EPSRC Research Outcomes 2022 Report

April 2023

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Contents

NOTE: This document should be viewed using Adobe Acrobat software. Use of other software, such as web browsers, may adversely affect chart appearance. All charts referenced in the report are indicative of the data and should not be solely relied upon as a reference for the outcomes of the visualised data.

1.0 Executive Summary

This report summarises the research outcomes reported by grant-holders to EPSRC. Unless otherwise indicated, it covers all new records submitted via the Researchfish system in or since 2017; it also demonstrates how improvements which enable outcomes data to be automatically harvested (or looked-up and then imported) from authoritative external sources have reduced the need to re-key data and, by doing so, improved data quality and reduced what is recognised as 'reporting burden'.

New and updated outcome records are collected annually in the following categories:

- Publications
- Collaborations and partnerships
- Further funding
- Engagement activities
- Influence on policy, practice, patients and the public
- Research tools and methods
- Research datasets, databases and models
- Intellectual property and licensing
- Medical products, interventions and clinical trials
- Artistic and creative products
- Software and technical products
- Spin-outs
- Use of facilities and resources

In addition, researchers are asked to describe the key findings of a project when it has finished and to summarise the subsequent impact as it evolves. Other categories, outside the scope of this report, cover 'awards and recognition' and researchers 'next destinations' after a project.

The submitted data combines structured data with free-text descriptions: the structured data allows the overall and relative volumes in each of the categories to be assessed, as well as limited qualitative analysis, while the free-text descriptions highlight specific, project-derived impacts. Furthermore, the data submitted in some categories, for example spin-outs and intellectual property, is augmented with additional valuable information obtained from authoritative third-party sources.

Overall, the outcomes data reported by researchers is an essential component in the evidence base EPSRC uses to illustrate how the research we fund delivers benefit nationally and internationally; it underpinned EPSRC's contribution to the UKRI submission to the 2022 Spending Review which resulted in the government's commitment to invest £25 billion over the next three years in world-class research and innovation across the UK; it continues to inform business cases and ongoing evaluations.

Highlights

With over 230k new records since 2017, Researchfish data yields some impressive figures.

116k
Publications reported

1,631
Patent families created

246
Spin-out companies incorporated

£762 Million
Additional Collaborator support

>50k
Public and / or beyond peer group engagement events

£1.6 Billion
Further funding recorded
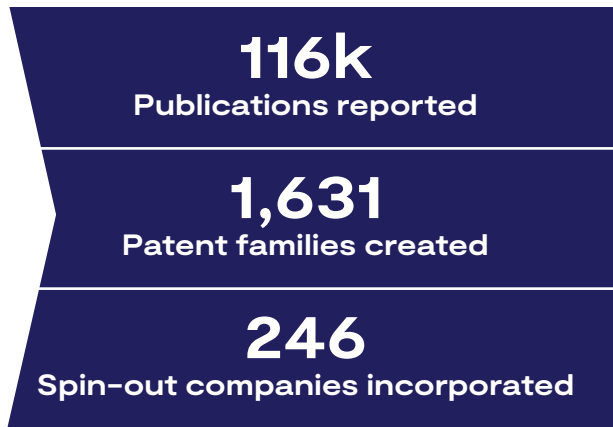
Publications account for c.50% of all new records submitted each year, and over 90% of these are journal articles or conference papers. Citation analysis (adjusted for field and year) demonstrates

the exceptional academic impact achieved by EPSRC-funded researchers, as shown by the top trace in each of these charts:

Field Normalised Citation Impact of publications
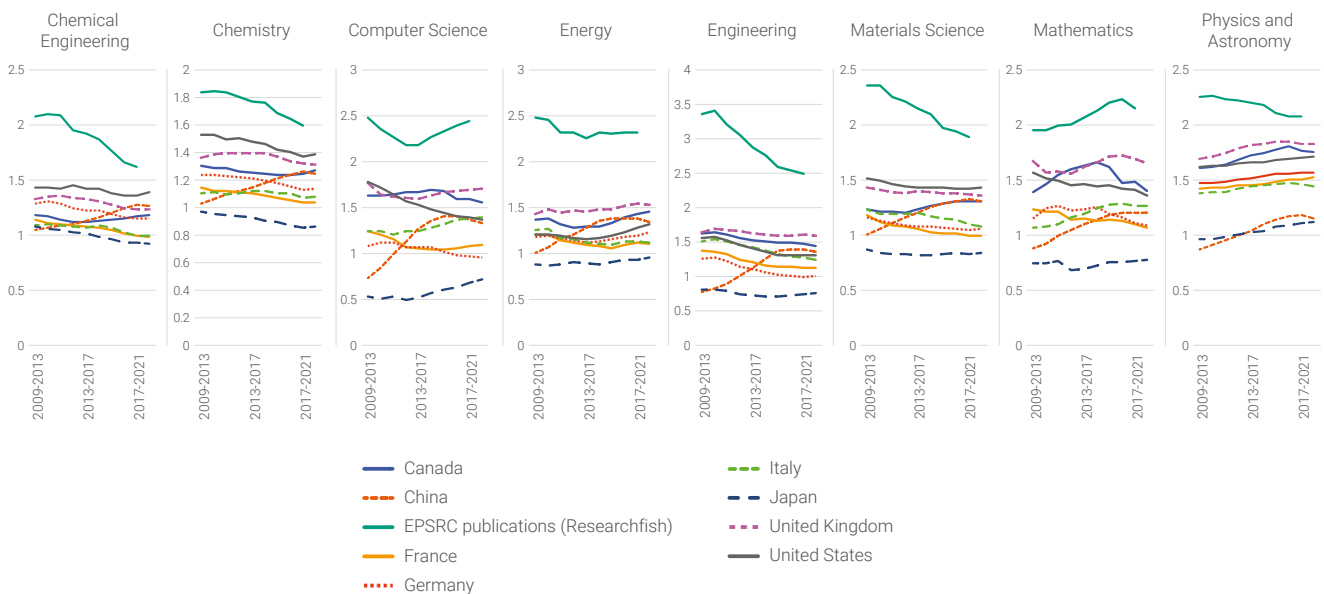
Field Normalised Citation Impact of publications attributed to EPSRC research grants and Fellowships. The approach accounts for differences in citation accrual over time, citation rates for different types of document (only articles and reviews are included), and field-specific differences. Values within a field are normalised so that 'World Average' for the field is always equal to 1. The analysis uses data from Elsevier SciVal and timescales refer to publication year.

The data indicate that EPSRC–funded projects attract around £762 million worth of additional collaborator support over and above the £1.2 billion provisionally committed in successful funding applications:

Submitted collaborations
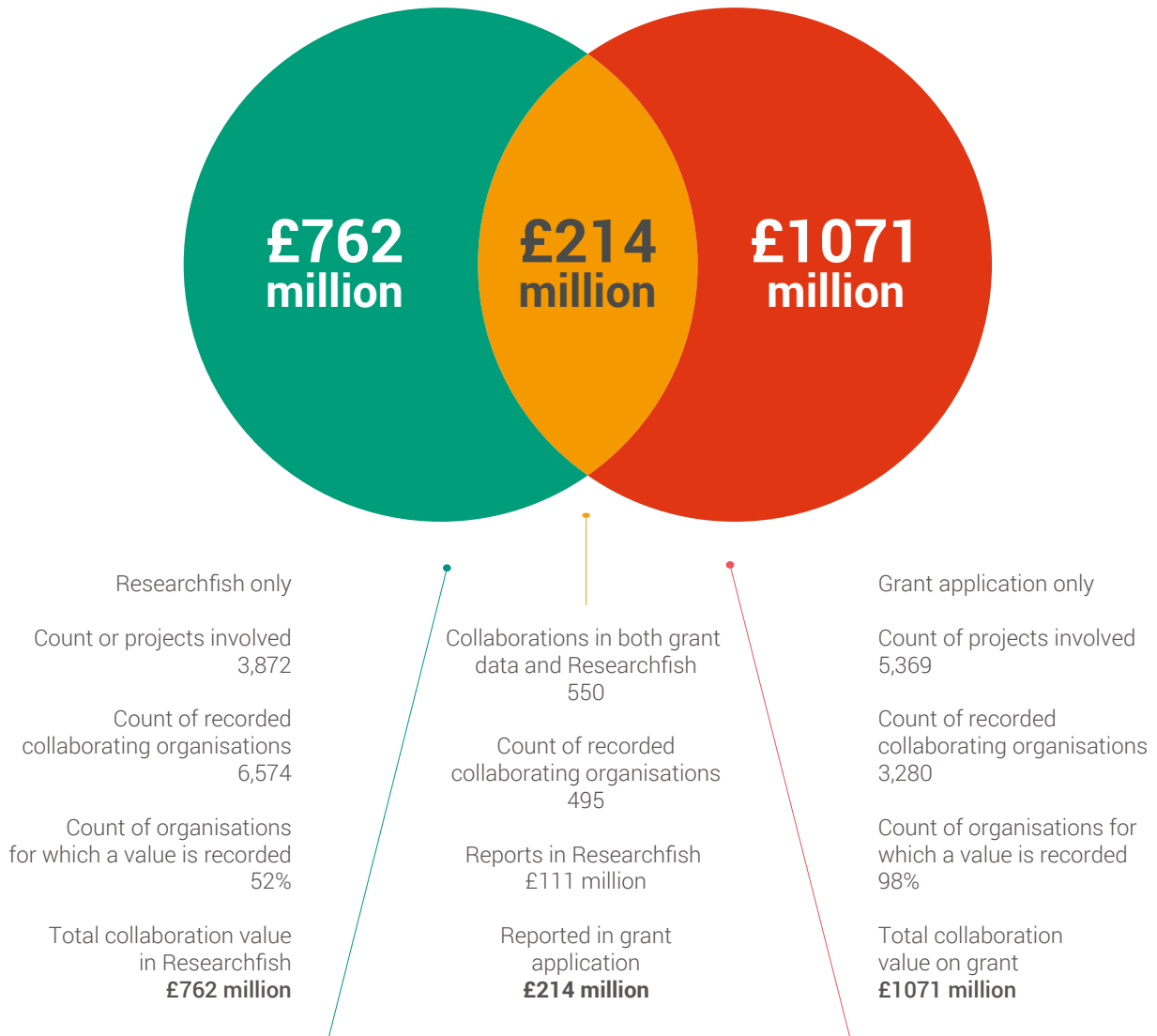
£762 million

£214 million

£1071 million

Researchfish only

Count or projects involved
3,872

Count of recorded
collaborating organisations
6,574

Count of organisations
for which a value is recorded
52%

Total collaboration value
in Researchfish
£762 million

**Collaborations in both grant
data and Researchfish**
550

Count of recorded
collaborating organisations
495

Reports in Researchfish
£111 million

Reported in grant
application
£214 million

Grant application only

Count of projects involved
5,369

Count of recorded
collaborating organisations
3,280

Count of organisations for
which a value is recorded
98%

Total collaboration
value on grant
£1071 million

Count and value of collaborations from grants that have submitted to researchfish© (but not reported collaborations)
462 and £132 million.

(i)   the matched records in Researchfish report a lower value (£111million) than committed at application stage
(ii) the £1,071 million listed against grant applications includes £132 million committed collaborative support to 462 projects at application stage which have since submitted no collaboration records via Researchfish;
(iii) see section 4.4 of report for related commentary.

EPSRC-funded research results in numerous successful patent applications — while they may take some years to be granted, most patent families attributed to research funded by EPSRC still have ten or more years left to run, as shown by these two charts:
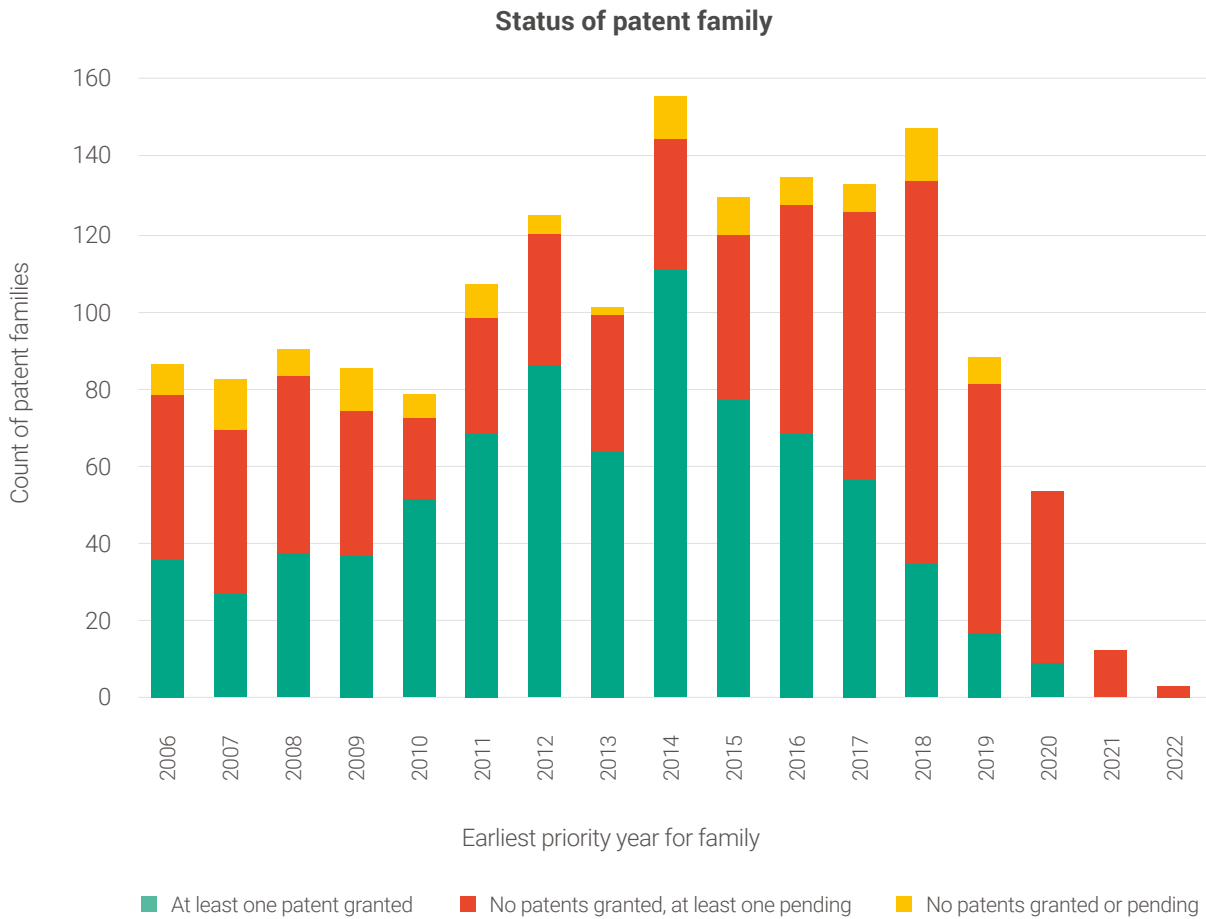
Status of patent family

At least one patent granted | No patents granted, at least one pending | No patents granted or pending

Number of years left to run for patent grants attributed to EPSRC research grants and fellowships
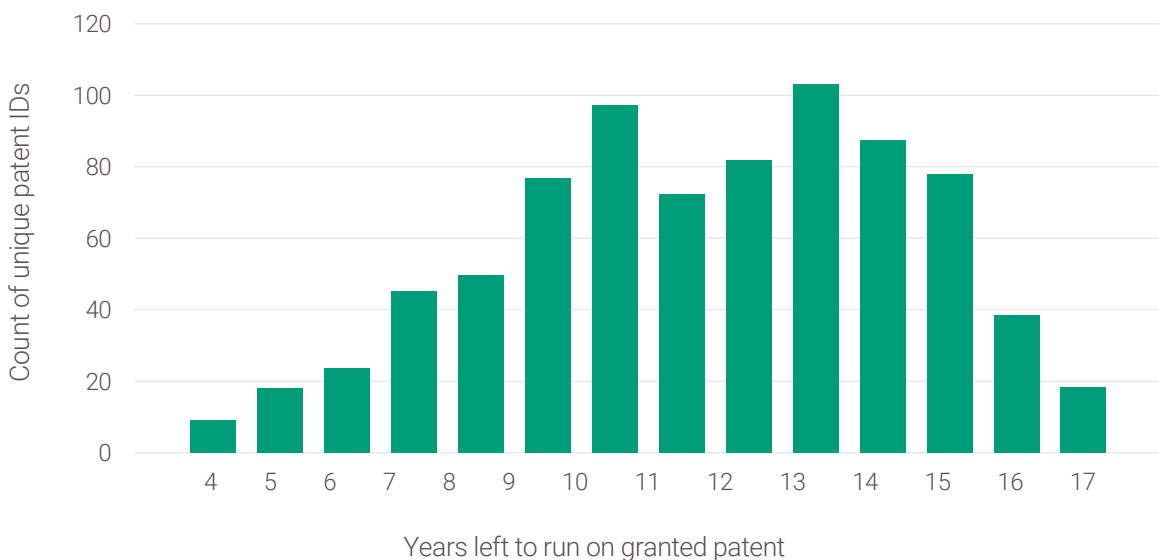
EPSRC-funded researchers deliver results which, in a highly competitive environment, enable them to successfully attract further funding from the private and public sectors in the UK and internationally. The annual value of this additional funding since 2017 has been in the range £1.4B to £1.5B annually.

Further funding by year outcome reported, amount and sector

Year outcomes were first submitted to Researchfish

■ UK Public ■ UK Private ■ International/Global
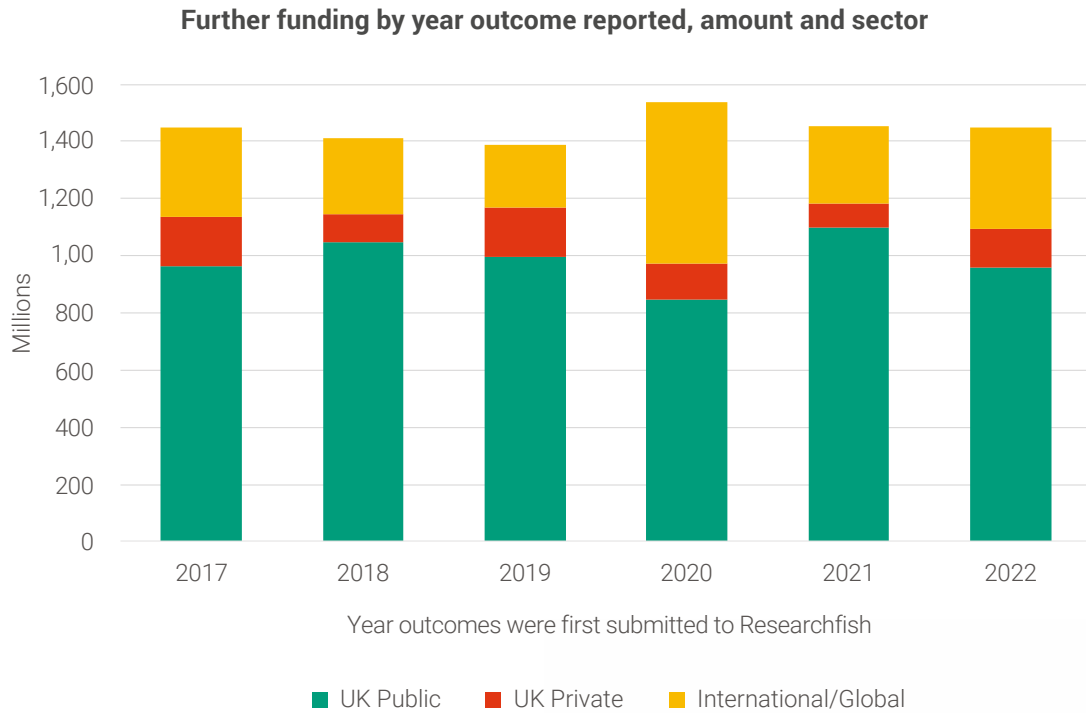
As shown by this chart, EPSRC–funded researchers communicate extensively nationally and internationally with a range of audiences beyond their peer-group boundaries. Over fifty thousand individual records, categorised by the researchers themselves, demonstrate the recorded range of audiences and geographic reach achieved:

Engagement by audience type and geographic location

How EPSRC has used the submitted data

In addition to being able to evidence the internationally recognised excellence of EPSRC-funded research through bibliometric analysis, and the extent to which EPSRC support leverages additional international and private/3rd sector resource for UK research, the submitted data is an invaluable source of examples demonstrating the real-world impact achieved by the research we fund. The following very few examples, all attributed to EPSRC research outcomes, are illustrative – more are contained throughout section 4 of the report.

- Routine efficient matching of 100's of kidney transplant patients with available donors.

- Faster, more sensitive NMR spectroscopy, reducing crucial analysis time from weeks to minutes.

- World-first direct numerical pore-scale simulator, improving the accuracy and lowering the cost of understanding how carbon capture and sequestration affects the overall permeability of underground reservoirs.

- Future Technology Transformations models inform understanding and mitigation of the global economic risks to trillions of dollars' worth of assets (e.g. pipelines, tankers, drilling equipment, oil reserves) arising from a transition to renewable energy sources.

- Internationally recognised benchmark research resource supporting the development of future multi-modal hearing-aids.

- Significantly influenced the International Maritime Organisation (IMO) to become the first worldwide regulatory body to adopt legally binding, global industry-wide, energy-efficiency measures to reduce CO_2 emissions.

- The Collision Reporting and Sharing system ('CRaSH'), which reduces police officer workload and increases public sector efficiency by reducing duplication in accident reporting, is in use by twenty-five UK police forces and has already delivered substantial annual savings.

- One of the world's largest collections of online-accessible research results is enabling SMEs to further develop and apply artificial intelligence to drug development. Two companies in particular, Ex Scientia and Kinetic Discovery, have grown substantially as a result and now employ approximately 50 people.

- The discovery of a druggable pocket in the SARS-CoV-2 spike protein, and simulations made possible by the UK ARCHER supercomputer showing how vitamins, steroids and potential antivirals might affect SARS-CoV-2, has motivated many groups to search for potential antivirals that could bind that pocket.

We are therefore profoundly grateful to all those who, year on year, take the time to reflect and keep us informed about the impact of their work via their Researchfish submissions.

2.0 Introduction

This report provides an overview of the outcome records that have been attributed to EPSRC funded research-grants and fellowships and submitted to EPSRC by the relevant Principal Investigators and Fellows (PIs) via the online Researchfish platform. Analysis of the submitted information helps EPSRC to understand the outputs, outcomes and impacts of the research it funds, provides valuable evidence to support a range of evaluation activities, and enables the identification of potential case studies, all of which contribute significantly to the case which EPSRC, as part of UKRI, makes for sustained public investment in research.

PIs are normally required to submit their records annually for the duration of the funded project and, because most outcomes and impacts emerge after a project ends, for a further 5-years after the period of funding[1,2]. The annual reporting period is usually between February and mid-March.

In general, each section of this report focuses on one of the specific 'common outcomes' collected in Researchfish. These include:

- Publications
- Collaborations and partnerships
- Further funding
- Engagement activities
- Influence on policy, practice, patients and the public
- Research tools and methods
- Research datasets, databases, and models
- intellectual property and licensing
- Medical products, interventions and clinical trials
- Artistic and creative products
- Software and technical products
- Spin-outs
- Use of facilities and resources

Other sections outside the scope of this report collect information on the 'awards and recognition' accorded to research team members and their 'next destinations' following the end of a project.

In addition to the above 'common outcomes', the short summaries of key findings and impact that EPSRC requires for each project are also covered in this report.

While EPSRC first used Researchfish in 2014, a large proportion of the records submitted in 2014 and 2016 represented data that had been collected previously using legacy systems and migrated into Researchfish. Because of differences between the data structures used in those systems and in Researchfish, many such records are 'incomplete' in Researchfish terms. Therefore, unless otherwise specified the data in this report covers all outcome records submitted to EPSRC since 2017; it also excludes outcome records attributed wholly to studentships or other funders.

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(1) While five years is the norm, some small grant schemes (e.g. travel grants) need only report for three years after the funding ends, while other particularly large or long-term investments may need to report for eight years after their funding ends.

(2) While reporting outcomes as required is a standard condition of EPSRC grants a PI may, exceptionally, be exempted from reporting in a particular year if this is justified by their personal circumstances.

3.0 Methodology

3.1 Researchfish submission overview

To put into perspective the number and type of outcomes reported to EPSRC via Researchfish, Table 1 below shows the annual count of EPSRC research-grants and fellowships for which a Researchfish return was submitted in years 2017 to 2022[3]; overall during that period 9,678 individual PIs have submitted new (or updated existing) outcomes on 20,434 grants.

Figure 1 below. shows the total number of PI's submitting and Table 1 below lists the annual number of PIs submitting outcomes, the number of unique outcomes submitted and the count of grants they are attributed to (note: individual outcomes can be assigned to more than one grant).

