related open access initiatives etc.

Conclusions

This review has demonstrated that GSI has a strong reputation and brand in the geoscience research community in Ireland, internationally in key areas, and is recognised as an important part of Ireland's research landscape. In particular, it is perceived as a strong advocate for excellent research, innovative ideas, supporting early career researchers and helping to build capacity in the Irish system.

However, externally funded researchers have identified limited funding, lack of an annual call schedule and short-term/very narrow topics as obstacles.

Overall, GSI technical teams are very supportive of the Research Programme and see it as a strong element of the organisation. Many of the issues raised, and opportunities identified, during discussions with GSI staff relate to the limited resources (time, staff and funding), of the technical teams and Research Team; when compared to other thematic research performers and funders/agencies in Ireland, GSI is significantly under-resourced.

Additional budget (and associated resources) for funded and co-funded projects would allow GSI's external collaborators and research network to more fully support Irish and EU policy and directives. The capacity built over the last 10 years should now be utilised to support key areas such as the Critical Raw Materials Act, groundwater directives, climate adaptation and energy policy. Emerging areas for future investment should also be monitored, along with horizon scanning for additional funding and research opportunities.

Collaborations with research performing organisations in Ireland and internationally are invaluable. They also provide GSI staff with important incentives and career pathways, while improving knowledge sharing and maintaining high standards for data and research outputs.

GSI would benefit from further assessment of its role as a Researcher Collaborator and Research Performer in future reviews.

The implementation of the recommendations included in this report will strengthen all GSI Programmes, and activities within the Department of the Environment, Climate and Communications, while supporting national and international policies, directives, and initiatives. However, effective development of the Research Programme will require meaningful engagement and support from the Department (DECC), GSI Senior Management team, administration and GSI technical teams. With this support, GSI and Irish researchers can play an even more significant role in delivering robust evidence and high quality data for policy, our society and the economy.

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Appendix – List of co-funding partners

Clean Energy Transition Partnership (CETPartnership)	A multilateral and strategic partnership of national and regional research, development and innovation programmes in European Member States and Associated Countries, aiming to boost and accelerate the energy transition and to support the implementation of the European Strategic Energy Technology Plan (SET Plan). www.cetpartnership.eu	
Environmental Protection Agency Ireland (EPA),	Aims to protect, improve and restore our environment through regulation, scientific knowledge. www.epa.ie	
ERA-MIN ERA-NET (Raw Materials),	A global, innovative and flexible pan-European network of research funding organisations, supported by EU Horizon 2020, that supports and promotes R&I cooperation in Europe www.era-min.eu	
Fulbright Commission in Ireland	The Fulbright Commission in Ireland annually awards grants for Irish citizens to study, research, or teach in the U.S. and for Americans to do the same in Ireland. www.fulbright.ie	
GEOthermica ERA-NET (Geothermal Energy)	Supports and promotes research and innovation in geothermal energy to make geothermal energy reliable, safe and cost-competitive www.geothermica.eu	
Irish Research Council (IRC) (now Taighde Éireann)	Supports excellent researchers in all disciplines at postgraduate, postdoctoral and principal investigator-led levels www.research.ie	
Marine Institute (MI),	Provides scientific and technical advice to the government to inform policy and support the sustainable development of Ireland's marine resources www.marine.ie	

Science Foundation Ireland (SFI) (*now Taighde Éireann)	Science Foundation Ireland (SFI) is the national foundation for investment in scientific and engineering research www.sfi.ie	
Sustainable Energy Authority of Ireland (SEAI)	SEAI is Ireland's national sustainable energy authority. working with householders, businesses, researchers, communities and government to create a cleaner energy future www.seai.ie	
Taighde Éireann	To promote and support research and innovation in Ireland. www.researchireland.ie	

Trinity College Dublin - ESRL	The Earth Surface Research Laboratory is funded by GSI and supported by TCD. This lab processes the Tellus geochemistry samples as well as supporting geochemistry and geoscience research. https://www.tcd.ie/geology/research/earth-surface-research-laboratory/	
Dublin Institute for Advanced Studies – INSN, Quake Shake, iMARL, MASTER, Magnetic Network	GSI supports a number of infrastructure hosted by DIAS. These include the national seismic network, Community seismology programme and equipment, marine acoustic equipment pool, magneto-telluric equipment pool, and a magnetic network. www.dias.ie	
ECORD/IODP	The European Consortium for Ocean Research Drilling is a management structure and part of the International Ocean Discovery Program (IODP) Exploring the Earth under the sea. www.ecord.org	