Figure 1: The count and percentage of EPSRC fellowship or research-grant PIs making a submission each year in Researchfish from 2017-2022. The total number of unique PI's having made a submission in this period is 9,678. The total number of research grants and fellowships to which outcomes were attributed during the period is 20,434.
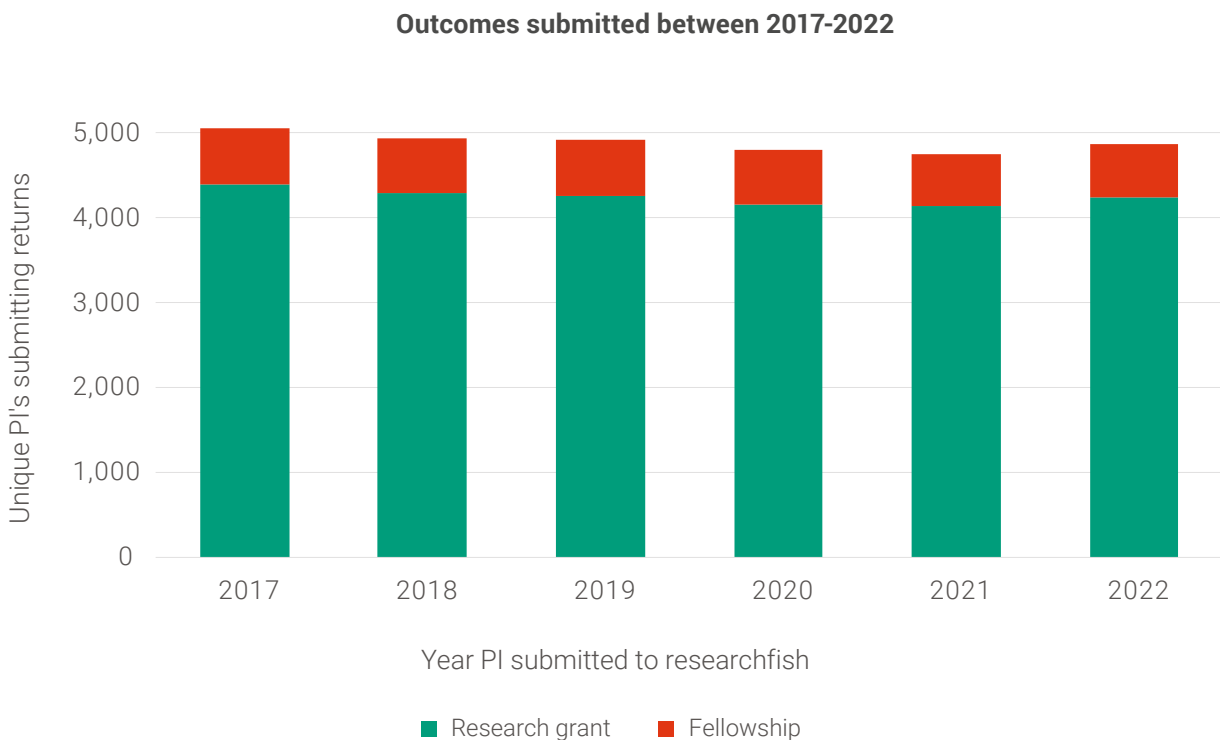
Outcomes submitted between 2017-2022

Table 1: Number of PIs and records submitted each year with associated grant value, 2017 - 2022

Year Submitted	Number of PIs submitting	Number of unique outcomes submitted	Number of unique grants
2017	5,061	227,965	8,518
2018	4,934	249,444	8,111
2019	4,930	269,889	7,906
2020	4,796	287,569	7,464
2021	4,750	309,258	7,206
2022	4,878	338,211	7,355

1) Outcomes can be submitted against more than one grant within a year. Duplicates have been removed in this count.
2) Numbers in each column cannot be added to create a grant total as PI's will submit against some of the same and some different grants each year and outcomes might be submitted in more than one year.
3) Grants will appear in more than one year as most grants are expected to be submitted against for 5 years post their end date.
4) Count of grants removes any duplicates in grant number due to transfered awards.

The largest number of PI's submitting outcomes was in 2017; the general reduction in the number of PIs mirrors the slight overall contraction in the number of PIs being expected to report (i.e. those actively funded or having been funding within the previous five years); the slightly lower figures seen in 2020 and 2021 reflect the impact of the COVID-19 pandemic. Overall compliance with our reporting requirements (as measured by the actual compared to the expected numbers of grants which have outcomes submitted) has been consistently high, although it too has understandably been impacted by the COVID pandemic (2017 = 96%, 2018 = 96%, 2019 = 97%, 2020 = 93%, 2021 = 90%, 2022 = 97%). Note that since a PI may be responsible for reporting on more than one grant, the rates of individual PI compliance with our reporting requirements differ slightly from the figures given above: 2017 = 97%, 2018 = 97%, 2019 = 97%, 2020 = 94%, 2021 = 92%, 2022 = 96%. No current EPSRC grants have yet had to be suspended due to non-compliance with our reporting requirements; the small proportion of closed grants for which no report is submitted is typically due to the retirement – or departure from academia – of the PI concerned.

3.2 Submitted data overview

Individual 'common outcome' records can be attributed to more than one grant, and Table 2 below shows, for each outcome type, the difference between the count of unique outcome records created in or since 2017, and count of record-to-funding attributions reported. For example, some of the 52,717 unique engagement records have been attributed to more than one EPSRC grant or Fellowship, leading to a total of 69,540 links between those unique records and EPSRC funding.

Table 2: The count of unique outcomes and count of total outcome-funding links recorded in or after 2017 for each outcome type in Researchfish.

Outcome Type	Total Outcomes	Unique Outcomes	Distinct count of Award References
Products	180	154	112
Spin-outs	605	394	482
IP	1,554	1,133	703
Artistic and Creative	1,564	1,145	401
Tools	2,072	1,733	1,136
Facilities	3,167	2,228	1,119
Software	3,198	2,578	1,403
Key Findings	4,435	4,435	4,435
Narrative Impact	4,533	4,533	4,533
Policy	5,669	4,075	1,359
Databases	6,695	5,232	1,925
Further Funding	17,686	13,066	4,646
Awards and Recognition	21,262	14,818	3,630
Collaborations	23,968	18,842	4,497
Engagements	69,544	52,775	4,929
Publications	163,595	113,263	10,015
Grand Total	**329,727**	**240,398**	**11,242**

Overall variations in the proportions of the different outcome types being attributed annually to EPSRC research are shown in Figs 2 and 3, in which research-grants and fellowships are considered separately to explore if they tend to result in different types of outcome.

For research-grants (Figure 2), the overall distribution of outcome types suggests that the proportion of non-publishing outcomes has increased over time. The proportion of engagement outcome types, especially, has increased over the last two years, which may reflect behavioural change during the pandemic. Fellowships (Figure 3) show a slightly different impact from the pandemic, with a small increase in publications and decrease in engagements. In both cases publications represent the largest share of outcome types; the small decrease over time for research grants is considered due primarily to the impact of legacy data comprising a much larger share of publication records because of previous approaches to reporting research outcomes; it may also reflect the increased use of harvesting publications metadata, as discussed below.

Figure 2: The distribution of common outcome types attributed to research grants as submitted in Researchfish between 2017-2021. The right pan`el excludes publications since the number of publications can account for ~50% of the outcome portfolio.

Percentage of outcomes submitted for each fellowship to Researchfish 2017-2022 by type

Percentage of outcomes submitted for each fellowship to Researchfish 2017-2022 by type

Excluding publications

Year first submitted

Year first submitted
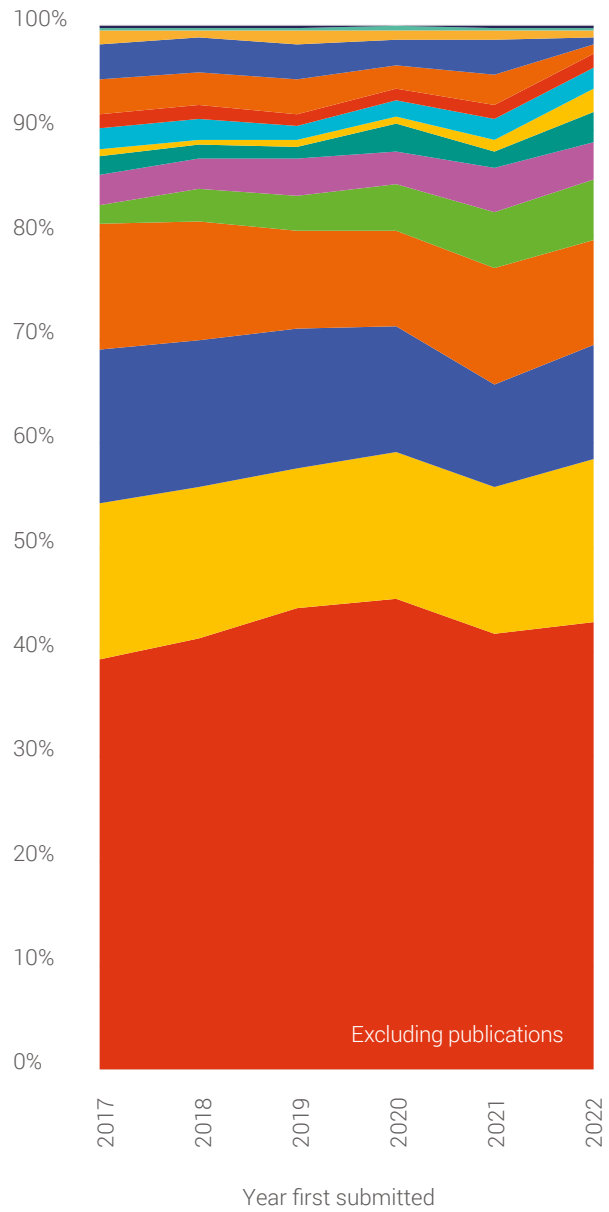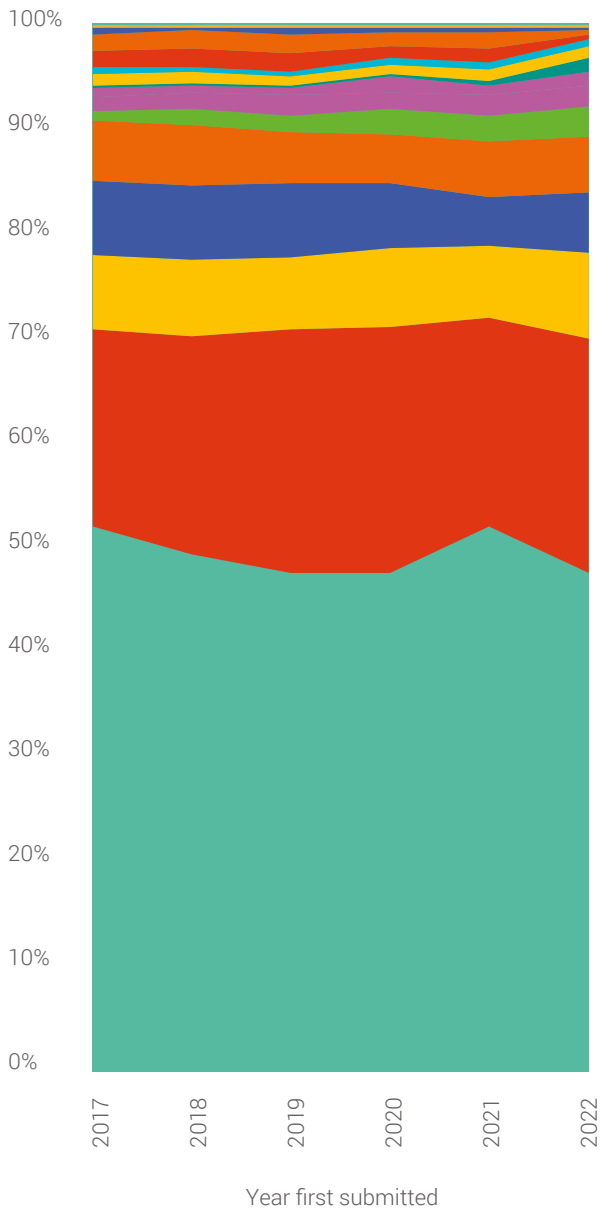
- Publications
- Engagements
- Collaborations
- Awards & Recognition
- Further Funding
- Databases
- Software
- Policy
- Facilities
- Artistic Creative
- Tools
- IP
- Narrative Impact
- Key Findings
- Spin-outs
- Products

Figure 3: The distribution of common outcome types attributed to Fellowships as submitted in Researchfish between 2017-2022. The right panel excludes publications since the number of publications can account for ~50% of the outcome portfolio.

Percentage of outcomes submitted for each fellowship to Researchfish 2017-2022 by type

Percentage of outcomes submitted for each fellowship to Researchfish 2017-2022 by type

Year first submitted

Year first submitted

Legend:
- Publications
- Engagements
- Collaborations
- Awards & Recognition
- Further Funding
- Databases
- Software
- Policy
- Facilities
- Artistic Creative
- Tools
- IP
- Narrative Impact
- Key Findings
- Spin-outs
- Products
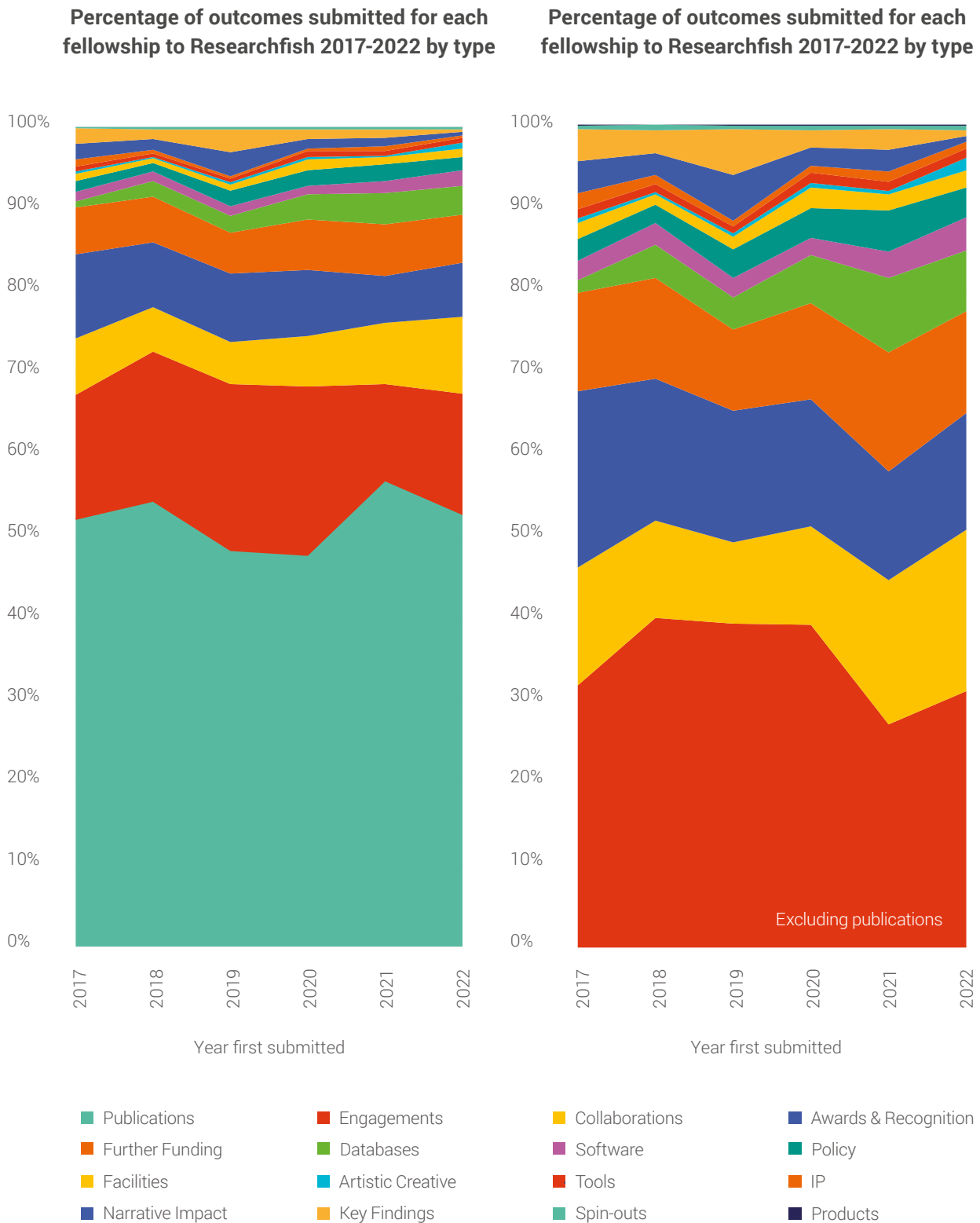
In 2021, however, it's noticeable that the share of publications as a type of outcome increased for both research grants and Fellowships. A possible explanation could be that the COVID-19 pandemic and related 'lockdowns' may have had less impact on the generation of publications than other outcome types such as 'awards & recognition' which noticeably reduced as a proportion of outcomes recorded in the same period.

3.3 Data challenges - overview

Although PIs are responsible for confirming the accuracy of submitted outcome records, the records themselves may have been created by others and, to the extent that they may be created manually they are subject to normal human error and/or misunderstanding of the information that is being asked for. The Researchfish system incorporates validation checks to reduce the occurrence of basic errors – for example to prevent the mis-attribution of an outcome if it pre-dates the start of a grant to which it has been attributed; it can however still be challenging to identify other forms of 'human error'.

In addition, the collaborative nature of research can lead different people to record the same outcome, leading to duplicate records and the wasted effort involved when different users create similar records describing the same actual outcome. Often, but not always, the different users will know each other, and to reduce duplication of effort the system allows them to 'share' their outcome records. Despite this, however, 'duplicate' records do inevitably still occur, typically when those creating them are unaware that someone else has already done so, but sometimes the same person creates more than one record describing the same outcome in the same Researchfish section and

attributes them to the same grant. It is straightforward to detect and take account of such duplicates if the records include unique persistent identifiers, such as DOIs; however, in the absence of such unique identifiers, duplicates can be very hard to detect.

An additional challenge arises from the fact that some research outcomes can properly by described using more than one of the Researchfish 'common outcome' types. For example, new software that constitutes an addition to shared research infrastructure may be recorded in the 'Research Tools and Methods' and/or the 'Software and Technical Products' section.

The overall research outcomes database must, therefore, be assumed to include some 'duplicate' records which refer to the same individual outcome, such that the total number of genuinely unique outcomes will be less than the sum of the count of unique outcomes given in each section. Despite this, and unless otherwise noted, the data described in this report is believed representative of the overall scale and distribution of different types of outputs and outcomes to have emerged from EPSRC funded research grants and Fellowships over recent years.

3.4 Understanding the real age of submitted outcome records

While the specific details of some research outputs are not expected to change over time, the impact that arises from them may yet evolve. Most 'common outcome' records in Researchfish therefore include space to summarise the outcome's impact and PIs are encouraged to update their records as appropriate in each submission period. Unfortunately, as the charts in Figure 4 and the data in Table 3 below show, 'common outcome' records are in practice very rarely updated, meaning that most of them must be considered as dating from when first - rather than most recently – submitted, and that the impact reported against individual outcomes is seldom up-to-date[4].

This issue is somewhat mitigated by the 'Narrative Impact' additional section which EPSRC (and most other UKRI Research Councils) adds to most grants. This asks researchers to summarise the longer-term impact of the project as a whole, and the responses provided comprise a particularly valuable source of evidence. Since 2020 EPSRC has proactively encouraged PIs to consider updating their responses to the questions in this section, and the 'Narrative Impact' chart in Figure 4 shows the success of this strategy: in 2022, some 60% of Narrative Impact records were either brand new, newly updated, or only one year old, representing a significant improvement to the contemporary relevance of EPSRC's research outcomes dataset.

(4) Note that the grand total data in Table 3 includes all records prior to processing to identify and exclude duplicates and clear errors. Thus the sum of the grand total figures over-states the number of useful submitted records.

(5) The 'Grand Total' figures represent the data as submitted and will include erroneous records undetected duplicates.

Figure 4: For the outcomes in Researchfish that include a written Impact Statement, the charts show, for each outcome type and year, the proportions of submitted records that were new, resubmitted without change, or updated.
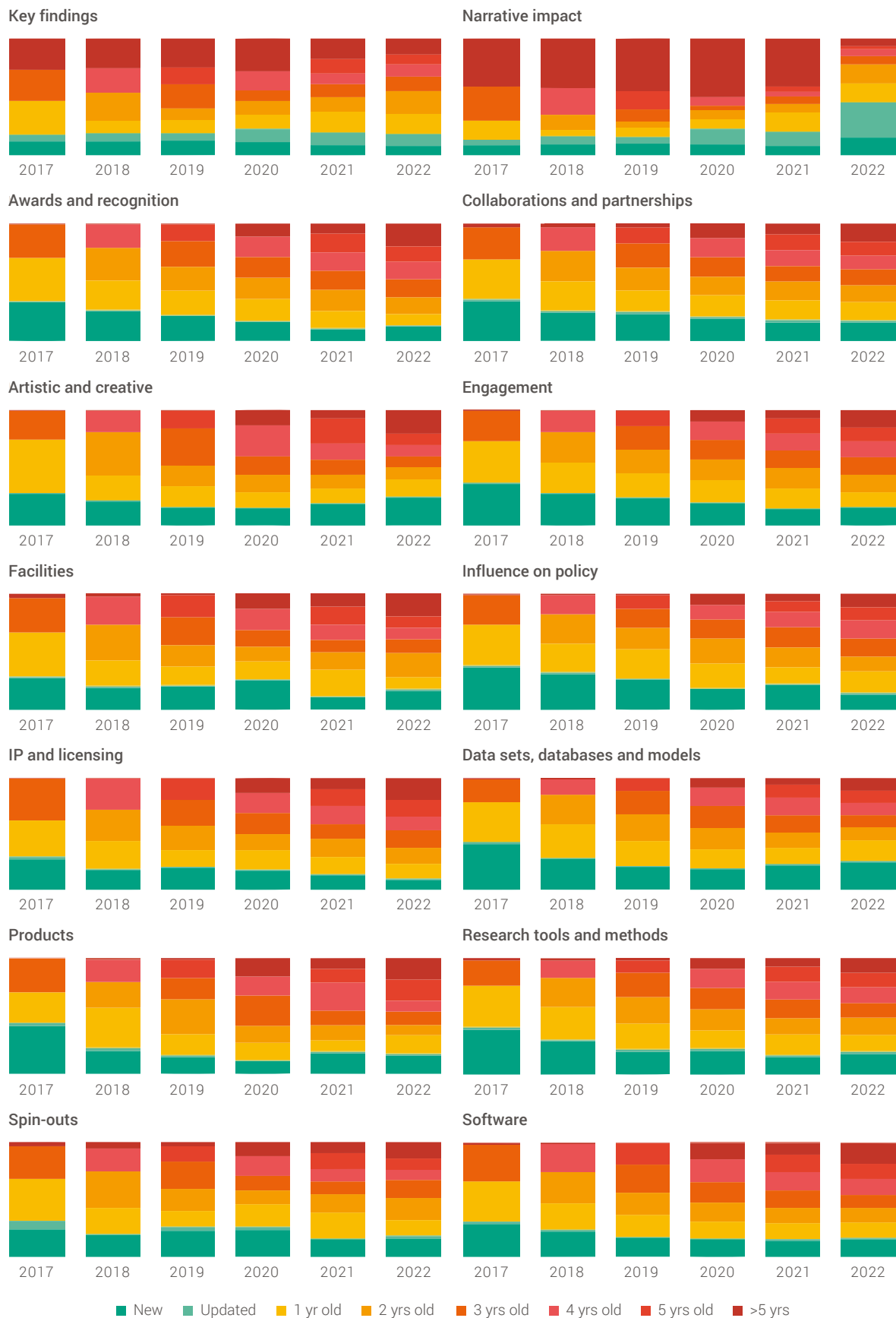
Age of written impact statements

Table 3: Data showing the raw counts of the impact statements that were last updated and submitted to EPSRC each year in Researchfish for research-grants and fellowships for each outcome type. This table is linked to the data shown in Figure 4.

Year the record was last updated

	2017	2018	2019	2020	2021	2022	Grand Total
Awards and recognition	19.4%	19.5%	19.6%	16.5%	11.2%	14.7%	**14,611**
Collaborations	18.0%	16.1%	18.7%	17.6%	17.5%	18.9%	**14,672**
Artistic & creative	14.7%	14.4%	11.8%	13.0%	18.2%	29.7%	**1,034**
Engagement	16.3%	16.7%	18.2%	17.7%	14.5%	17.6%	**52,444**
Use of facilities	15.9%	12.9%	16.3%	25.2%	12.0%	20.3%	**1,204**
Intellectual Property	23.5%	15.8%	19.1%	17.6%	14.9%	10.7%	**1,139**
Policy influence	15.7%	18.5%	18.3%	14.3%	20.6%	15.1%	**1,515**
Medical products/ interventions	29.6%	17.0%	13.2%	10.1%	17.6%	17.0%	**159**
Database	16.3%	14.4%	12.8%	13.5%	19.0%	26.4%	**2,794**
Research methods	18.9%	17.7%	15.2%	18.0%	15.2%	19.9%	**1,771**
Spin-outs	18.5%	13.1%	19.4%	22.3%	14.4%	18.5%	**444**
Software	20.4%	18.4%	15.5%	15.5%	15.6%	17.5%	**2,472**
Key findings	22.0%	22.9%	21.9%	24.9%	19.8%	16.9%	**6,627**
Narrative impact	16.2%	19.2%	17.5%	22.9%	18.2%	36.6%	**5,303**

3.5 Improvements to the reporting process

During the period covered by this report Researchfish has made significant advances in 'inter-operability'. By exploiting the shared used of agreed unique identifiers, such as 'DOI's, these reduce the time it takes researchers to report some common outcome types – records in external systems that include attribution to a valid grant reference can now be directly imported to PI's portfolios of 'Publications', 'Artistic and Creative Products', Software and Technical Products' and 'Research datasets/databases' in Researchfish. In addition, if such direct import (a.k.a. 'harvesting') is not possible (because the available data does not include a valid grant reference), the system allows records in those sections, and in the 'Further Funding', 'Intellectual Property', and 'Medical Products, Interventions and Clinical Trials' sections, to be directly identified and imported from authoritative external sources such that the PI need only add any descriptive information (such as 'impact') and link the imported record to the relevant research grant.

A further advance is that researchers are able to link their ORCID and their Researchfish accounts in such a way that if they confirm a publication in their ORCID account it will within a very short time appear in their Researchfish account where they can then make the necessary link(s) to the relevant grant(s) which funded the work.

The impact of these advances are well illustrated in other sections of this report, notably in Figure 12 and the inset chart in Figure 27, both below. In principle, this degree of automation enables researchers to focus much more on recording details of outcomes and impacts that cannot be looked up; indeed, it is considered likely to have contributed to the observed reduction of 'publications' as a proportion of all submitted outcomes noted in section 3.2 above. A further advantage is that by re-using data from authoritative sources the quality of outcomes data is significantly improved.

4.0 Results

The following sections describe the data submitted in response to the common outcome types in Researchfish, beginning with PI responses to the 'Key Findings' and 'Narrative Impact' additional questions.
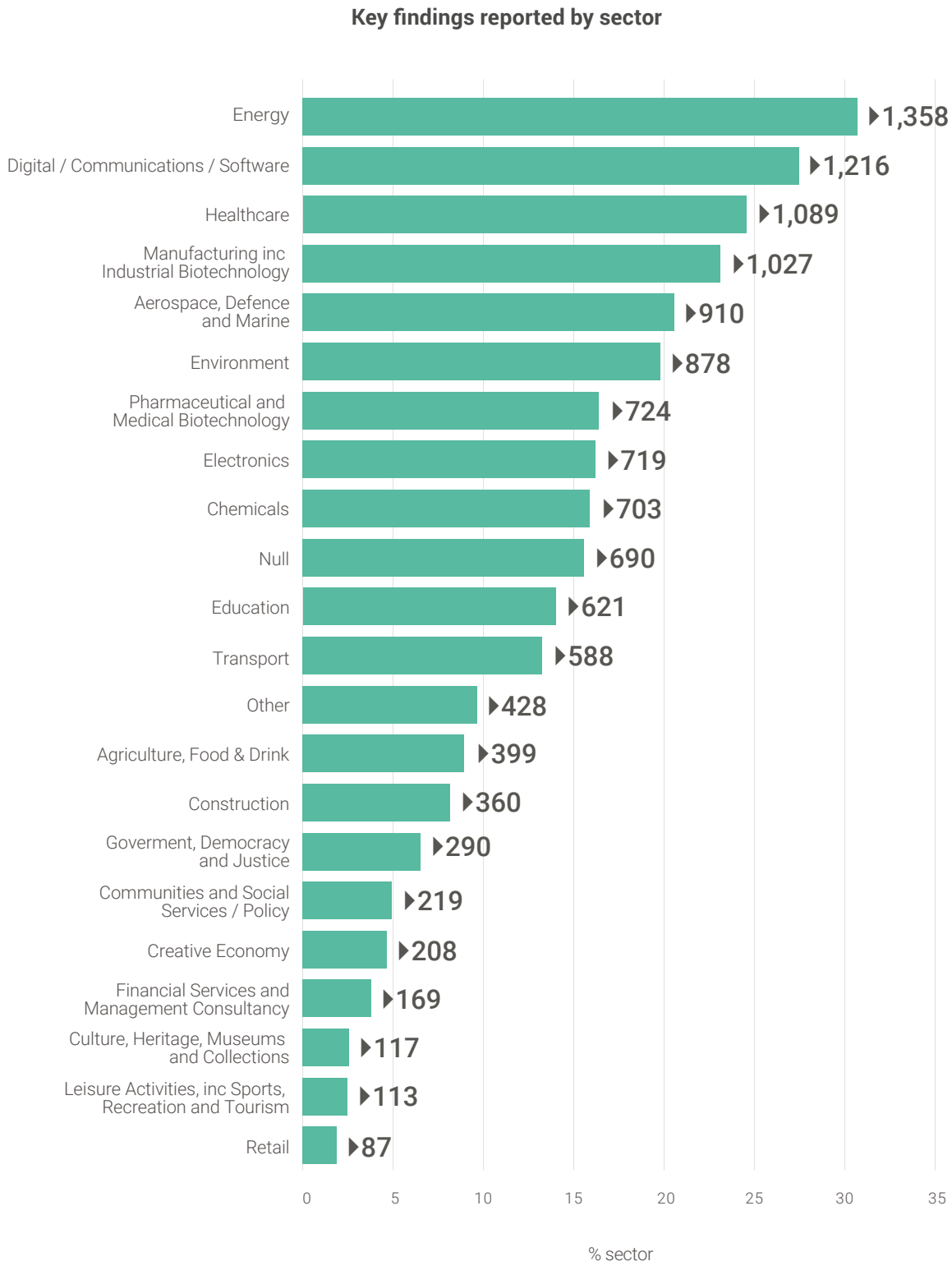
4.1 Key Research Findings

EPSRC asks researchers to summarise the 'Key Findings' of each research grant and fellowship in Researchfish. Most often 'Key Findings' take the form of new knowledge, but it is also appropriate to use the section to record, for example, the extent to which funded travel or networks achieved what was intended. While not part of the 'common question set' shared by all funders using Researchfish it is important for accountability because, irrespective of the duration of funding, or the number and type of any 'common outcome' records (there may even be none), it provides a single space in which the PI/Fellow can succinctly address the 'so what?' question once the funding has ended, and provide an early indication of how they think the results of their work may find application – typical responses may refer to intellectual property thought to be of industrial interest, or to the potential relevance to various fields of recent advances in understanding and modelling physical phenomena. Researchers can also use the section to highlight any systemic issues that may have restricted their ability to use the awarded funding as planned. Since 2017, key findings records have been submitted for 4,435 EPSRC funded research grants and fellowships.

When creating a 'Key Findings' record researchers are asked which industry sector(s) they believe their findings are most relevant to (Figure 5 below). The three sectors most frequently identified are Energy, Digital/IT, and Healthcare.

Most (61%) respondents to the Key Findings section confirmed meeting their original objectives, and 15% indicated their objectives were partially met. However, 16% recorded that there were no Key Findings to report, and 8.3% recorded that it was too early to identify any key findings since the project was still active (Figure 6 below). Recognising this EPSRC from 2021 has taken steps to reduce reporting burden by transitioning to asking the 'Key Findings' question only in the last year of a grant and in the two submission periods after it ends; this replaces the former practice of asking it in the first available reporting period (when in most cases there is little to report) and for five years after it ends (as new Key Findings are not expected to emerge long after a grant ends).

Figure 5: The counts and frequencies with which PIs/Fellows identify different sectors as likely to find their research findings of particular value. (Source: responses in Researchfish between 2017-2022 to the 'Key Findings' additional question added to EPSRC funded research grants and fellowships).

Key findings reported by sector

Sector	Value
Energy	1,358
Digital / Communications / Software	1,216
Healthcare	1,089
Manufacturing inc Industrial Biotechnology	1,027
Aerospace, Defence and Marine	910
Environment	878
Pharmaceutical and Medical Biotechnology	724
Electronics	719
Chemicals	703
Null	690
Education	621
Transport	588
Other	428
Agriculture, Food & Drink	399
Construction	360
Goverment, Democracy and Justice	290
Communities and Social Services / Policy	219
Creative Economy	208
Financial Services and Management Consultancy	169
Culture, Heritage, Museums and Collections	117
Leisure Activities, inc Sports, Recreation and Tourism	113
Retail	87

% sector

Research has shown that interactive virtual reality can model how viral proteins and inhibitors bind to a SARS-CoV-2 enzyme known as the main protease (Mpro). This finding is allowing researchers to use virtual reality to further understand how the enzyme works and should help with the design and testing of new potential drugs to combat SARS-CoV-2.

Figure 6: EPSRC PIs/Fellows view as to whether the original objectives of the research funded had been met (Source: responses in Researchfish between 2017-2022 to the 'Key Findings' additional question added to EPSRC funded research grants and fellowships). Only records which reported Key Findings are included, and only the most recent version of the Key Findings was counted as the answer may have changed over time.

Extent to which Original Objectives were considered to have been met, by % of Awards

Count of Awards ■ 2,092 ■ 702 ■ 16 ■ 918
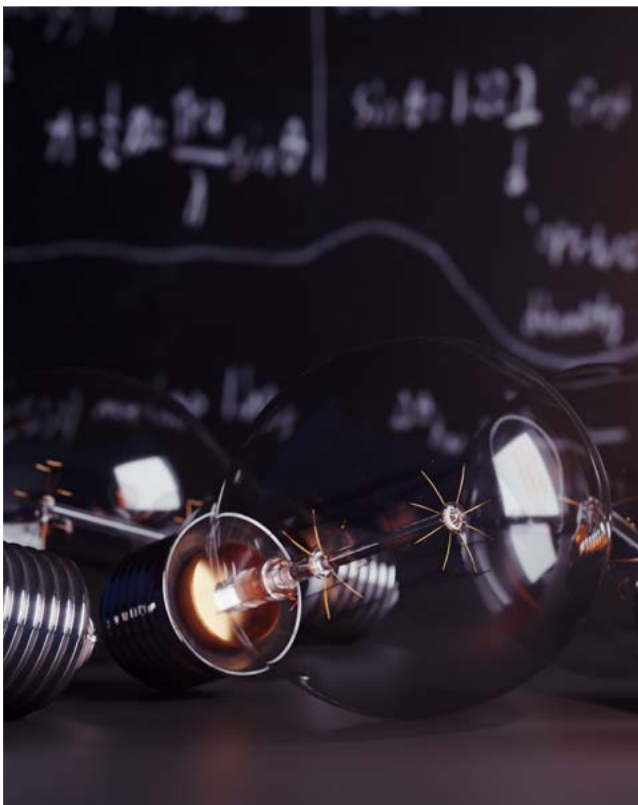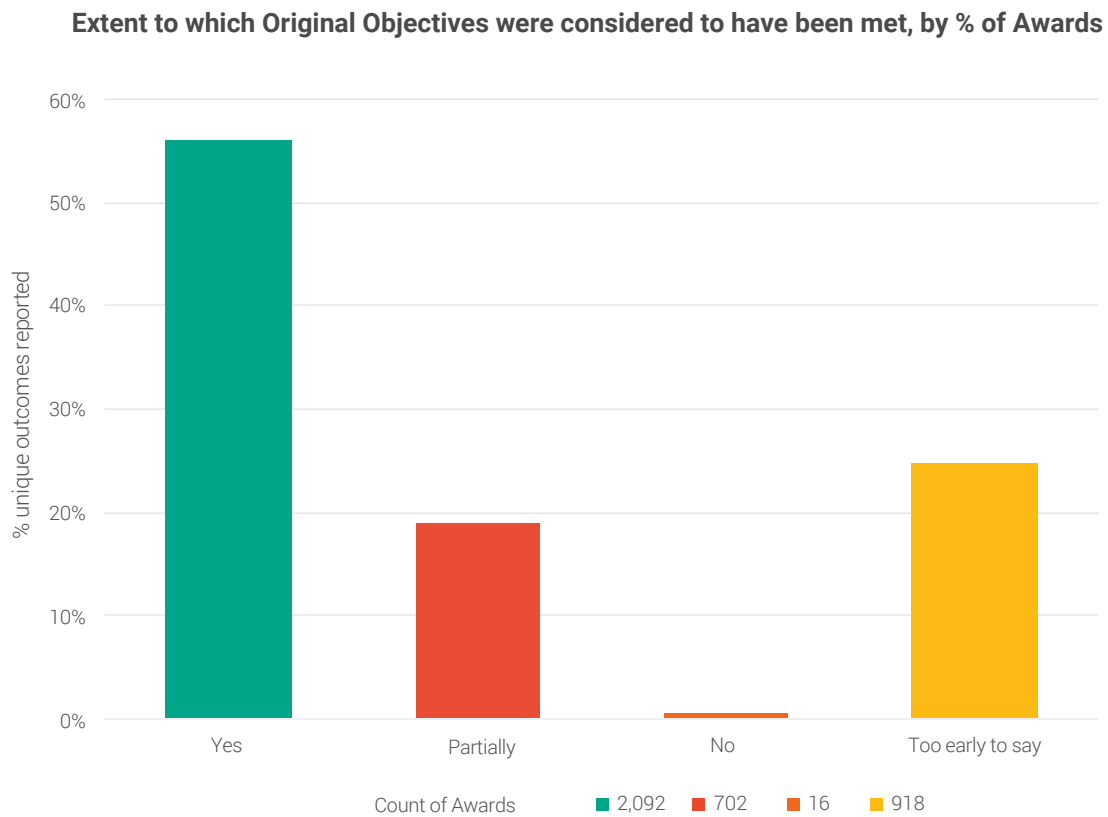
When the 'Partially' option is selected researchers are asked to indicate one or more reasons from a short list. In descending order of frequency of citation, the reasons chosen during 2017-2022 were:

- Experimental, methodological or technical issues (51%)

- Staffing matters (e.g. skills shortages, recruitment delays, unexpected extended leave or departure of staff) (38%)

- Changing landscape of research programme (25%)

- Other resourcing issues (e.g. difficulty/delay in securing key equipment) (19%)

- Difficulties with collaborative partners (10%)

- Higher than anticipated risk levels (9%)

- Access to archives, data or participants (7%)

- Unrealistic initial objectives (6%)

- Regulatory issues (2%)

4.2 Narrative Impact

Although many of the common outcome types in Researchfish include space for a description of the impact of the specific outcome being recorded, such records seldom convey the impact of a project as a whole. EPSRC therefore asks all PIs/Fellows to summarise - and to update over time - the overall impact attributable to each project (the emphasis is on impact beyond the confines of academia, although significant impact across the academic community can also be recorded). These 'Narrative Impact' records comprise a particularly valuable resource, providing an overview of the differences which a project has made, or shows signs of making. They are regularly reviewed and are frequently used to demonstrate how the research we fund benefits the wider economy and society at large.

Examples of impact reported via this section and used in EPSRC case studies include:

- Accurate forecasting the power output from nearly one million solar PV locations across the UK, resulting in a significant reduction in the demand forecast error and enabling National Grid to improve energy management and potential annual savings of £13m;

- Efficient matching of 100's of kidney transplant patients with available donors;

- Advice on the monitoring and operation of ventilation systems and indoor air quality having been incorporated in UK government guidance on the safe post-COVID reopening and operation of sports, entertainment and hospitality venues;

- Improvements to the sensitivity of NMR spectroscopy making it possible to analyse in mere minutes structures that would previously have taken weeks to decipher;

- The success of spin-out company Holiferm, founded by two former EPSRC doctoral students, in bringing biosurfactants to market.

To-date, there have been 4,533 unique 'Narrative Impact' reports submitted between 2017-2022 on the same number of EPSRC funded research-grants and fellowships. These records collectively comprise an essential evidence base that underpins our ability to demonstrate the wider impact of EPSRC-funded research - their importance cannot therefore be over-stated, and grant holders with older records that have not changed in some years are particularly asked to provide updates as appropriate in each submission period. It is encouraging to note that some 60% of narrative Impact records submitted in 2022 were new or last updated as recently as 2021 (see Figure 7 below).

Figure 7: Age of narrative Impact submission in each submission period, 2017-2022 (chart extracted from Figure 4 above)
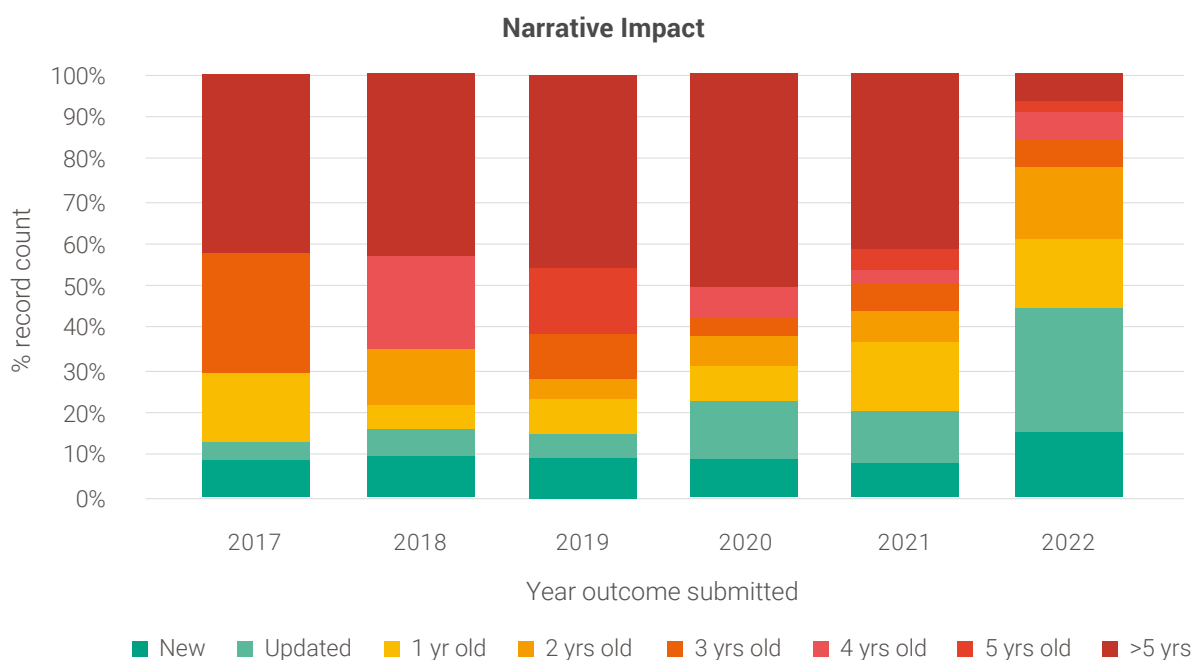
Within the 'Narrative Impact' section researchers are asked to indicate if the project impact falls into one or more of four different 'impact categories', and they are also asked to indicate the industry sector(s) in which the research has been used. The aggregate of the impact categories chosen are shown in Figure 8 below: 'Economic Impact' (39% of records) features most often for EPSRC-funded grants and fellowships, followed by 'Societal Impact' (26%); 'Cultural Impact' and 'Policy Impact' are each attributed to around 11% of the records with the remaining 13% not stating a type of impact. The industry sectors in which research outcomes are reported to have been used are shown in Figure 9 below. The top two sectors are energy (18%) and digital/IT (17%); education and healthcare are level in third place, each cited by around 13% of records; manufacturing and the environment a close equal fourth, with each cited around 12% of the records. Around 36% of records do not have a sector selected.

Figure 8: The counts and frequencies with which different 'types' of impact have been reported by EPSRC funded research grants and fellowships using Researchfish in the period 2017- 2022. One or more of the four 'types' of impact can be claimed for each grant reported on.

Narrative Impact by type of impact

Percentage of impact type, where known
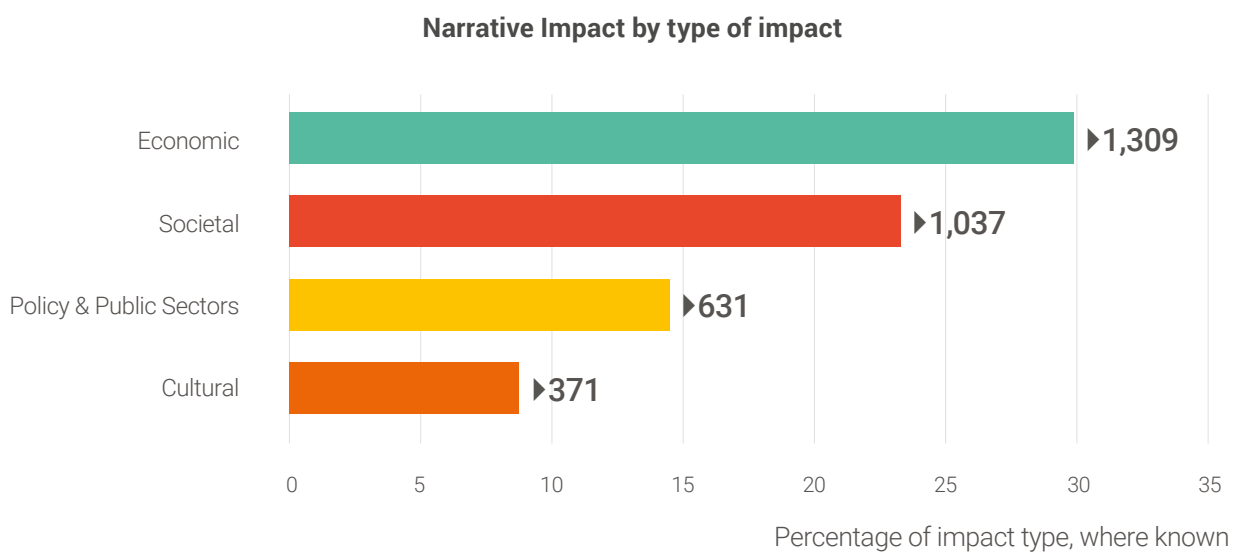
Total unique NI sisnce 2017: 4375
Total NI with unspecified impact: 2364
Grants can have more than one kind of impact

Figure 9: The counts and frequencies with which different sectors have been identified as being impacted by EPSRC funded research grants and fellowships using Researchfish between 2017-2022. More than one sector can be claimed for each grant reported on.

Narrative Impact by sector

| Sector	Count
Null	▶2,189
Energy	▶663
Digital / Communication / IT / Software	▶612
Education	▶501
Healthcare	▶481
Manufacturing, including Industrial Biotechnology	▶458
Environment	▶435
Aerospace, Defence and Marine	▶390
Electronics	▶303
Transport	▶300
Chemicals	▶266
Pharmaceuticals and Medical Biotechnology	▶243
Government, Democracy and Justice	▶231
Construction	▶172
Other	▶171
Agriculture, Food and Drink	▶164
Communities and Social Services / Policy	▶142
Creative Economy	▶112
Culture, Heritage, Museums and Collections	▶97
Financial Services and Management Consultancy	▶76
Leisure Activities, inc Sports, Recreation and Tourism	▶57
Retail	▶44

% sector

4.3 Publications

Publications are the most common outcome type submitted to EPSRC in terms of counts. Figure 10 below shows the total count, by publication year, of Researchfish publication records attributed to one or more EPSRC grants; the data draws on information originally submitted using legacy systems. The low-but-increasing volumes recorded in the earlier years reflect the transition from 'Final Reports' - one-off 'paper form-based' snapshots of outputs/outcomes that had to be submitted within 3 months of a grant ending, and which EPSRC continued to receive, albeit in dwindling numbers, until mid-2013; they required researchers to identify only their 'top 5' outputs. This limitation, and the fact that some publications arising from a research grant are not produced within that timeframe, were key reasons for moving to the current reporting process which allows regular updates to output and outcome records.

Figure 10: Overall counts of publications recorded in Researchfish and attributed to EPSRC research grants or Fellowships, by publication type and year of publication. Note as data is collected early in 2022 the data for 2021/22 is likely to be incomplete.

Types of publications published each year, as submitted to Researchfish (2014 onwards) for research grants and fellowships funded by EPSRC
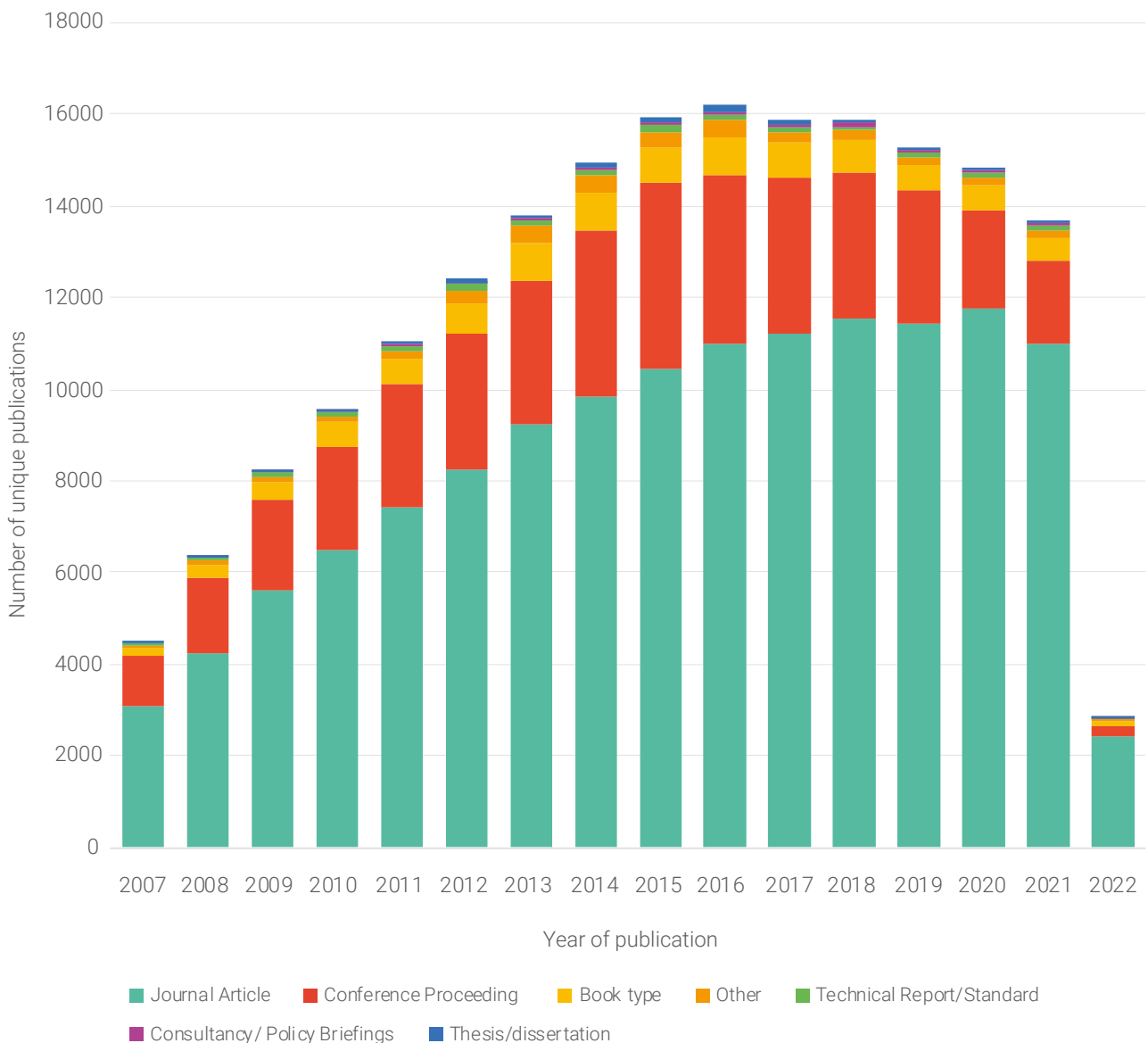
Since 2017 a total of 163,021 publication-grant attributions, covering a total of 112,754[6] unique publications attributed to 9,990 unique grants/ fellowships, and spanning publication years 2007[7] -2022[8], have been reported through Researchfish to EPSRC;

Figure 11 below shows how the counts of newly reported publication records have varied across the period. Of the publications reported, 70% are journal articles, 21% are conference abstracts, and 5% are books/book chapters; the remaining 4% are distributed across a range of publication types.

Figure 11: Count of publication types by year as submitted to Researchfish since 2017 and attributed to EPSRC research grants or Fellowships, by publication type and year of publication. Note as data is collected early in 2022 the data for 2021/22 is likely to be incomplete.
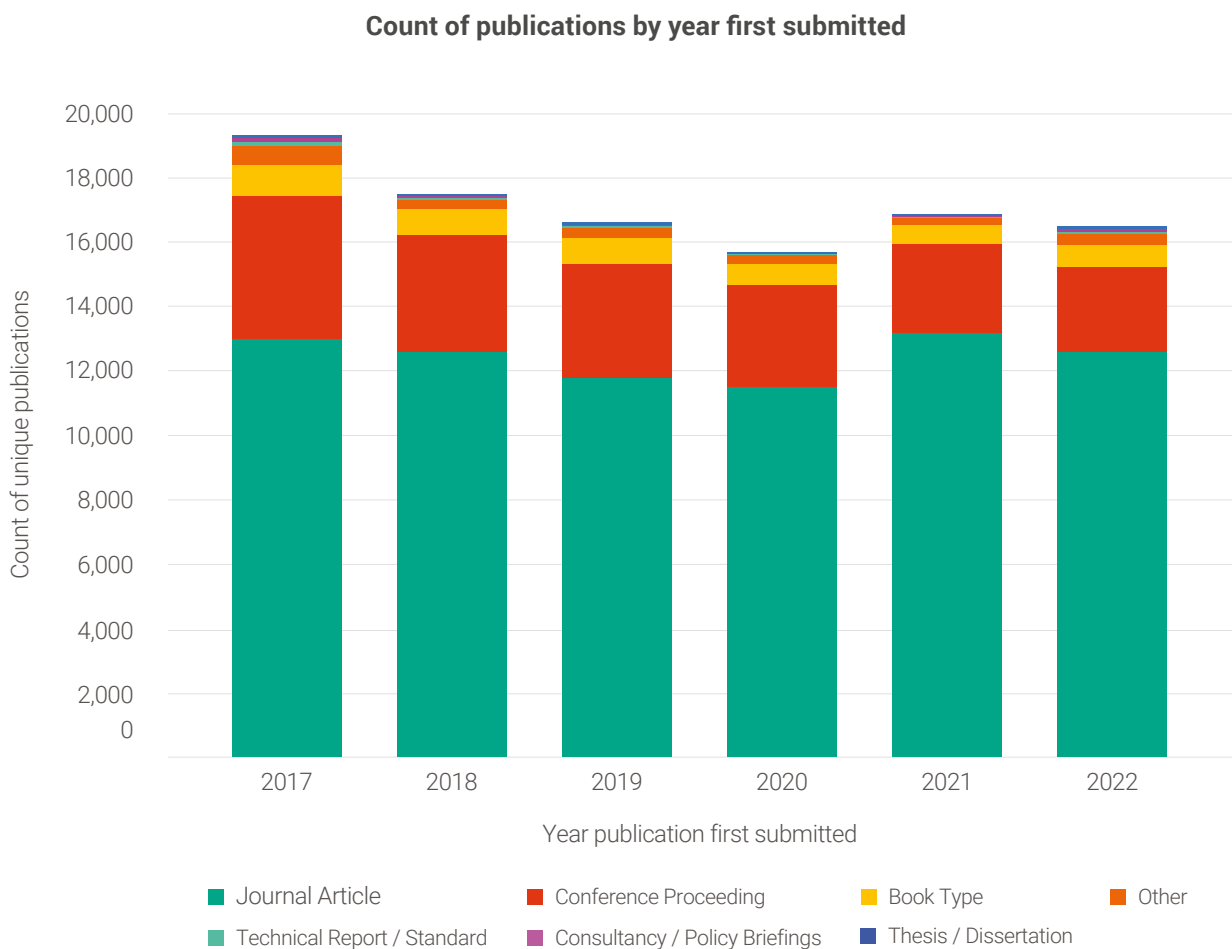

Count of publications by year first submitted

Legend:
- Journal Article
- Conference Proceeding
- Book Type
- Other
- Technical Report / Standard
- Consultancy / Policy Briefings
- Thesis / Dissertation

(6) The number of individual publications is smaller because researchers can attribute a single publication to more than one grant.

(7) Publications published before 2007 are omitted from this analysis.

(8) Publications from 2022 are included for interest but only partial data for the year was available when the data was collected in February/March of that year.

Where publishers' metadata describing a publication includes the reference number of the EPSRC grant which supported work, the Researchfish system can harvest the full publication record, typically from the Crossref database. If the metadata does not include a grant reference number the Researchfish user interface allows a user to import publication records from either their ORCID account or from the displayed results of looking up a unique identifier of the publication (such as a DOI, PubMed ID, Web of Science ID, ISBN, EThOS ID, etc). As shown in Figure 12 below, these methods now account for around 90% of publication records attributed to EPSRC-funded research. This reflects metadata improvements in the publishing eco-system and steps by Researchfish to automate elements of the submission process, demonstrating the significant advantage of embedding 'systems interoperability' into research information systems: by dramatically reducing the need to re-key data that already exists elsewhere it improves data quality and enables researchers to focus more on other aspects of outcome's reporting.

Figure 12: Percentage of publication records entered manually, looked-up (including imported from users' ORCID accounts), or automatically imported into Researchfish, by year of first submission to EPSRC.

% Breakdown of how publications were entered into Researchfish
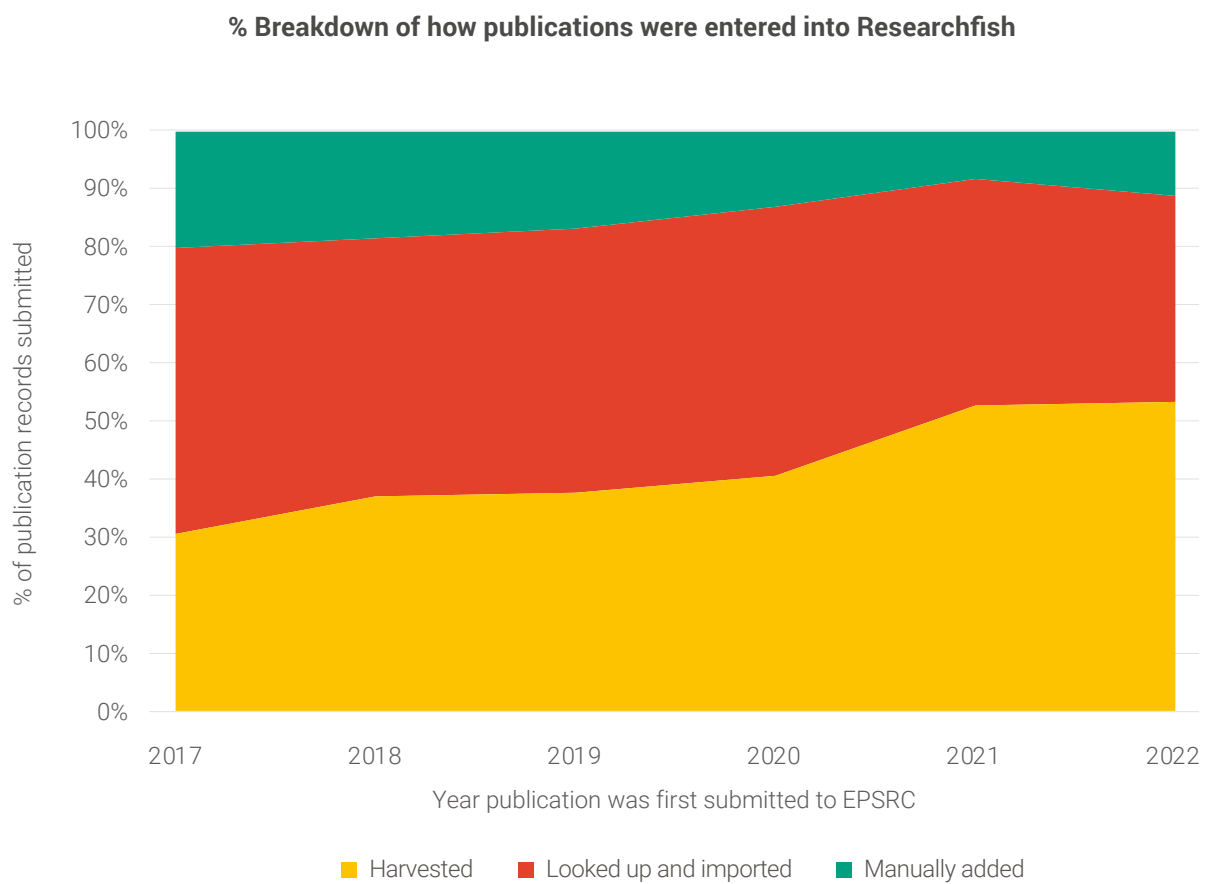
If a publication's metadata cannot be harvested or looked up, then a record describing it can be created manually. Figure 13 and Figure 14 below show how the count, and proportion by publication type, of new manually created publication records has changed over the period 2017-2022: it is evident there has been a consistent reduction in the proportions of such records represented by Journal Articles, Conference Proceedings and Books.

Figure 13: Types of manually created publication records per year (records attributed to EPSRC research grants or Fellowships and submitted to EPSRC during the period 2017-2022)

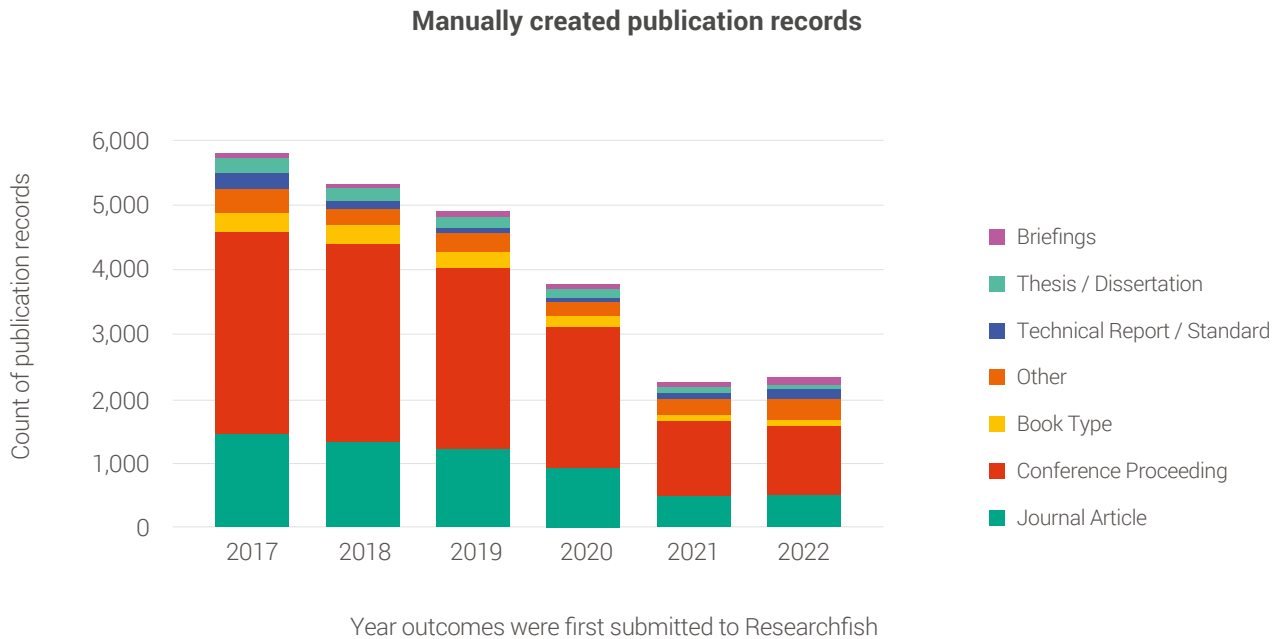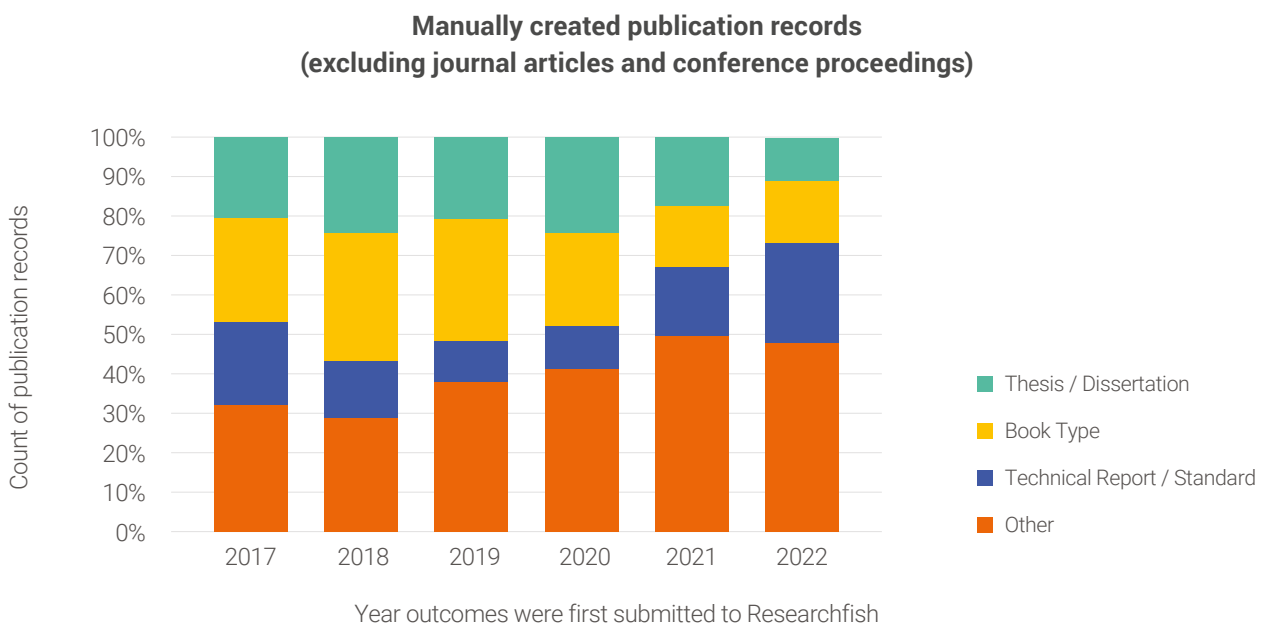**Manually created publication records**

Figure 14: Proportional variation in the major categories of publication records created manually, excluding Journal Articles and Conference Proceedings (records attributed to EPSRC research grants or Fellowships and submitted to EPSRC during the period 2017-2022).

**Manually created publication records
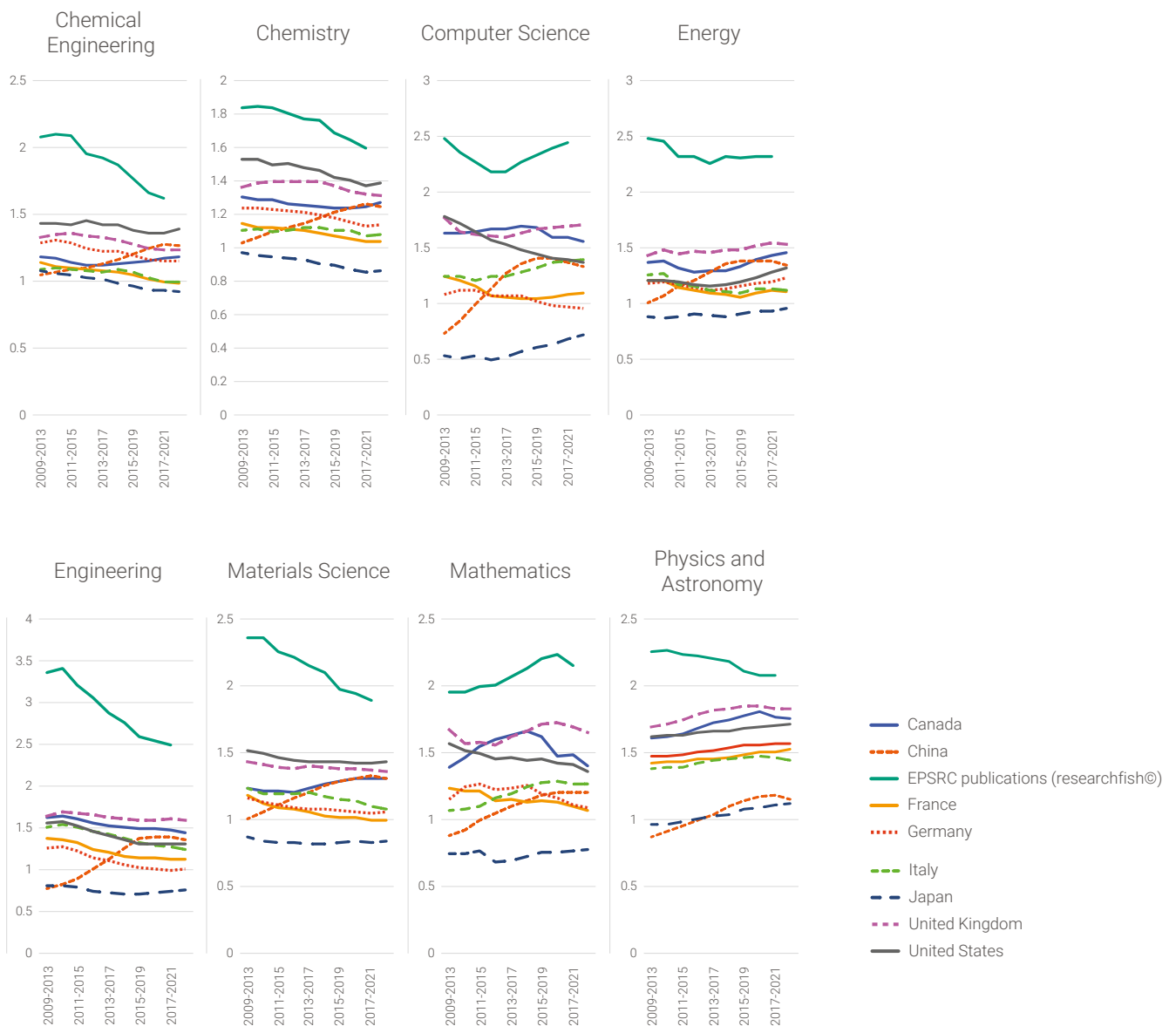(excluding journal articles and conference proceedings)**

It is not clear why the overall proportion of new manually created publication records slightly increased in 2022; it may possibly be a consequence of the COVID-19 pandemic, with researchers perhaps able to spend more time engaged in producing policy studies, technical reports and other types of publication less likely to have harvestable metadata.

As shown in Figure 15 below[9], bibliometric analysis of publications attributed to EPSRC provides strong evidence that the research we fund is not only consistently above world average, but also well above the averages of the UK and major competitor nations (USA, China, Canada, France, Germany, Italy, Japan)

Figure 15: Field Normalised Citation Impact of publications attributed to EPSRC research grants and Fellowships. The approach accounts for differences in citation accrual over time, citation rates for different types of document (only articles and reviews are included), and field-specific differences. Values within a field are normalised so that 'World Average' for the field is always equal to 1. The analysis uses data from Elsevier SciVal and timescales refer to publication year.

Field Normalised Citation Impact of publications

4.4 Collaborations & partnerships

Collaboration information related to EPSRC funded projects is normally first provided to EPSRC at the application stage and held in our grants system. The data represents commitments by prospective project partners to collaborate with the PI and provide additional resource to the project if the application is successful. Researchers are asked to use Researchfish to confirm such collaborations, and to provide details of any new collaborations since the project began. However, because the two systems are entirely separate, and do not assign shared unique identifiers to each collaboration, if the same project partner is mentioned in both systems it can be challenging to determine whether the data reported via Researchfish represent an additional commitment or confirmation of the actual values received in respect of an original commitment disclosed at the application stage.
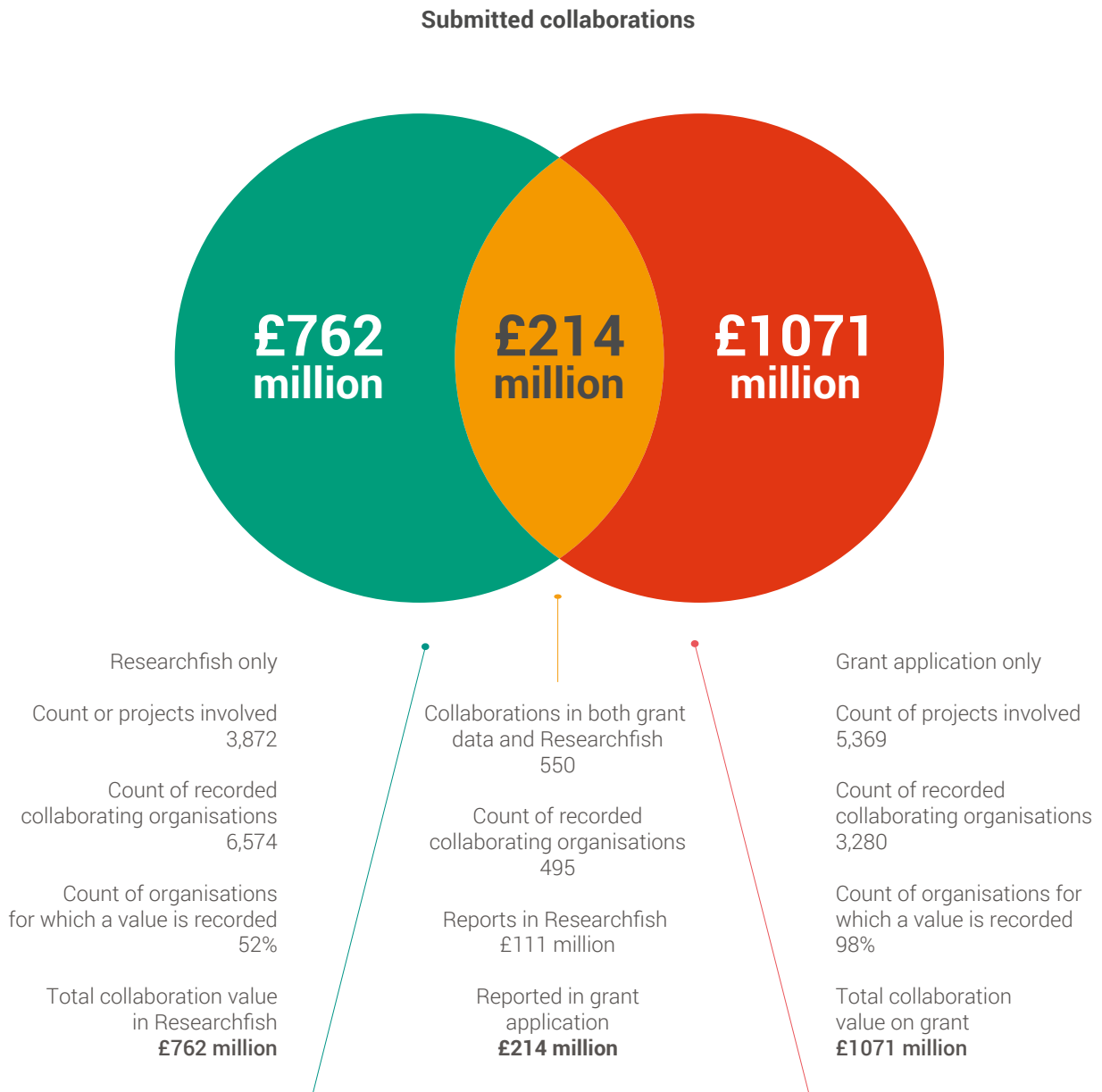
To limit the dataset, data from the grant system was limited to grants with an end date post 01/01/2012 and Researchfish data was limited to 2017 onwards. Grants are asked to report for up to 5 years after the end date of their grant so grants ending in 2012 would still be reporting in 2017.

The Venn diagram in Figure 16 shows the overall values (sum of cash/in-kind) and counts reported in Researchfish and in our grants system for all collaborations linked to EPSRC funded research-grants and fellowships. The funding applications in the dataset cover 5,439 projects delivered by researchers at 100 Universities and involving 3,342 collaborating partner organisations. Researchfish records with matching collaborators have been identified in 10% of the 5,439 projects identified at the application stage (the same records match 15% of the collaborators on those projects). The contribution values recorded in the matching Researchfish records are consistently lower than mentioned at application stage (£111M versus £214M). Although this could indicate that the actual resource provided is lower than was originally intended (perhaps due to changes in the collaborator's business environment?) it is important to note that (i) the relevant questions ask specifically about 'contributions made' and (ii) it is currently not possible to edit previously entered figures, so it is perhaps likely that the amounts recorded represent initial contributions received and that the figures have simply not been updated (the inability to edit a previously entered collaboration value is a known issue which Researchfish are currently working to address). Note also that although having identified collaborative partners at application stage, in some cases (covering 462 projects with collaboration commitments totalling £132Million) the relevant grants have submitted no 'collaboration' records via Researchfish in or since 2017.

The 'values' quoted in Figure 16 aggregate all contributions irrespective of whether described as 'cash' or 'in-kind', and the 'counts' include collaborations for which no cash on 'in-kind' value is recorded. Records in Researchfish that cannot be matched to a commitment in the relevant applications are assumed to be new. Records provided at the application stage that cannot be matched to a record in Researchfish could be indicative of real collaborations that have simply not been recorded in Researchfish, or of anticipated collaborations which never materialised for a variety of possible reasons.

Figure 16: Researchers disclose prospective collaborators at the application stage and are asked to record actual collaborations and collaborators in Researchfish. To avoid double-counting it is necessary to identify as far as possible when collaborations reported in Researchfish refer to commitments originally recorded in grant applications, and the overlap in this Venn diagram shows the degree to which such records have been identified. 'Total' Grant Application figures refer to collaborator commitments made in successful grant applications with end dates post 01/01/2012, irrespective of whether a grant has or has not made a submission in Researchfish. The Researchfish data is from 2017-2022.

Submitted collaborations

£762 million   **£214 million**   **£1071 million**

Researchfish only

Count or projects involved
3,872

Count of recorded
collaborating organisations
6,574

Count of organisations
for which a value is recorded
52%

Total collaboration value
in Researchfish
£762 million

Collaborations in both grant
data and Researchfish
550

Count of recorded
collaborating organisations
495

Reports in Researchfish
£111 million

Reported in grant
application
£214 million

Grant application only

Count of projects involved
5,369

Count of recorded
collaborating organisations
3,280

Count of organisations for
which a value is recorded
98%

Total collaboration
value on grant
£1071 million

Count and value of collaborations from grants that have submitted to researchfish© (but not reported collaborations)
462 and £132 million.

(i)   the matched records in Researchfish report a lower value (£111 million) than committed at application stage.
(ii) the £1,071 million listed against grant applications includes £132 million committed collaborative support to 462 projects at application stage which have since submitted no collaboration records via Researchfish.
(iii) see section 4.4 of report for related commentary.

The overall 'collaborator sector' breakdown of cash and in-kind contributions for all collaborations as listed in the application and Researchfish are shown in Figure 17 below, alongside the counts of collaborations and the projects involved.

Figure 17: Top graph: collaboration count and aggregate value, by type of collaborating organisation and contribution, as recorded in applications that have subsequently submitted outcomes using Researchfish to EPSRC for research-grants and fellowships during 2017-2022. Bottom graph: collaboration count and aggregate value, by sector of collaborating organisation and contribution, as recorded in Researchfish during 2017-2022.

Value of collaborations by sector from grants and fellowships submitting a Researchfish return 2017-2022 (value recorded on grant applications)
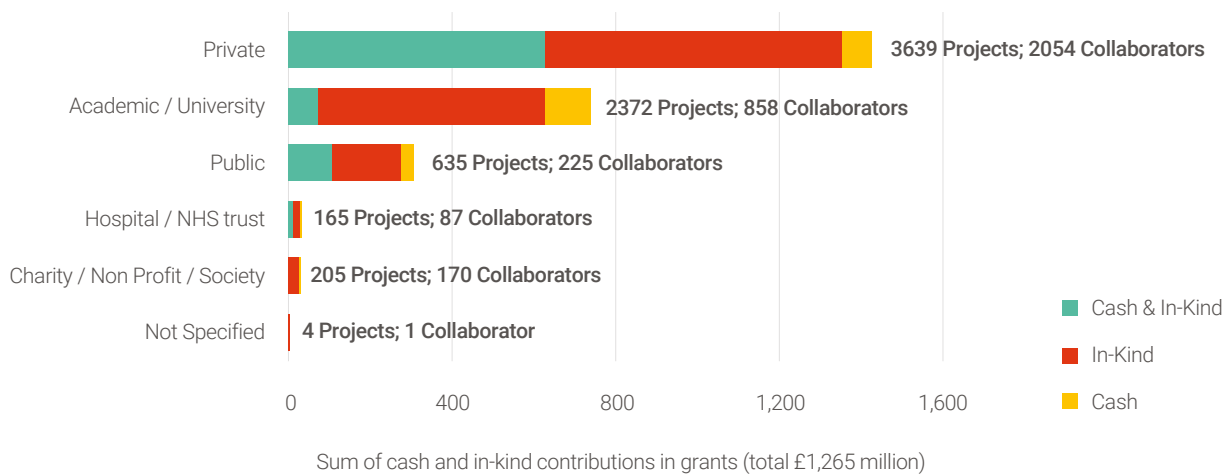
Sum of cash and in-kind contributions in grants (total £1,265 million)

Value of collaborations by sector from grants and fellowships submitting a Researchfish return 2017-2022 (value recorded in Researchfish submissions)

£ Millions
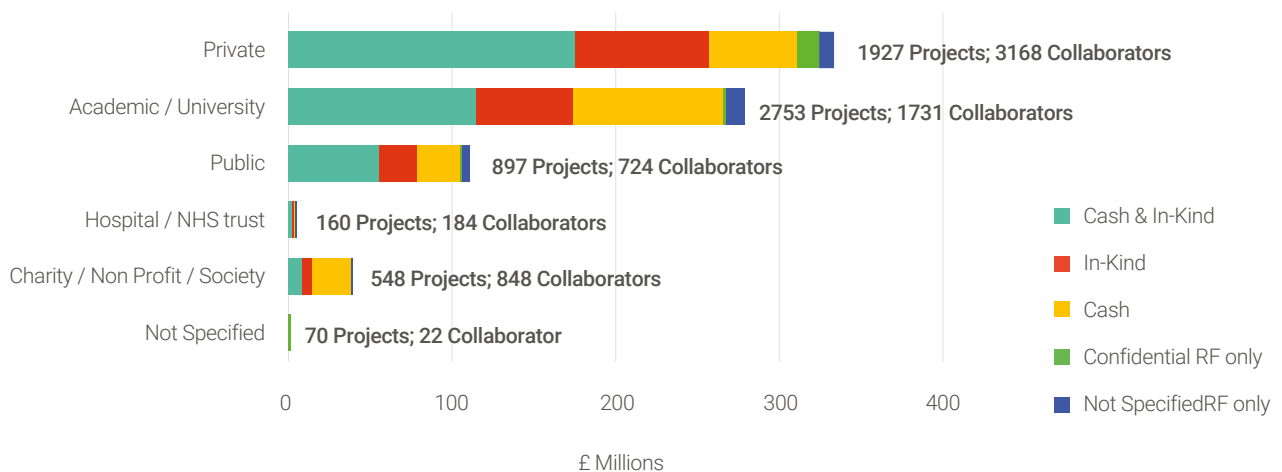
To minimise the risk of double-counting, the datasets were combined such that all the collaborations from the application data where the grant has subsequently made a Researchfish submission were included as well as only those from the Researchfish data which name collaborating organisations not recorded in the original grant applications.

Figure 18 illustrates the global distribution of recorded collaborators and Figure 19 below illustrates the regional distribution of non-public sector UK collaborators.

Figure 18: The global distribution of collaborators supporting EPSRC research-grants and fellowships. This overview combines the collaboration data from applications where a grant has subsequently made a Researchfish submission, with any additional collaborations reported via Researchfish but not mentioned within the associated grant application (thus avoiding potential duplication). For each global region the stated figures give the percentage by count of collaborations, the count of collaborators beneath this, and value of collaborative commitments by the collaborators based in that region. The adjacent pie charts show the proportion by sector[11] of the collaborating organisations. 'Not specified' corresponds to collaborators either based in more than one country and their exact location could not be identified, or where the data is ambiguous (for example where an acronym which applies to several organisations is used).

Global collaborations on EPSRC research grants and fellowships, combining data on grants with an end date after 1st January 2012 and Researchfish outcomes 2017-2022
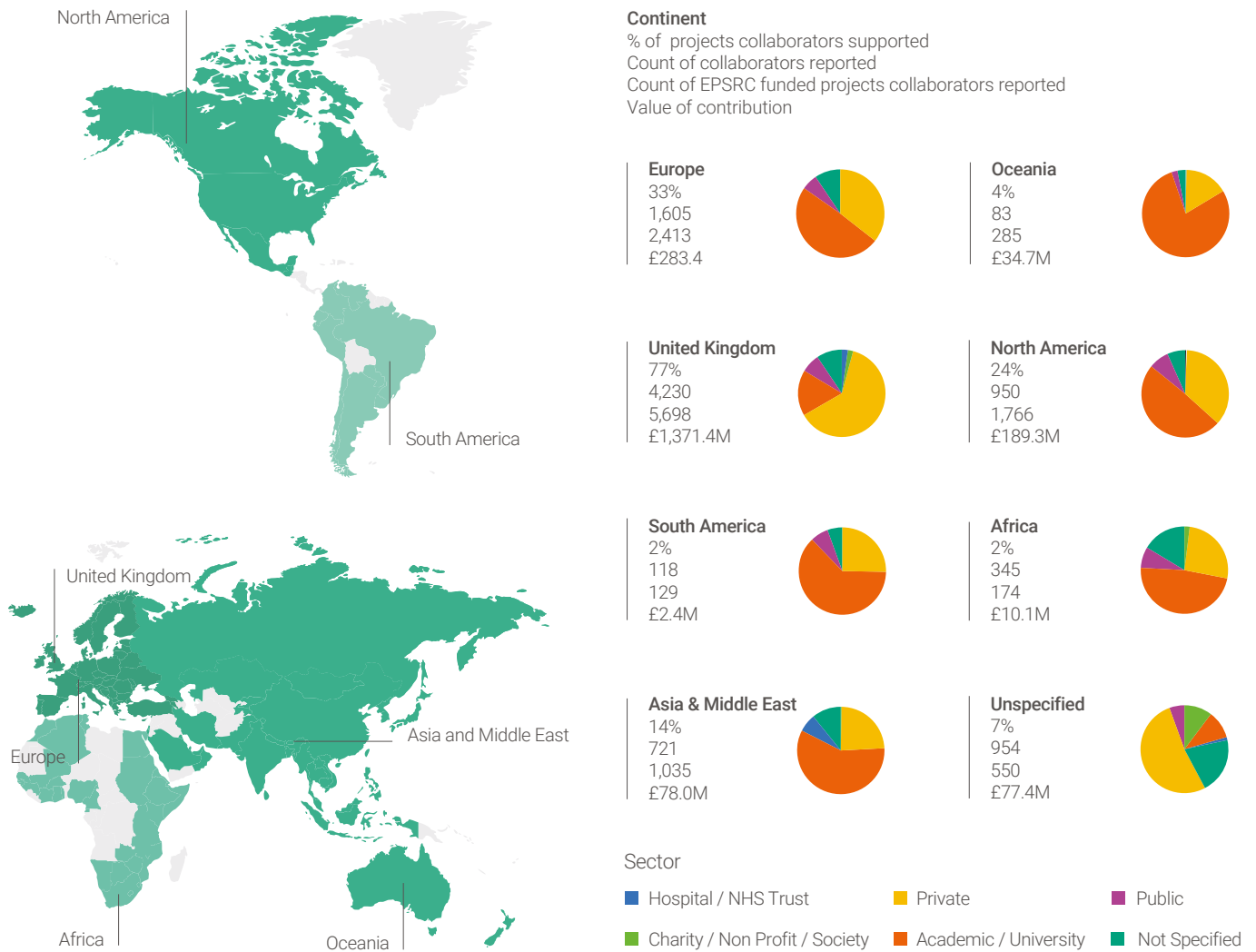
Continent
% of projects collaborators supported
Count of collaborators reported
Count of EPSRC funded projects collaborators reported
Value of contribution

Europe
33%
1,605
2,413
£283.4

Oceania
4%
83
285
£34.7M

United Kingdom
77%
4,230
5,698
£1,371.4M

North America
24%
950
1,766
£189.3M

South America
2%
118
129
£2.4M

Africa
2%
345
174
£10.1M

Asia & Middle East
14%
721
1,035
£78.0M

Unspecified
7%
954
550
£77.4M

Sector
- 🟦 Hospital / NHS Trust
- 🟨 Private
- 🟪 Public
- 🟩 Charity / Non Profit / Society
- 🟧 Academic / University
- 🟩 Not Specified

Shades on the map are used to indicate regional areas; in Africa and South America they highlight countries indicated in the source data.

(11) To simplify and align the sector categories used in application records with those used by Researchfish, the following mappings were made:

Grant application collaborator categories	map to	Researchfish categories
Industrial / Commercial	⟶	Private
Hospital / NHS Trust	⟶	Hospitals
Charitable Organisation, Professional Institution, Civic Organisations, Trade Associations and RTOs	⟶	Charity/Non-Profit/Learned Society
Government Department, Local and Regional Government	⟶	Public
Academic Institution, Independent Research Org, Public Research Organisation	⟶	Academic/University

Combining collaborations data from funding applications and Researchfish (for all grants and fellowships which ended after 1st January 2012 and for which a Researchfish submission was made in the period 2017-2022), our analysis has identified 37,611 recorded collaborations involving 9,358 unique collaborating organisations collaborating on 5,529 unique EPSRC funding agreements. Collective cash and in-kind contributions from these collaborations sum to £2,047M. By count of collaborations, UK organisations (committing £1,371 million) were involved in 77% of collaborations; European organisations (committing £284 million) were involved in 33% of collaborations; North American organisations (committing £189 million) were involved in 24% of collaborations. (Figure 18). Within the UK, and considering only 'non-public sector' collaborations (i.e. excluding academic/universities, hospitals, and public organisations), the regions with the most collaborating organisations are London (21% by count, contributing £220M), followed by the South East (16% by count, contributing £146M), and the East (11% by count, contributing £87M) (Figure 19). Appendix Table 9 provides a more detailed breakdown of the location of UK-based collaborators, and Appendix Table 10 provides a more detailed breakdown by location and type of collaborator.
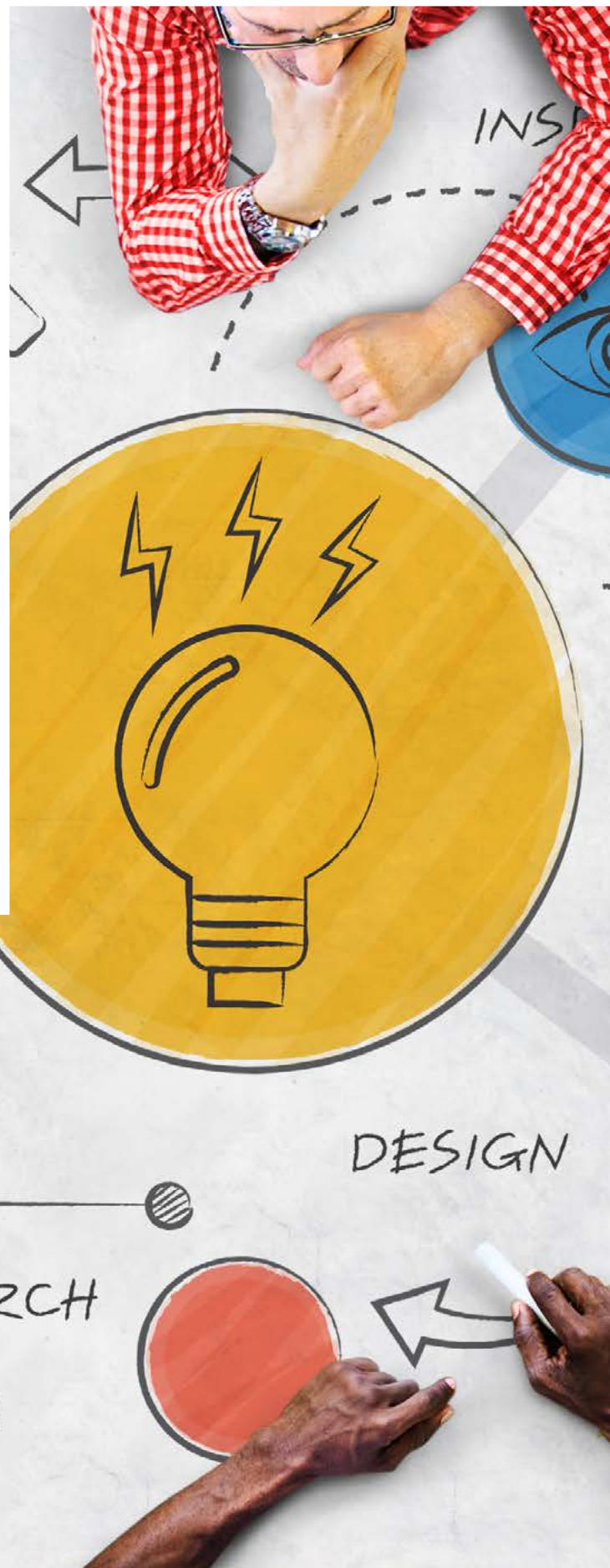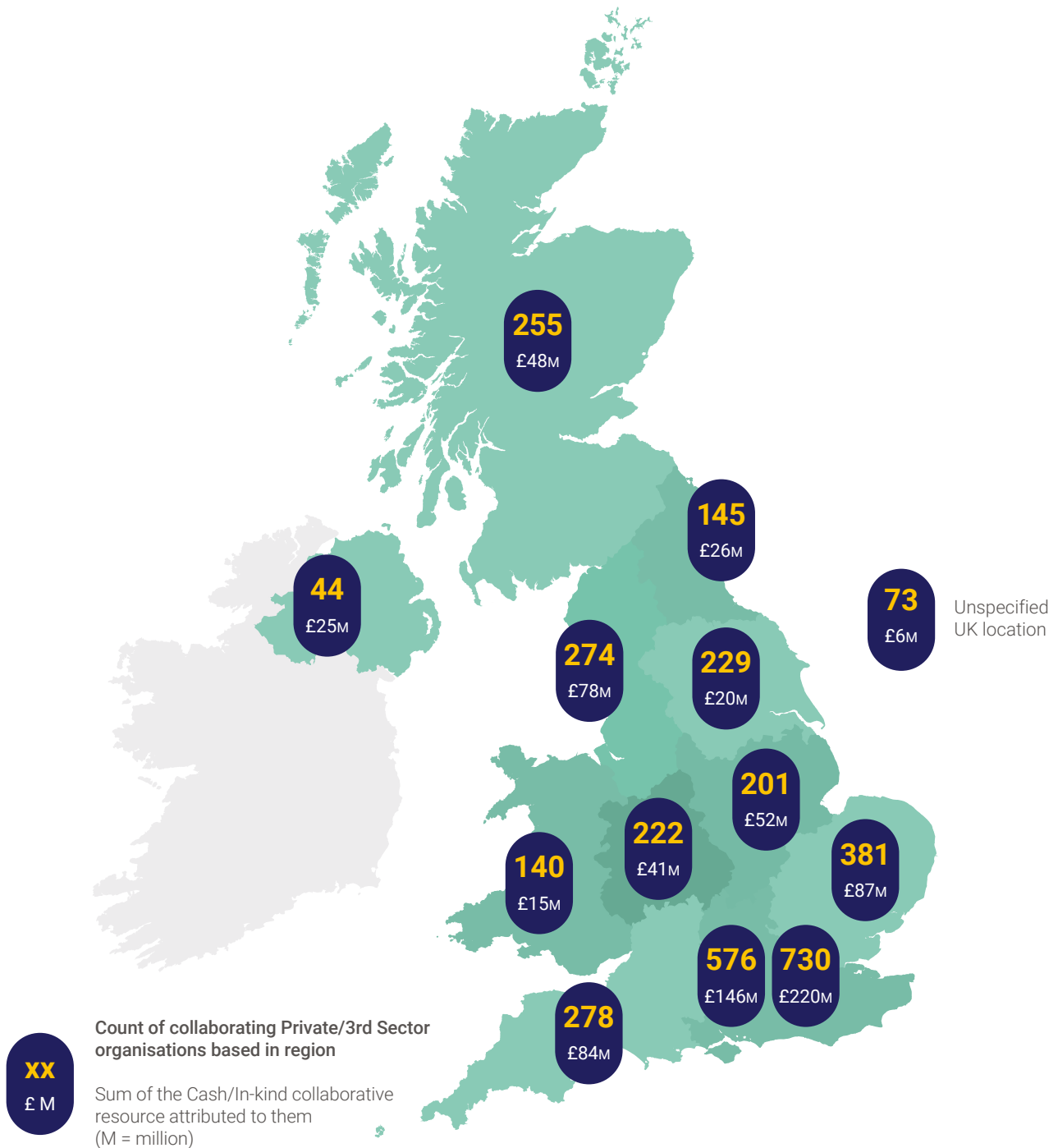
Figure 19: The distribution of private/3rd sector UK-based collaborators supporting EPSRC research-grants and fellowships. This overview combines the collaboration data from applications where a grant has subsequently made a Researchfish submission, with any additional collaborations reported via Researchfish but not mentioned within the associated grant application (thus avoiding potential duplication). For each UK region the stated figures give count of unique collaborators and the sum of cash and in-kind collaborative commitments by the collaborators based in that region. The data excludes UK public funding organisations (academic/universities, hospitals, and public organisations).

UK private/3rd sector collaborators on EPSRC research grants and fellowships, combining data on grants with an end date after 1st Jan 2021 and Researchfish outcomes 2017-2022.

255
£48M

145
£26M

44
£25M

73
£6M
Unspecified
UK location

274
£78M

229
£20M

201
£52M

222
£41M

381
£87M

140
£15M

576
£146M

730
£220M

278
£84M

XX
£ M

Count of collaborating Private/3rd Sector
organisations based in region

Sum of the Cash/In-kind collaborative
resource attributed to them
(M = million)

4.5 Further funding

Further funding, from any source, that is given to expand or extend the research supported by a grant can be recorded in Researchfish as an outcome of that grant. Such records are helpful in (i) understanding the extent to which additional research investment arises from other sources as a consequence of our funding (ii) enabling improved tracking of the progress of research in an area and of the funding sources accessed at different stages.

As with other 'common outcome' types the analysis in this section is restricted to records submitted in years 2017-2022. However, the submitted data is complex and care is required to avoid 'double counting' because a single instance of further funding can be recorded more than once by different researchers and attributed by them to multiple grants. An additional challenge arises when researchers report receiving a share of further funding awarded to a consortium. In such cases the submitted record should detail the overall sum awarded to the consortium (which could include support for work outside the remit of EPSRC) and the share allocated to support the researcher's work. Finally, detailed analysis of the records submitted has exposed some cases of clear errors in data entry; these include some cases in which the further funding that is cited has the same reference as a grant to which it is attributed, and others in which it refers to funding which substantially pre-dates a grant to which it is attributed.

Bearing the above factors in mind, the analysis in this report (i) excludes identifiable duplications, (ii) includes only the amounts of consortia funding explicitly reported as intended to extend or expand the research previously supported by EPSRC, and (iii) excludes any records in which the further funding attribution has been identified as clearly erroneous.

Overall, 48% of fellowships and 40% of research grants submitting a Researchfish return in the period 2017-2022 have included at least one 'further funding' record. In total some 12,570 such records were attributed to 3,873 research-grants and fellowships, and in aggregate they report a total of £8.7 billion at a rate typically between £1.4 billion to £1.5 billion annually. Sources outside the UK account for £2 billion (23%) and the balance is from known UK sources. Further funding from within the UK is primarily from the public sector, amounting to some £5.9 billion overall, and most of this (£5.2 billion) is from UKRI, typically as subsequent grants following the normal competitive peer reviewed application process[12]. In contrast, UK private/3rd sector organisations[13] are recorded as having committed £784 million during the period. Figure 20 below shows the annual value of further funding reported and Figure 21 below shows the overall distribution of the records by their count, value and intended use. Notably, over 60% of the records report funding in amounts up to £200k. Figure 22 below shows the same data by count, intended use and year in which the record was first submitted.

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(12) Some records acknowledge funding from UKRI grants which the grant holding organisations are, subject to specified criteria, permitted to allocate on a discretionary basis; for example 'Impact Acceleration Accounts'.

(13) This category includes businesses, charities, and learned societies.

Figure 20: Value (£million) per year of new 'further funding' records attributed to EPSRC research grants or Fellowships and submitted to EPSRC via researchfish during the period 2017-2022.

Further funding by year outcome reported, amount and sector

Year outcomes were first submitted to Researchfish

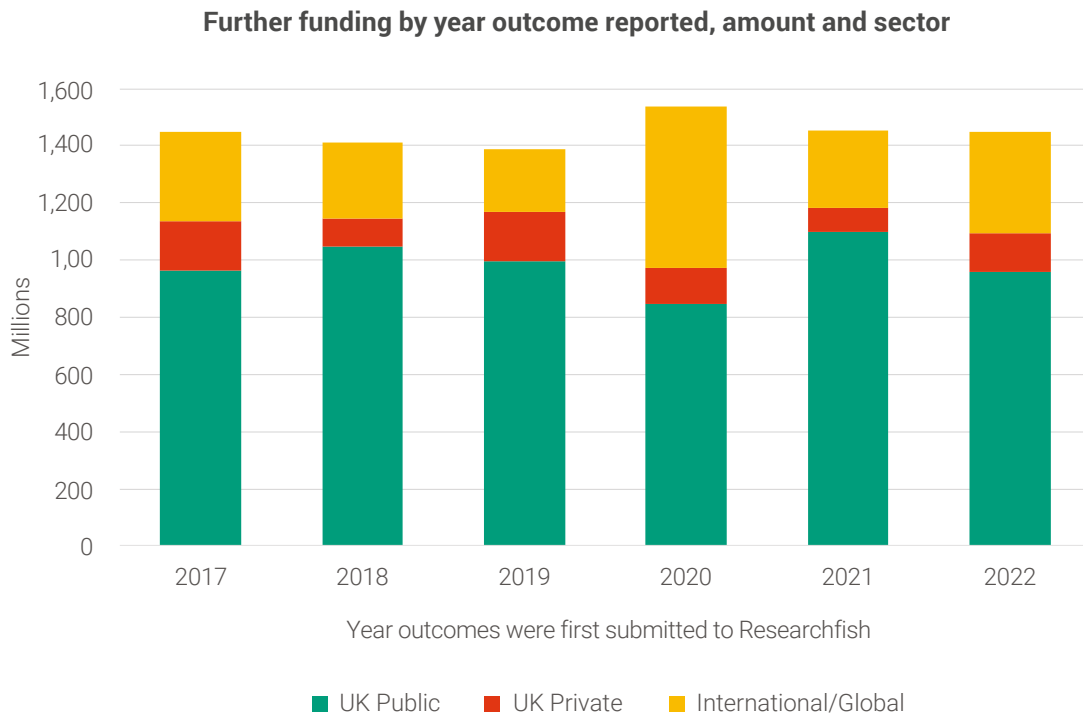■ UK Public   ■ UK Private   ■ International/Global

Figure 21: The percentage and value of unique instances of further funding attributed by researchers to EPSRC funded research-grants or fellowships, and first reported to EPSRC between 2017-2022.

Percentage of further funding outcomes reported, by value

■ Research grant   ■ Studentship   ■ Fellowship   ■ Capital/Infrastructure   ■ Travel/Small personal   ■ Unspecified
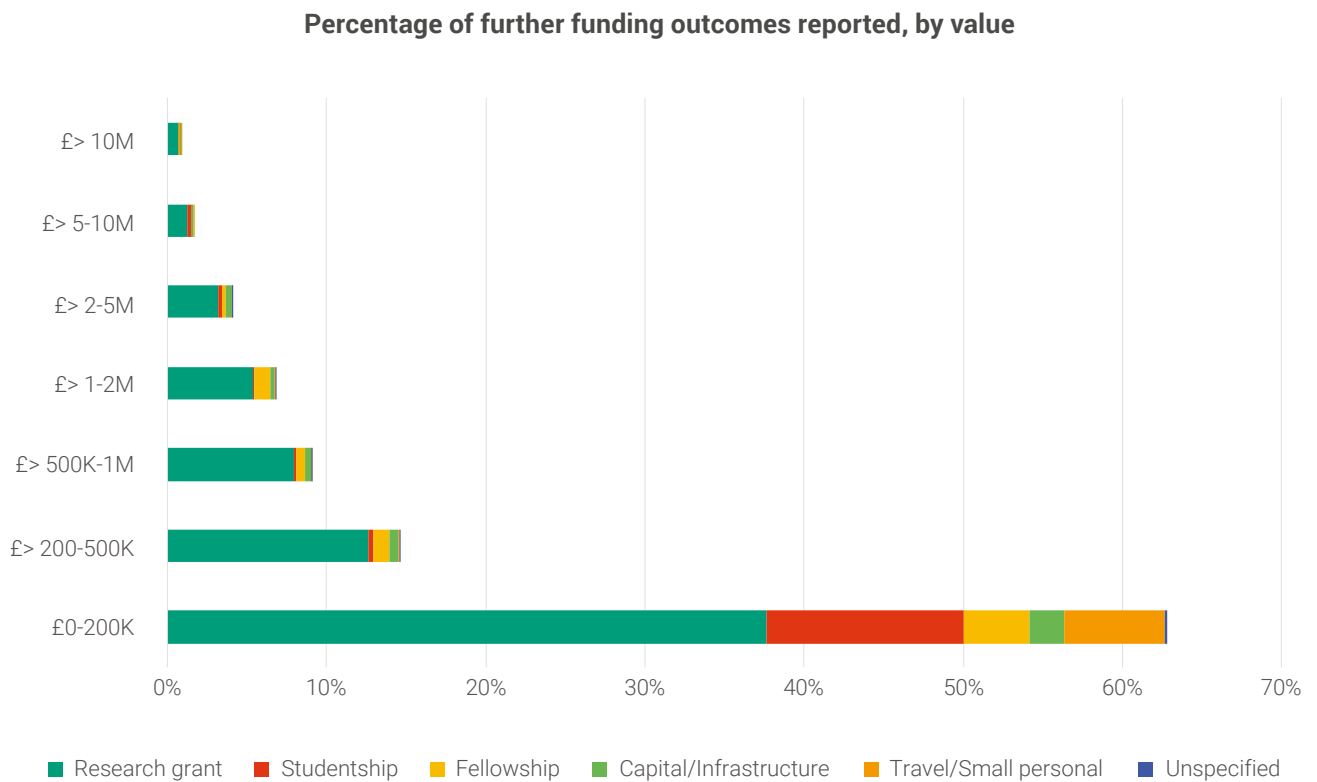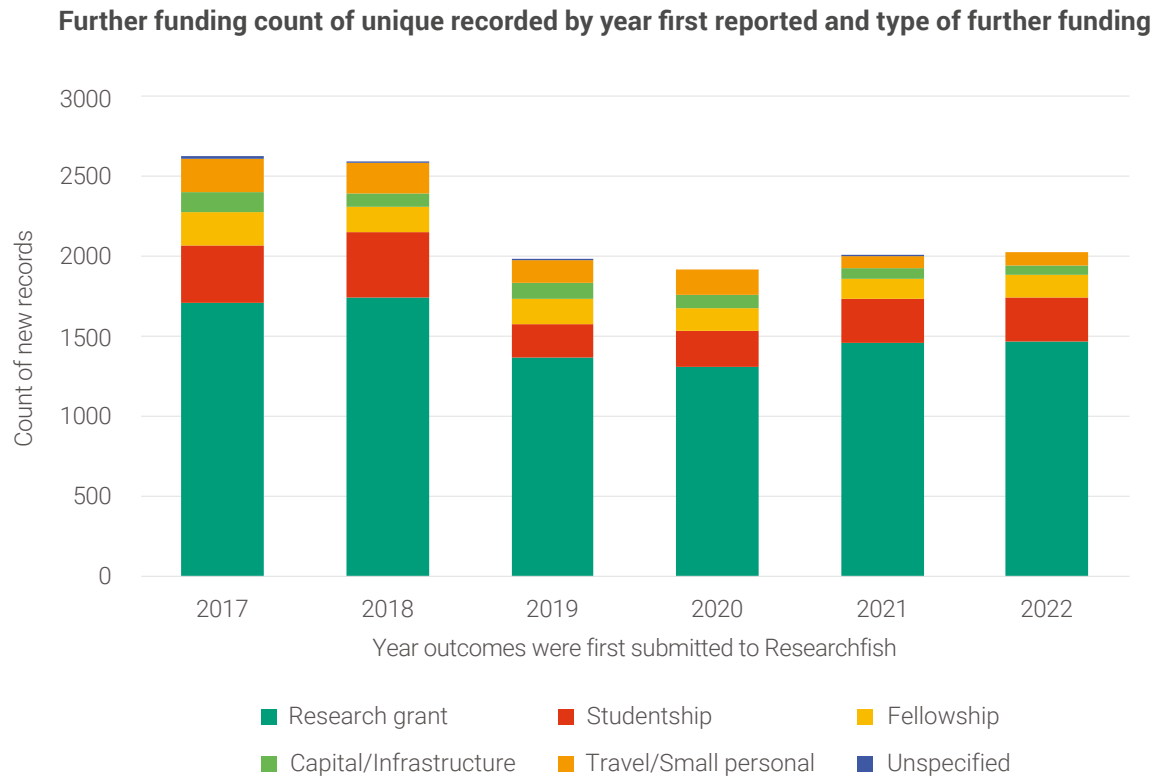
Figure 22: Count per year of new 'further funding' records attributed to EPSRC research grants or Fellowships and submitted to EPSRC via researchfish during the period 2017-2022. Further funding categories are captured as part of the record.

Further funding count of unique recorded by year first reported and type of further funding

EPSRC categorises research grants and fellowships by the 'Lead Theme' which funds them (e.g. Engineering, Physical Sciences, etc.). The next two charts show the relationship between the Lead Themes and the type of 'further funding' that was reported (Figure 23) and by the extent to which the 'further funding' was reported as being part of larger amounts awarded to consortia (Figure 24). Further funding allocated to grants funded by multiple themes account for £1.2B; grants funded by the 'manufacturing and circular economy' theme (£1.2B), the 'healthcare technologies' theme (£1B), the 'ICT' theme (£1B), the 'engineering' theme (£0.94B), the 'energy & decarbonisation' theme (£0.94B) and the 'physical sciences' theme (£0.83B) account for most of the further funding between 2017-2021.

Note 1: Themes have different budgets, fund different volumes of research, and the research itself has different underlying costs. In addition, the theme categories themselves have evolved with changes in how the EPSRC portfolio is managed: the last year in which 'Living with Environmental Change' funded a grant was 2018, and the first years in which 'Business Engagement' and 'International' funded any grants were 2018 and 2019 respectively. Hence, while the relative significance of themes is clear, the data should not be taken out of context.

Note 2: records attributed to grants funded by the same lead them are counted only once, but records may be counted multiple times if attributed to multiple grants funded by different lead themes. Therefore, the total value of further funding should not be estimated by summing the amounts attributed to each lead theme in Figure 23 below.

Figure 23: Further funding attributions provided to EPSRC funded research-grants and fellowships, split by EPSRC portfolio 'lead theme'. The data is from projects submitting a Researchfish return to EPSRC via Researchfish between 2017-2022, and for each 'lead theme' shows the intended purpose of the further funding, where known.

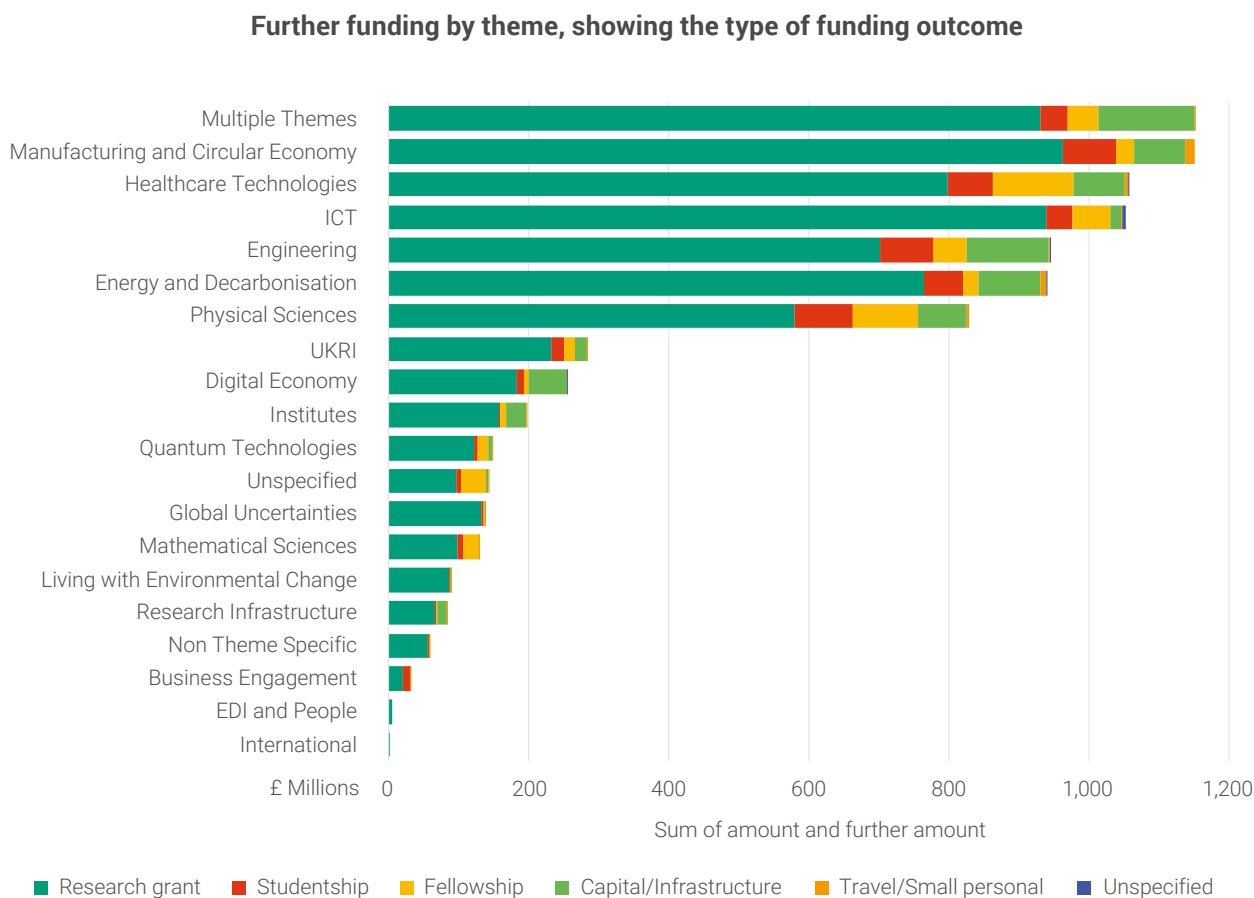**Further funding by theme, showing the type of funding outcome**

Figure 24: Further funding attributions provided to EPSRC funded research-grants and fellowships, split by EPSRC portfolio 'lead theme'. The data is from projects submitting a Researchfish return to EPSRC via Researchfish between 2017-2022, and for each 'lead theme' shows the balance between dedicated further funding and that which is comprised of shares of larger amounts award to consortia.

Further funding by theme, including detail showing amount attributed to involvement in consortia
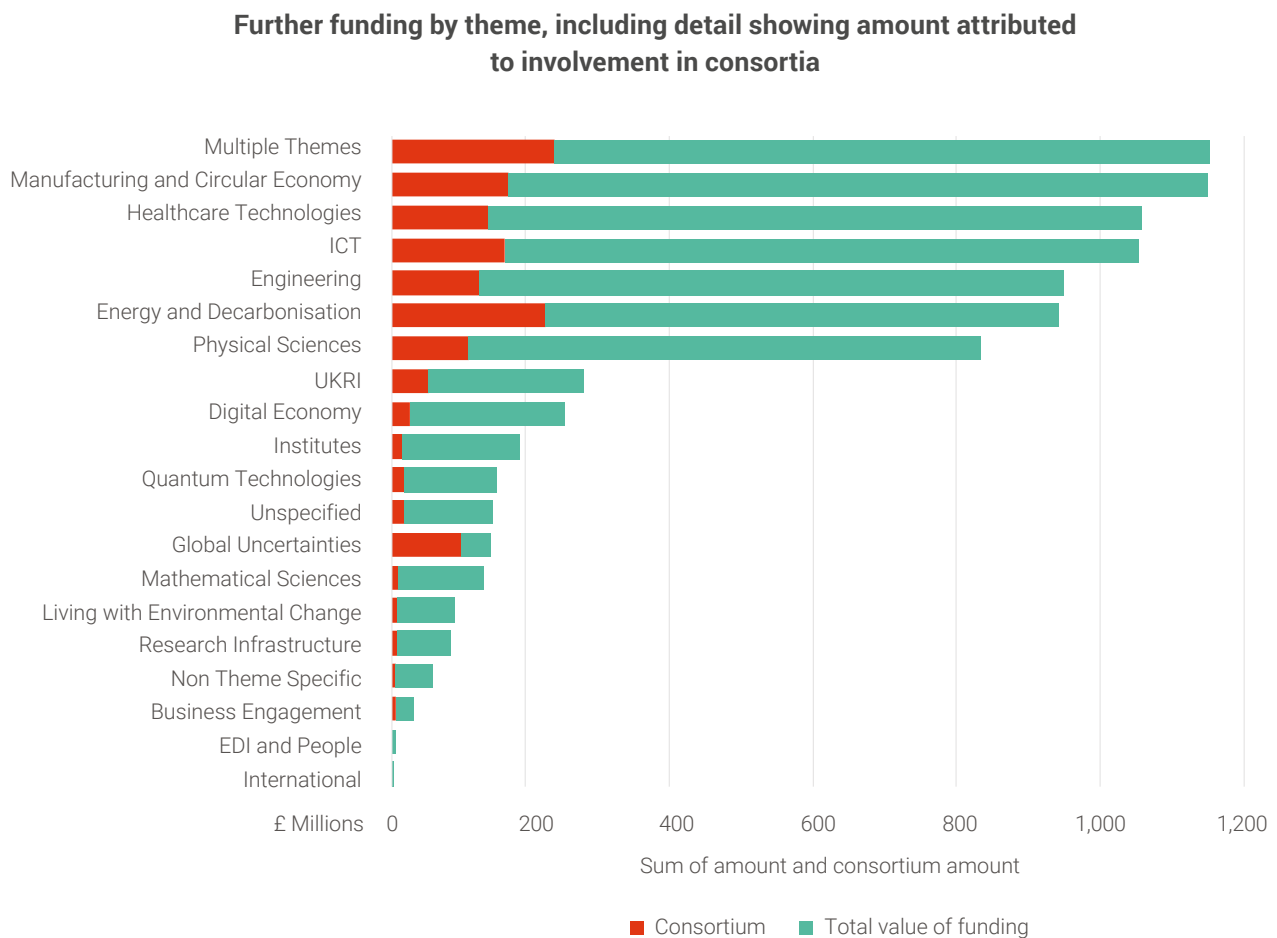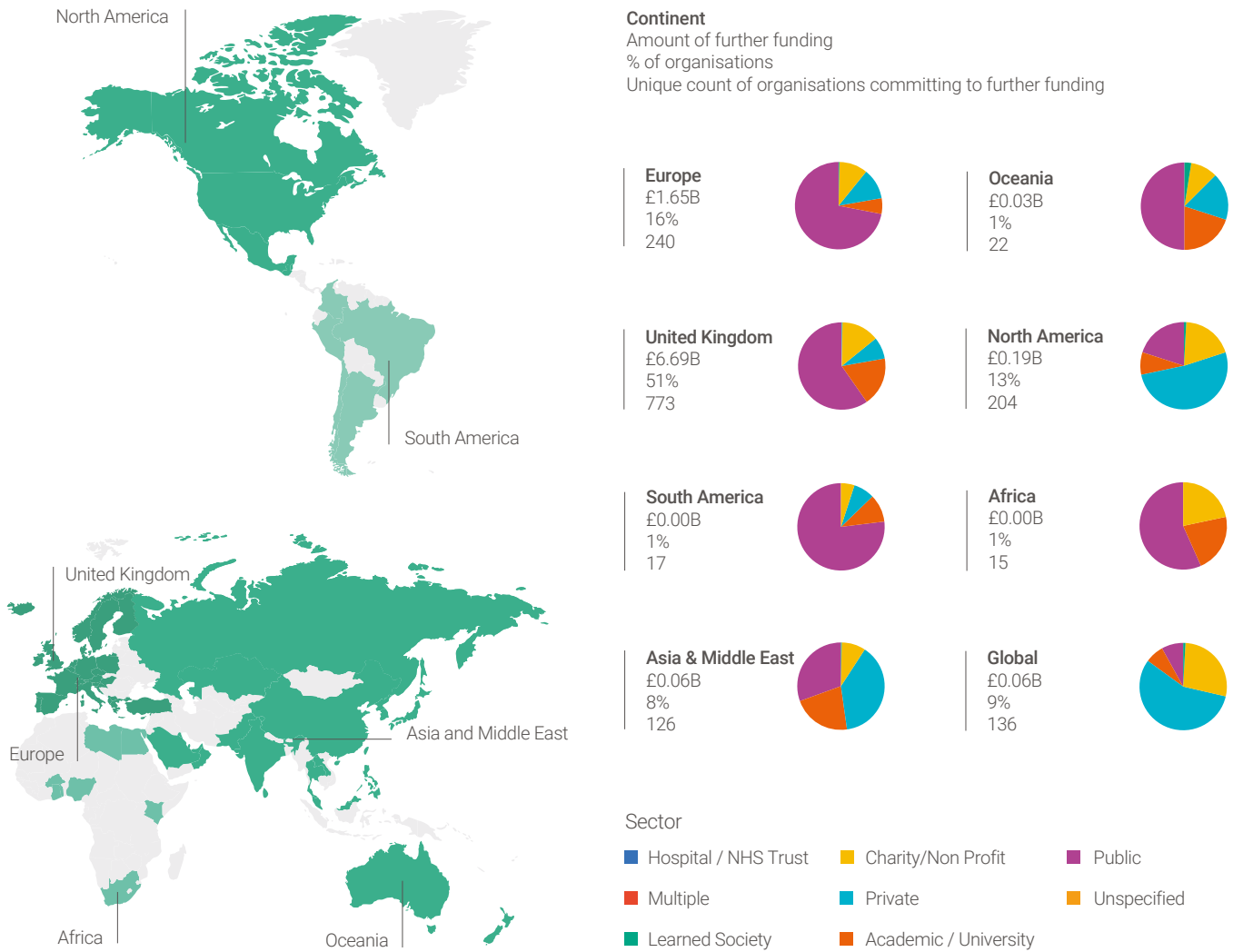

Figure 25 shows, by geographical region, the type of further funding source and the overall counts and values of the unique further funding records first reported during the period 2017-2022. Just over half the records (51%), worth approximately £6.7B, are attributable to UK sources. Within the UK, sources in the private/3rd sector account for 62% of the records and some £784 million, while 38% are public sector (including subsequent UKRI funding, of which £4.9B is in the form of direct grants following successful applications and the balance is allocated from UKRI block grants which research organisations are permitted to allocate selectively at their discretion). In contrast, the c.16% of further funding records attributed to the European Union have a total value of approximately £1.65B, reflecting the importance to UK research in recent years of EU member organisations/ funding programmes, such as CERN and Horizon 2020.

The distribution within the UK of private and charitable/not-for-profit organisations recorded as sources of further funding is shown in Figure 26 below. It must be noted that a significant proportion (15%, linked to £18 million) could not be allocated to single location or region; however, of the sources that could be located, 17% are based in London (linked to £701M) and an additional 6% (linked to £94M) are outside London but still in the South East of England. The East of England and Scotland are home to 7% and 5% respectively of the sources (linked to £75M and £29M respectively); no other UK region accounts for more than 5% of the identified sources, but those in the South West and the North West each account for records valued at £64M. Appendix Table 7 lists the counts of distinct further funding records per region, and Appendix Table 8 lists the top 20 non-public sector sources of further funding.

Figure 25: The global distribution of sources of further funding attributed to EPSRC research-grants and fellowships. The chart aggregates data from unique records submitted to EPSRC through Researchfish between 2017-2022. The aggregated data given for each named global region are, in order, the percent and the count of unique further funders, and beneath the equivalent GBP total that has been offered in funding to extend/expand research support by EPSRC. The adjacent pie charts show the proportion by sector of the further funding source. 'Not specified' corresponds either to multi-national sources based in more than one region, or to ambiguous data (e.g. source is identified only by an acronym which could apply to several organisations.

Global distribution of further funding sources

Continent
Amount of further funding
% of organisations
Unique count of organisations committing to further funding

Europe
£1.65B
16%
240

Oceania
£0.03B
1%
22

United Kingdom
£6.69B
51%
773

North America
£0.19B
13%
204

South America
£0.00B
1%
17

Africa
£0.00B
1%
15

Asia & Middle East
£0.06B
8%
126

Global
£0.06B
9%
136

Sector

- Hospital / NHS Trust
- Charity/Non Profit
- Public
- Multiple
- Private
- Unspecified
- Learned Society
- Academic / University

Shades on the map are used to indicate regional areas; in Africa and South America they highlight countries indicated in the source data.

45

Figure 26: Distribution of UK private/3rd sector sources of further funding attributed to EPSRC research-grants and fellowships. The chart aggregates data from unique records submitted to EPSRC through Researchfish between 2017-2022. The circles show the counts of unique further funding sources in each region; the adjacent data is the aggregate value of further funding linked to those sources. The data excludes UK public funding organisations (academic/universities, hospitals, and public organisations). The 'multiple regions/not specified' category refers to organisations with more than one UK location, and to records specifying a UK source but which have insufficient detail to allow determination of a regional location.

Count of unique UK private or 3rd sector partners offering further funding and value of further funding offered

33
£21M

9
£2M

71
£18M
Unspecified
UK location

4
£0.1M

18
£46M

22
£2M

8
£7M

18
£25M

40
£35M

8
£1M

56
£49M

164
£569M

26
£9M

XX
£ M
Count of Private/3rd Sector sources
of Further Funding based in region

Sum of Further Funding
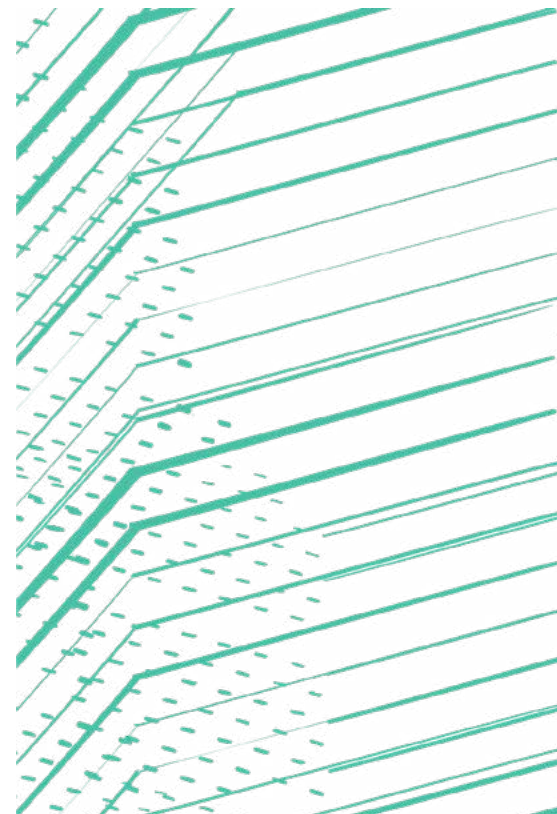resource attributed to them
(M = million)
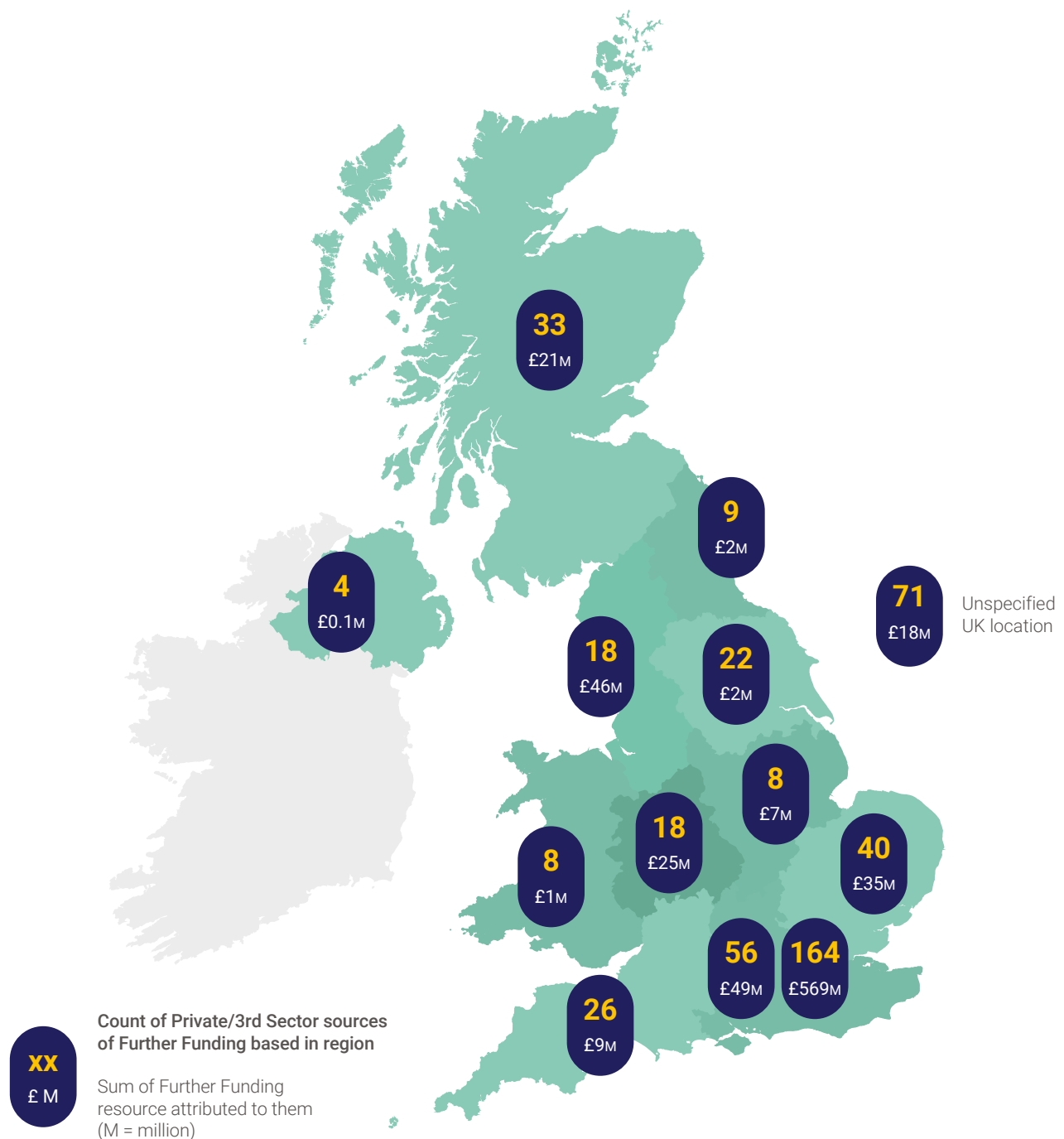
4.6 Datasets, databases and models

An overview of all the 'datasets, databases and models' records attributed since 2017 in Researchfish to EPSRC funded research-grants and fellowships is provided in Figure 27 below, which shows the breakdown by year of first submission to EPSRC and type of database/dataset/model.

Overall, 5,219 unique data type outcomes, attributed to 1,917 unique grants, have been reported through Researchfish to EPSRC during the period 2017-2022. 'Database/collection of data' accounts for 81% of the total number of unique records reported, followed by 15% categorised as 'computer model/algorithm', and the remaining 4% variously as 'data handling and control' or 'data analysis technique'. Appendix Table 2 lists the yearly percentages and counts for the different output/outcome sub-types of newly submitted records in this Researchfish section.

Figure 27 shows the significant growth in the number of data outcomes reported to EPSRC since 2017, and the inset line graph shows the growth in the proportion of 'data' records created by automatic harvesting or use of the lookup option. The evident step change between 2019 and 2020 (37% increase) coincides with the successive availability in Researchfish of the 'unique ID look-up' feature and automatic harvesting. In combination they have made it easier and quicker for a PI to add/confirm the datasets/databases they attribute to their grant(s); they have also improved data quality by significantly reducing the need to enter data manually.

There have also been external incentives to increase the sharing of research data and software. There has been growing support by Funders for Open Research/Open Data alongside an increased focus on reproducibility of research. Some publishers have responded by providing new, innovative means to share data type outcomes, making it easier and more attractive to share data more widely, however practice varies by discipline and important barriers (real or perceived) to widespread sharing still exist, for example concerns around confidentiality, data misuse, and the fear of being scooped in a research culture still characterised by many as 'publish or perish'[14].
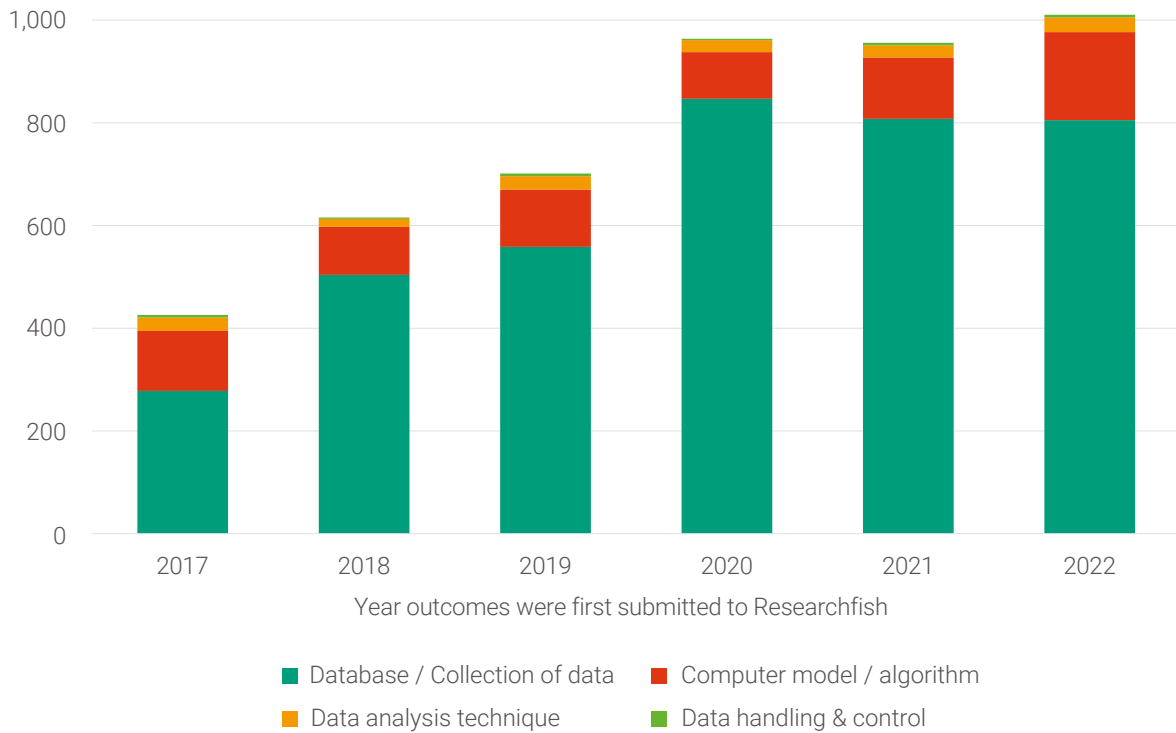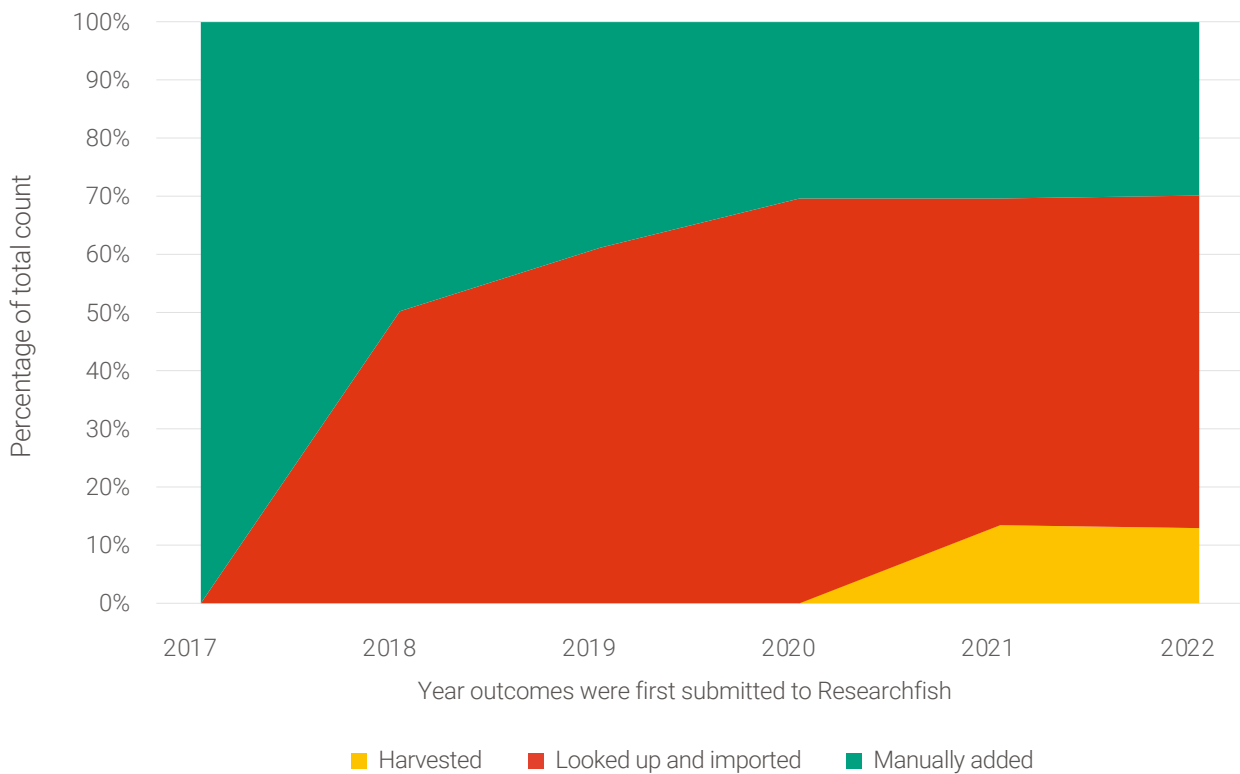
Flow models predicting how fluids flow through rocks are used for a range of purposes, for example in management of water resources, carbon capture and storage (CCS) and renewable energy solutions. Information submitted against grant EP/P031307/1 confirmed the first ever direct numerical pore-scale simulator has been made available as open source and is used by R&D institutions from industry and academia in North America, South America, and Europe. The research has resulted in improved accuracy at a fraction of the computational cost of traditional approaches, and opens the possibility of understanding how structural change caused by chemical reaction during CCS affects the overall permeability of underground reservoirs.

Figure 27: The counts and types of 'datasets, databases and models' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the proportion of each type in each year. The area graph (below) reflects the growth in the proportion of records created using 'looked-up' or harvested data records.

Data outcomes submitted to EPSRC for research grants and fellowships

- ■ Database / Collection of data
- ■ Computer model / algorithm
- ■ Data analysis technique
- ■ Data handling & control

Percentage breakdown of how data outcomes were submitted

- ■ Harvested
- ■ Looked up and imported
- ■ Manually added

4.7 Software & technical products

A total of 2,568 unique 'software and technical product' records, attributed to 1,395 unique research grants or fellowships, have been reported through Researchfish to EPSRC during the period 2017-2022. Of the unique 'software and technical product' records submitted to EPSRC, researchers categorised 68% as software (including 'e-Business platforms' and 'Grid Applications'), 16% as webtool/applications, 8% as 'new/improved technique/technology', 3% as 'physical models/kits', and 3% as 'systems, materials and instrument engineering'; the remaining 2% were allocated to other categories as listed in Figure 28 below. Appendix Table 4 lists the yearly percentages and counts for the different output/outcome sub-types of newly submitted records in this Researchfish section.

The proportion of 'software' records that are either looked-up or harvested jumped from 4% in 2020 to 22% in 2021, reflecting both the ability of Researchfish to harvest metadata directly from Datacite and the increased creation of Datacite records by research organisations on behalf of their researchers. It may also suggest increased understanding of the importance and value of 'open science' and a growing willingness, given appropriate infrastructure, to openly share research data.

Figure 28: The counts and types of 'software & technical products' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the percentage of the outcome sub-type per year first submitted.
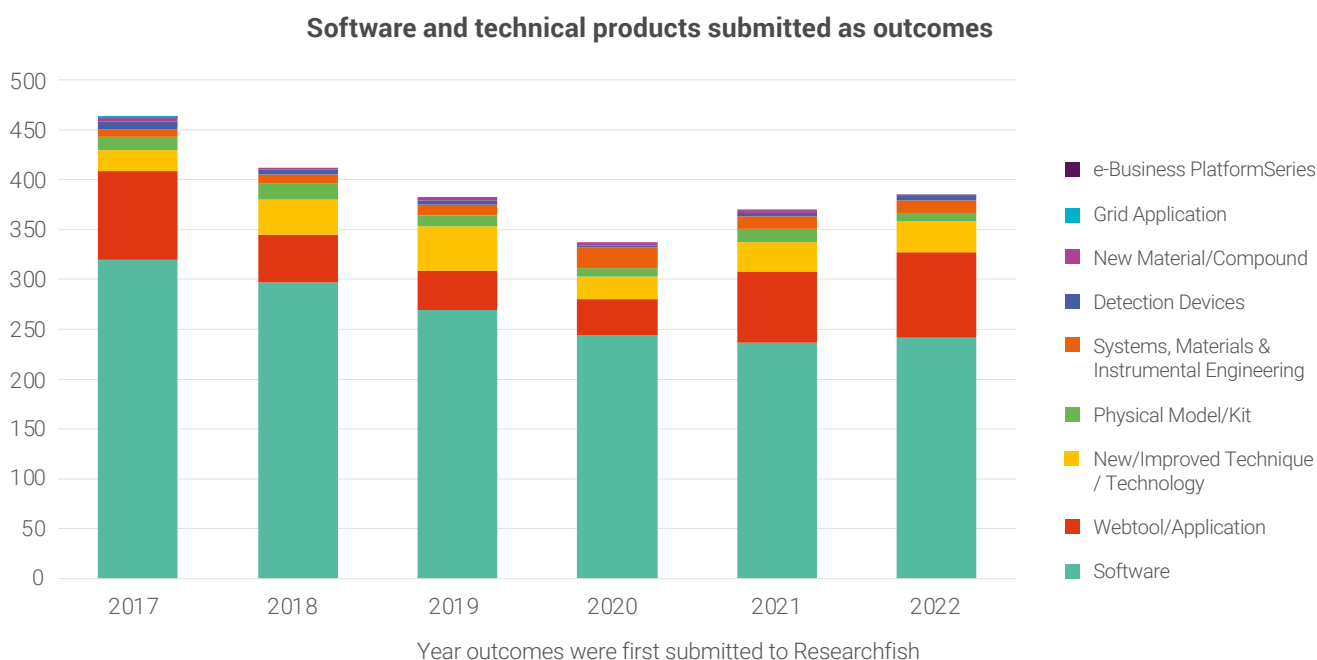
Researchfish records show that EPSRC Fellowship EP/K007254/1 supported the development the Future Technology Transformations (FTT) family of models. These help assessment of the impact of climate change mitigation policies, by simulating the diffusion of new energy technologies across the global electricity, transport, household heating and steel sectors. Available in commercial and open-source versions, FTT models evaluate greenhouse gas emissions in these sectors, investment in plants and equipment, sectoral prices, fuel use and the costs of chosen energy policies. The commercial version, which covers the world divided into 53 countries or regions, has informed numerous impact assessments of national electricity policies (e.g. in Germany, Japan, Korea, India, China, Brazil, EU); the freely available open-source version is used to teach graduate students. An important outcome of the FTT models has been the opportunity to understand and mitigate the global economic risks to trillions of dollars' worth of assets (e.g. pipelines, tankers, drilling equipment, oil reserves) arising from a transition to renewable energy sources.

4.8 Research Tools & methods

A total of 1,733 unique 'research tools and methods' outcome records, attributed to 1,136 unique grants or fellowships, have been reported through Researchfish to EPSRC during the period 2017-2022. Given the predominantly 'life science' flavour of most of the outcome sub-types available in this section of the Researchfish 'common question set', it is unsurprising that EPSRC researchers have categorised the majority (71%) of the records submitted to EPSRC as 'improvements to research infrastructure'. The balance comprises 17% as 'technology assays or reagents', 6% as the 'modelling of mechanisms or symptoms', 5% as 'physiological assessment or outcome measure' and the remaining 1% to other categories as listed in Figure 29 below. Appendix Table 5 lists the yearly percentages and counts for the different output/outcome sub-types of newly submitted records in this Researchfish section.
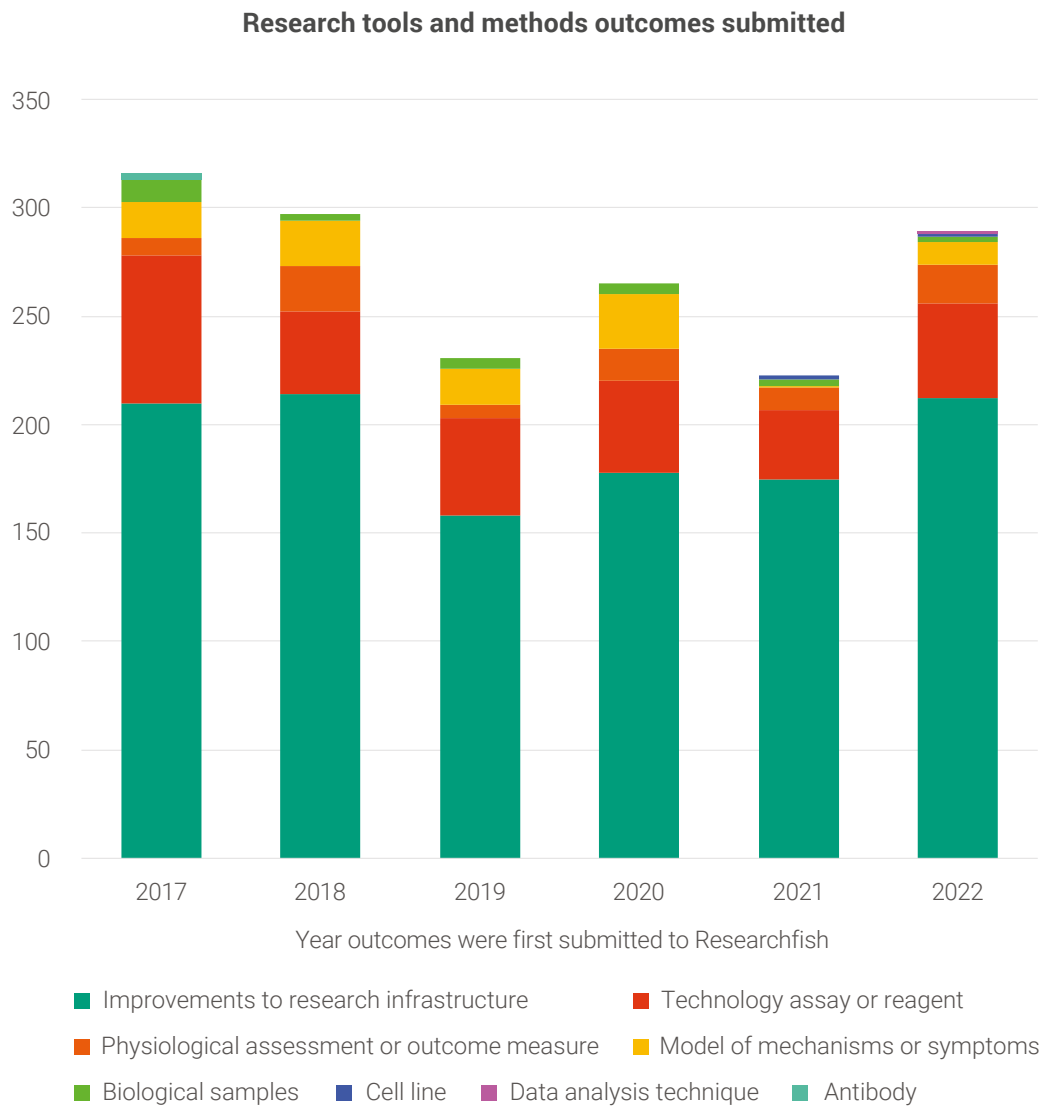
Example records categorised as an 'Improvement to Research Infrastructure'[15]:

Title	Cochleanet: A robust language-independent audio-visual model for speech enhancement
Description	A novel language-, noise- and speaker-independent audio-visual (AV) deep neural network (DNN) architecture, termed CochleaNet, was developed for casual or real-time speech enhancement (SE). The model jointly exploits noisy acoustic cues and noise robust visual cues to focus on the desired speaker and improve speech intelligibility. The proposed SE frmework is evaluated using a first of its kind AV binaural speech corpus, ASPIRE, recorded in real noisy environments, including cafeteria and restaurant settings. We demonstrate superior performance of our approach in terms of both objective measures and subjective listening tests, over state-of-the-art SE appraoches, including recent DNN based SE models.
Type of Material	Improvements to research infrastructure
Year Produced	2020
Provided to Others?	Yes
Impact	Our developed AV speech enhancement approach has been widely used and cited by researchers worldwide as a benchmark resource. It's continuing to be utilized for real-tim AV prototype development for future multi-modal hearin-aids, as part of a follow-on EPSRC funded programme grant (COG-MHEAR).
URL	https://www.sciencedirect.com/science/article/pii/S1566253520302475

Title	Place Based Carbon Calculator (PBCC)
Description	Funded by a CREDS Impact Acceleration Grant. The PBCC generates an estimate of the per head carbon footprint for every neighbourhood in England, using a variety of data sources. An interactive web-based map can be interrogated at Local Super Output Area and Local Authority aarea for the carbon footprint, LSOA level data on travel to work, home heating & energy efficiency; 15 min travel isochrones for walking, cycling & public transport; The location of every bus stop, tram and rail station in Englance, colour coded by frequency of service from it. Comparative stats are presented for comparison neighbourhoods and the whole of England etc.
Type of Material	Improvements to research infrastructure
Year Produced	2021
Provided to Others?	Yes
Impact	The PBCC was launched with an attendance of over 300 and is available at www.carbon.place. The website has had over 13,000 visitors in the first month, with very high levels of attention on social media and in the industry press/ Project leader Malcolm Morgan did a TV interview as part of a 10 minute news item on the regional BBC programme Look East. A follow-up bespoke webinar for a cross-Whitehall group of civil servants that has resulted in major additional central governement funding for the PBCC. It is being used by several local authorities and third sector organisations.
URL	http://www.carbon.place

(15) https://gtr.ukri.org/projects?ref=EP%2FM026981%2F1

Figure 29: The counts and types of 'research tools & methods' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the percentage of the types of outcomes per year that are submitted.

Research tools and methods outcomes submitted

Legend:
- Improvements to research infrastructure
- Technology assay or reagent
- Physiological assessment or outcome measure
- Model of mechanisms or symptoms
- Biological samples
- Cell line
- Data analysis technique
- Antibody

X-axis: Year outcomes were first submitted to Researchfish
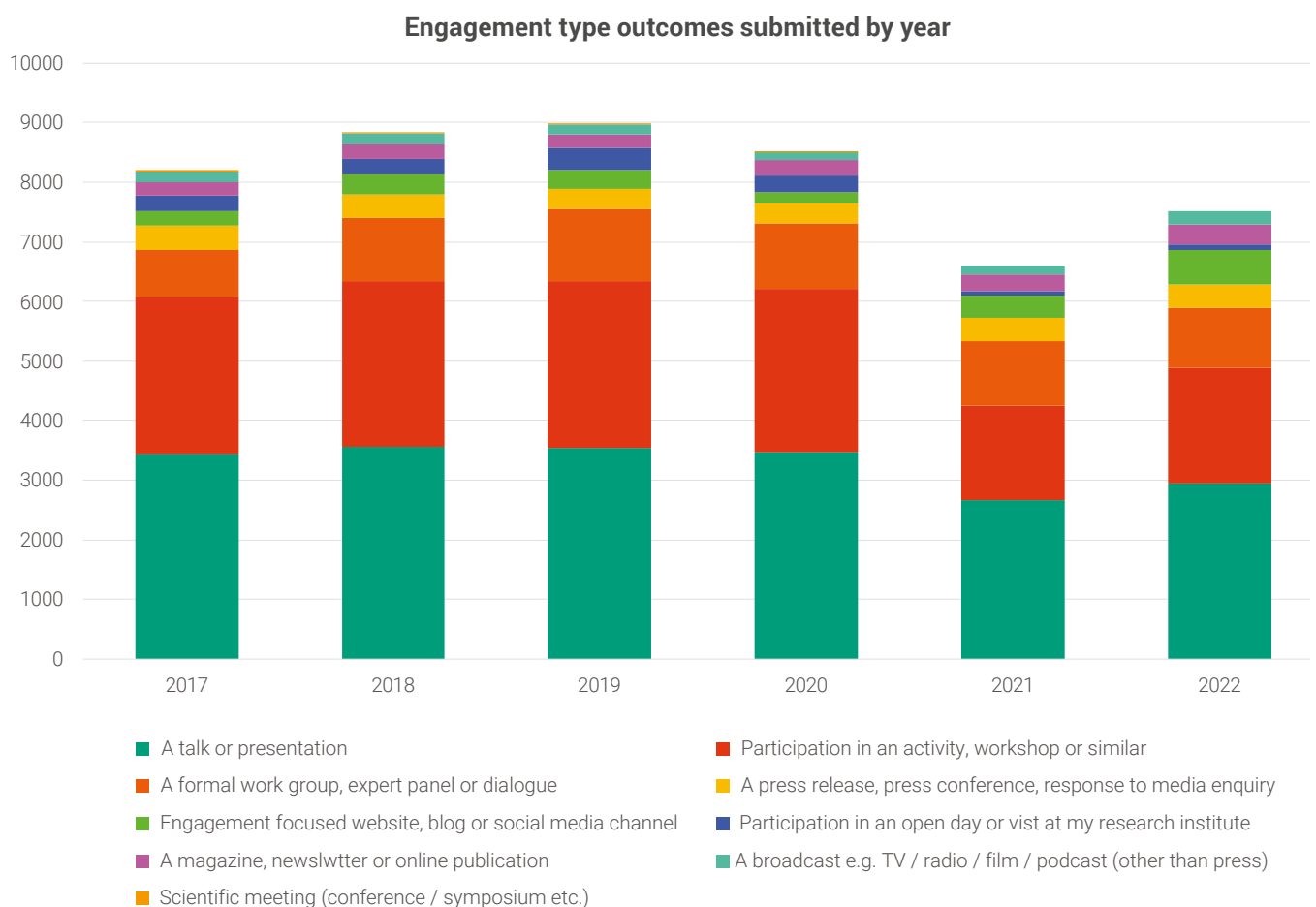
4.9 Engagement activities

Research engagements reported through Researchfish inform understanding of how research funded by EPSRC is disseminated more broadly. A total of 52,717 unique 'engagement activities' records, attributed to 4,916 unique research grants or fellowships, have been reported through Researchfish to EPSRC during the period 2017-2022. Of the 'engagement activities' records submitted to EPSRC, researchers categorised 40% as a 'talk or presentation', 30% as a 'workshop' or similar activity, 13% as a 'formal working group, expert panel or dialogue', 5% as a 'press release, press conference or response to a media enquiry', and assigned the remaining 7% to other categories as listed in Figure 30 below. The drop in engagements between 2020 and 2021 (22%) is reflective of the lockdown period which severely limited all 'in-person' engagement opportunities. Appendix Table 6 lists the yearly percentages and counts for the different output/

outcome sub-types of newly submitted records in this Researchfish section.

When recording an 'engagement activity' in Researchfish researchers are asked to estimate the geographical reach of their activity. As shown in Figure 31 below the submitted data indicates almost half (49%) of the engagement activities undertaken have an International reach; some 33% are estimated to have a National reach, 10% a regional reach within a country and 8% as being 'local' to the area where the engagement activity took place[16].

Researchers are also asked to indicate the primary audience of an engagement activity, and Figure 32 below shows the relative variation of audience type and estimated reach of activities recorded as taking place during the years 2017-2022.

Figure 30: The counts and types of 'engagement activities' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the percentage of the types of outcomes per year that are submitted.

Engagement type outcomes submitted by year

Legend:
- A talk or presentation
- Participation in an activity, workshop or similar
- A formal work group, expert panel or dialogue
- A press release, press conference, response to media enquiry
- Engagement focused website, blog or social media channel
- Participation in an open day or vist at my research institute
- A magazine, newslwtter or online publication
- A broadcast e.g. TV / radio / film / podcast (other than press)
- Scientific meeting (conference / symposium etc.)

(16) Data presented in Figure 31 and in Figure 32excludes engagements with no geographical reach mentioned, which represents ~0.7% of the total portfolio.

Figure 31: Percentage breakdown of the reported 'reach' of the 'engagement activities' attributed to EPSRC research grants or fellowships and first submitted to EPSRC via Researchfish in or since 2017.
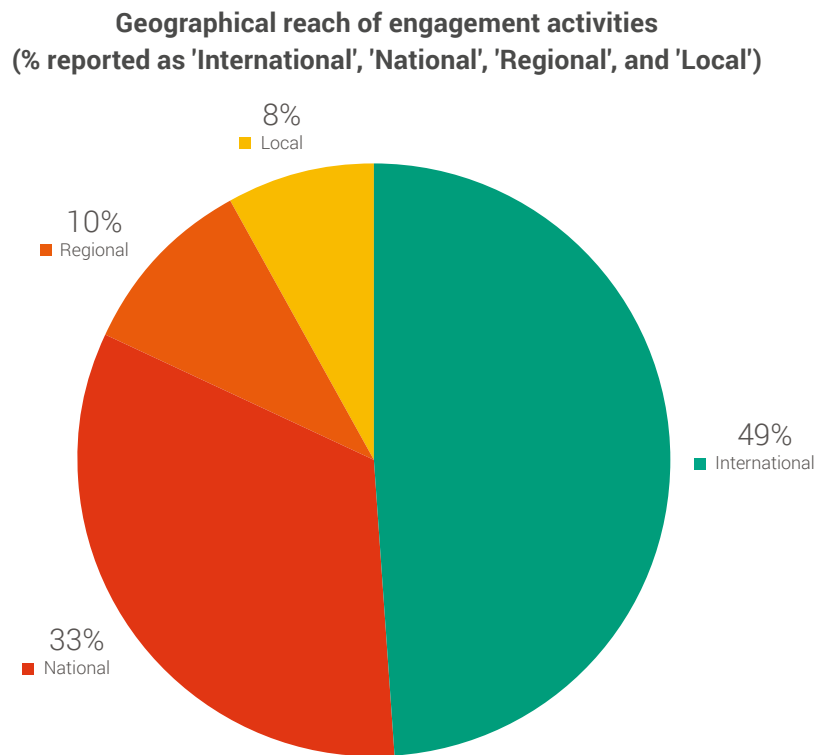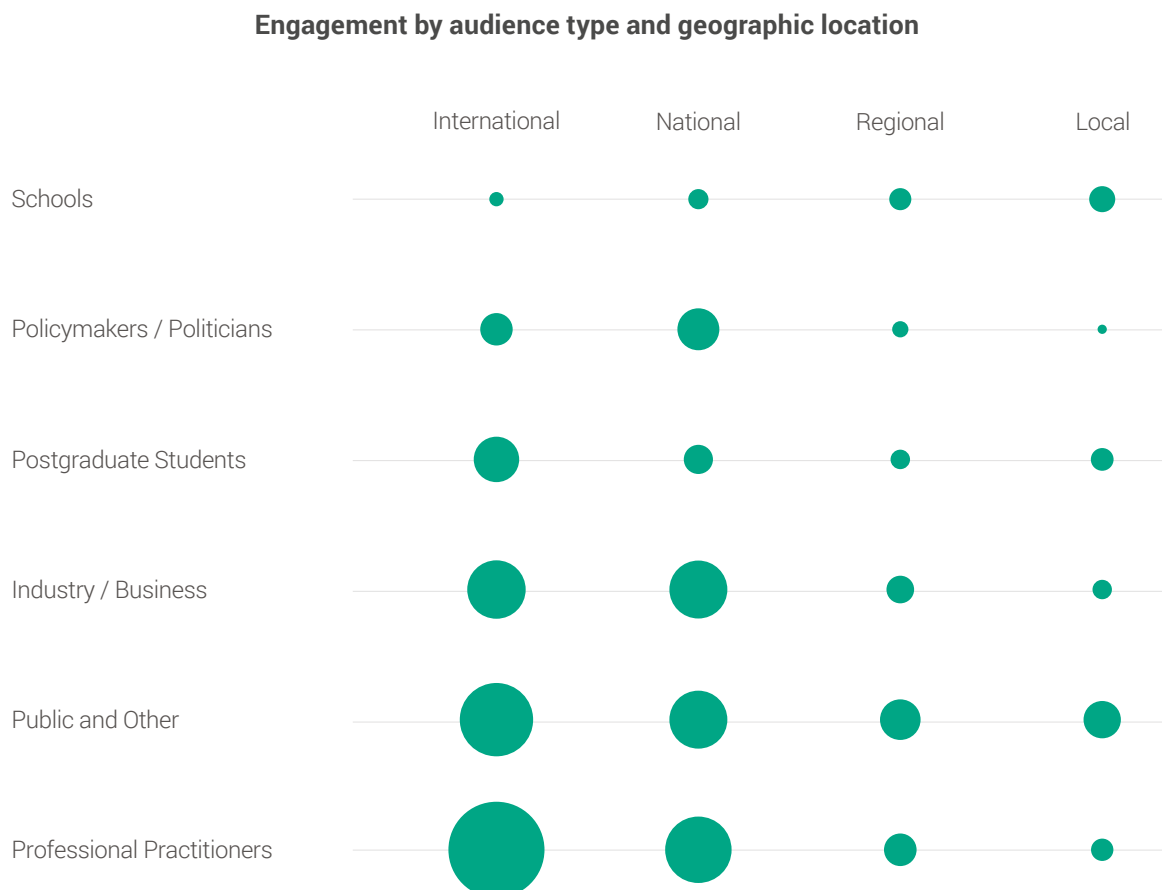
**Geographical reach of engagement activities
(% reported as 'International', 'National', 'Regional', and 'Local')**

Figure 32: The primary audience for engagements reported in Researchfish 2017-2022 by geographical reach.

Engagement by audience type and geographic location

Researchfish records linked to grants EP/H02011X/1 and EP/K039253/1 evidence the importance of engagement activities. Using vessel location and speed information from the Automatic Identification System (AIS), and specially developed ASK-C software, the research predicted that levels unless concerted action was taken international shipping GHG emissions could, by 2050, be up to 130% higher than in 2008. Persistent engagement by the researchers helped inform debate on measures to tackle this global problem and in 2018 the International Maritime Organisation (IMO) became the first organisation to adopt legally binding, global industry-wide, energy-efficiency measures to reduce CO_2 emissions. In addition, continued emphasis of the necessity of further de-carbonisation by the sector has contributed to a breakthrough international acknowledgement of the need to introduce carbon price on shipping emissions.

4.10 Influence on policy, practice, patients & the public

The Researchfish 'influence on policy, practice, patients and the public' section allows users to record data where their research has informed discussion of, and may have directly influenced, public policy, professional practice, patients or the general public. A total of 4,175 unique 'policy' outcomes, attributed to 1,360 unique research grants or fellowships, have been reported through Researchfish to EPSRC during the period 2017-2022. Researchers categorised 40% of those records as being involved in an advisory or guidance committee', 29% as providing input to a national consultation or government review', and 17% as 'influenced training of practitioners or researchers'; the remaining number as other policy influences as listed in Figure 33 below, which also shows how use of the various available categories has varied over time; note that the 'Contribution to professional practice' category was unavailable prior to 2022.

External research commissioned by EPSRC and drawing on the recently developed 'Overton' database of citations to academic literature in policy-related publication indicates that the count of records in Researchfish reporting influence by 'Citation' very significantly under-represents the extent to which

EPSRC-funded research is referred to by public policy makers and the sources of information which may influence them. The 'Overton' study, which analysed publicly accessible 'policy documents' to identify citations to research articles attributed to EPSRC funding, found that articles attributed to EPSRC (a) were cited 1.7 times more often than other articles published in the same journals during the same sampled timeframes; (b) have been cited in over 1,800 policy documents linked to the governments of 40 different countries (including the EU); (c) were cited in over 470 UK official publications at all levels, ranging from Parliamentary Select Committee reports/research briefings to the National Audit Office.

Researchers categorise each 'influence on policy, practice, patients and the public' records submitted to EPSRC by the industry sector(s) that are, or are likely to be, affected (Figure 34 below). More than one sector can be assigned to a record and the chart shows the extent to which researchers indicate their EPSRC-funded work is impacting policy and/or practice across different industry sectors; energy, environment and digital/IT sectors feature the most strongly, and retail, leisure and culture the least.
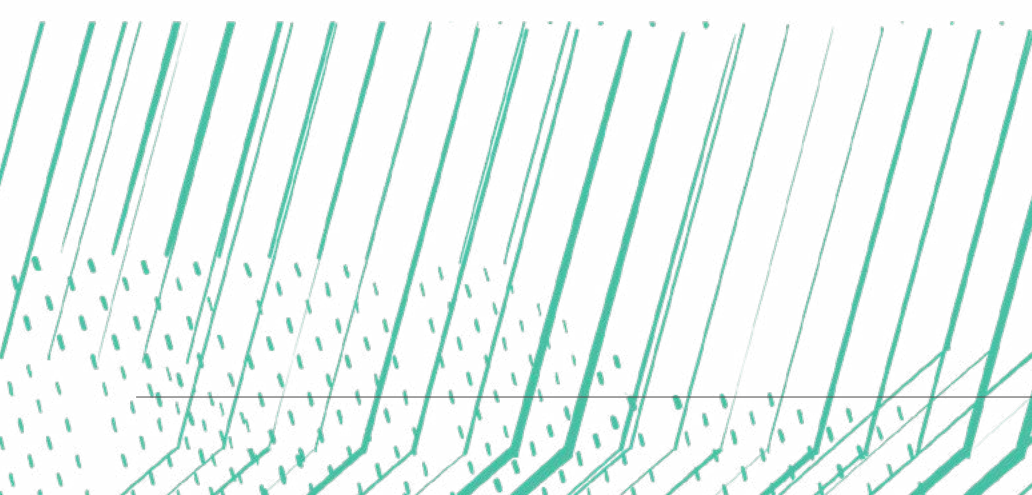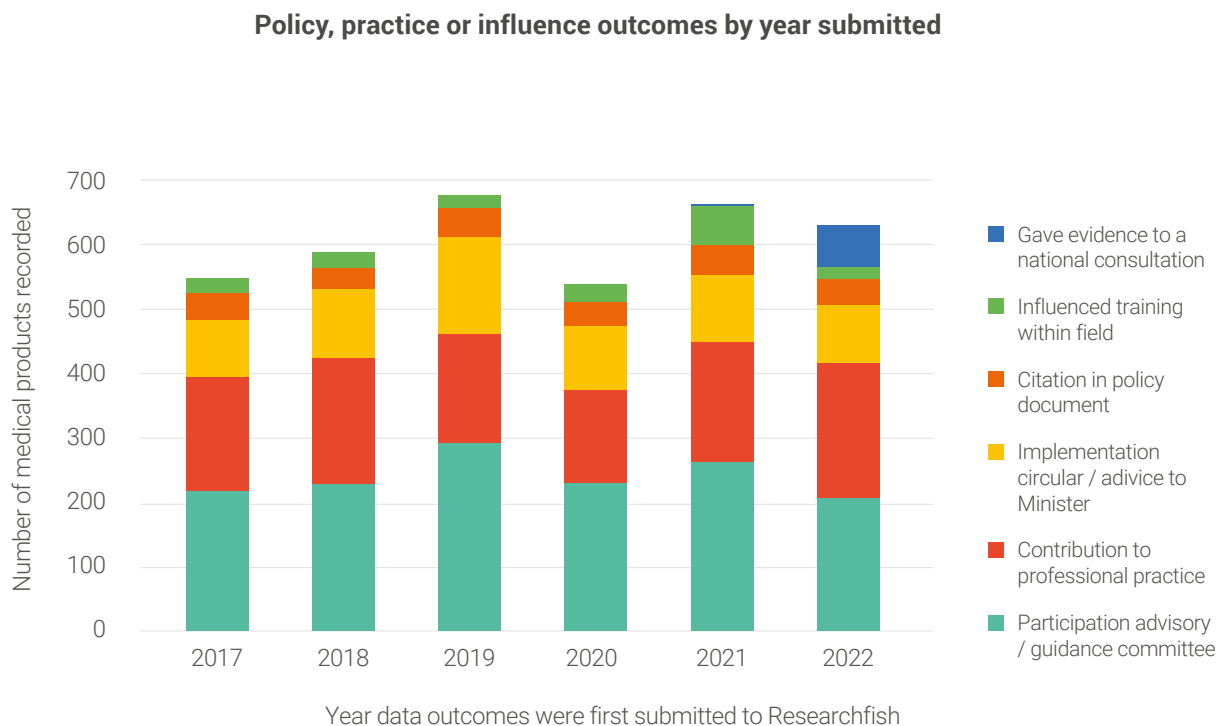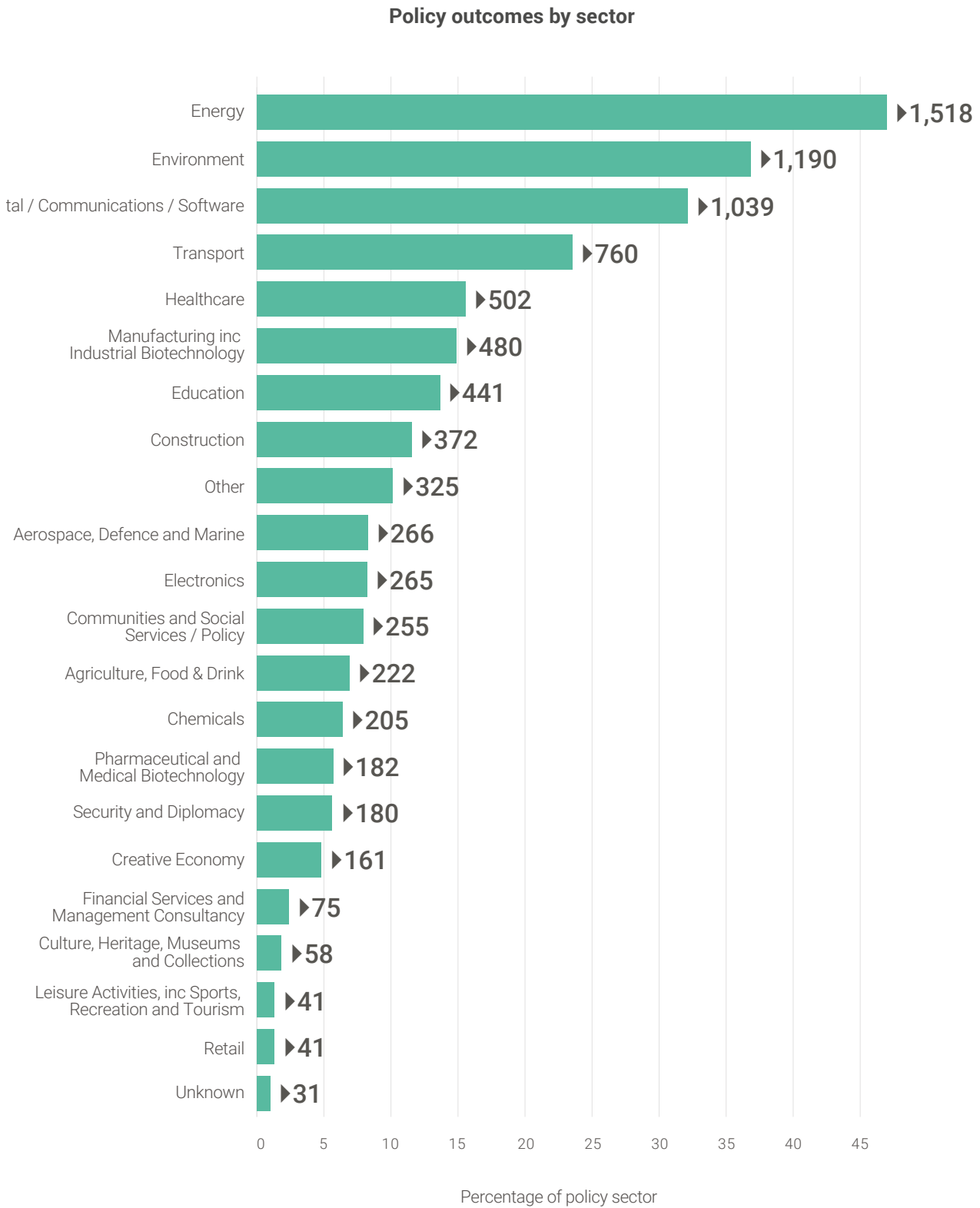
*Figure 33: The counts and types of 'Influence on Policy, Practice, patients and the Public' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. ***

Policy, practice or influence outcomes by year submitted

Category used in the chart	Categories in Researchfish
Contribution to professional practice	Contribution to a new or improved professional practice
Citation in policy document	Citation in clinical guidelines Citation in clinical reviews Citation in other policy documents Citation in systematic reviews
Gave evidence to a national consultation	Gave evidence to a government review Participation in a national consultation
Implementation circular/advice to Minister	Implementation circular/rapid advice/letter to e.g. Ministry of Health
Influenced training within field	Influenced training of practitioners or researchers
Participation advisory/guidance committee	Membership of a guideline committee Membership of a guidance committee Participation in an advisory committee

Figure 34: The industry focus of 'policy influence' records attributed to EPSRC research grants or fellowships in Researchfish and submitted to EPSRC during 2017-2022, by count and percentage of records indicating the reported 'influence' as relevant to each sector. Note: a researcher may categorise a record as relevant to more than one sector.

Policy outcomes by sector

Sector	Count
Energy	1,518
Environment	1,190
tal / Communications / Software	1,039
Transport	760
Healthcare	502
Manufacturing inc Industrial Biotechnology	480
Education	441
Construction	372
Other	325
Aerospace, Defence and Marine	266
Electronics	265
Communities and Social Services / Policy	255
Agriculture, Food & Drink	222
Chemicals	205
Pharmaceutical and Medical Biotechnology	182
Security and Diplomacy	180
Creative Economy	161
Financial Services and Management Consultancy	75
Culture, Heritage, Museums and Collections	58
Leisure Activities, inc Sports, Recreation and Tourism	41
Retail	41
Unknown	31

Percentage of policy sector

Research grant EP/M017877/1 reported:

"The research outputs and impact engagement (e.g., impact events documented in Researchfish) resulted in the UK Department for Transport acquiring a contract to develop a mobile accident reporting device/app for recording details of road accidents at the roadside. One of the motivations for this development is that the funded project revealed that memory bias can result from delayed reporting of road accidents by police officials. The mobile device is in later stages of development and will initially be used by selected police stations and units before being used across the UK. The device reduces police officer workload, increasing public sector efficiency, by reducing duplication in accident reporting. The device also has the potential to improve survival, morbidity, and quality of life of road users by improving insight into road accident causation through improvement in the reliability of accident data."

The Collision Reporting and Sharing system ('CRaSH') is the result: in use by 20 UK police forces it reduces police officer workload, increases public sector efficiency by reducing duplication in accident reporting, and has already delivered annual savings in the region of £7.5m per year. The DfT is currently exploring opportunities to promote the device internationally.

4.11 Spin-outs

EPSRC has been collecting data about spin-out companies established to exploit the results of research funded by EPSRC (and its predecessor) for a considerable period. To date we have recorded some 1,600 such companies (hereafter referred to as 'EPSRC spin-outs'), the oldest of which was incorporated some 40 years ago. A growing proportion (currently 37%) of our records originated from Researchfish, which although not the only source, is now much the most significant way in which we first hear about a new spin-out: 269[17] of the 290 identified 'EPSRC spin-outs' incorporated since 2017 have been reported via Researchfish. A reducing proportion (currently 43%) originated in legacy reporting systems but have since been confirmed in Researchfish; 20% of our records either originated in legacy systems and have not since been re-submitted via Researchfish or are attributed to funding that does not report through Researchfish. In each case, however, links to our funded research have been verified and the data is routinely monitored and refreshed using data from Companies House and other sources. Spin-out company records in researchfish are a particularly rich source of impact evidence and inform many EPSRC Case Studies; examples including Ziylo, Brill Power, Sirakoss, KETS Quantum Security, Porotech, AudioScenic, Encortec, and EpiPix to name a few. Brief information on over 1000 spin-out companies linked to EPSRC research is available on the UKRI 'Gateway to Research' website via this link: bit.ly/SpinoutslinkedtoEPSRCfunding.

As of November 2022 62% of the companies were still active with a collective employee count of at least 23,842 (only 73% of the companies have published employee count data), and a collective annual turnover of at least £5.7B (only 16% of the companies have published this data). The digital/IT, manufacturing, and healthcare sectors account for the top 3 areas of spin-out activity to-date (Figure 35). To see the overall sector breakdown of spin-out by year of incorporation please refer to Figure 36 below.

(17) The lower figure quoted in the highlights section excludes companies that have since been dissolved or which may not meet the criteria to be classed as a true 'Spin-out'

Figure 35: Industry sectors of spin-outs companies linked to EPSRC funded research. The 'dissolved' category includes companies that have been merged or taken over. This analysis draws on data collected via Researchfish and from other sources, including the Bureau van Dijk 'FAME' database to determine activity status. Please note that in this analysis companies are allocated to the sector that best describes their primary activity, even though they may in practice work across multiple sectors.

Spin-out companies resulting from EPSRC funding, by sector

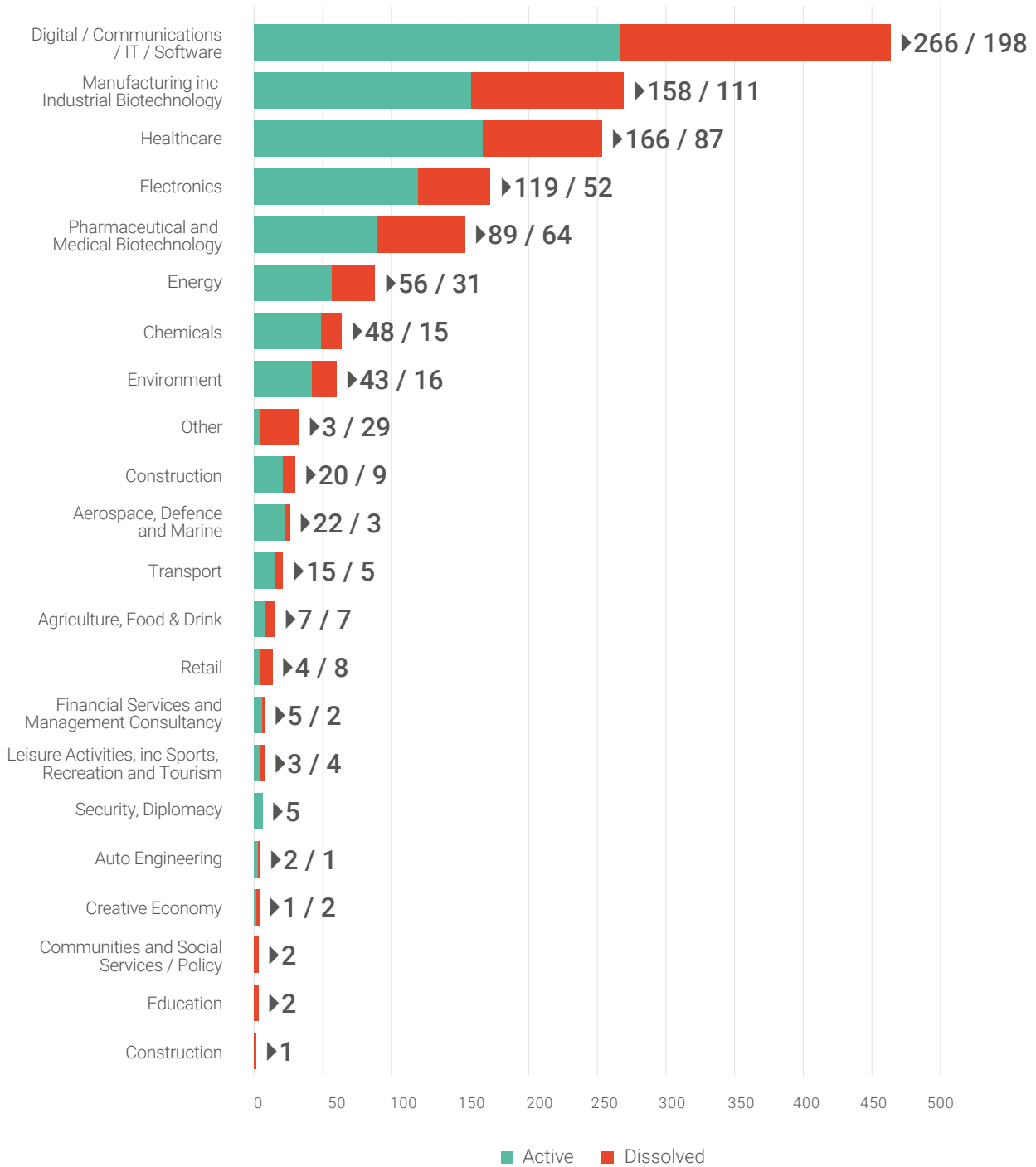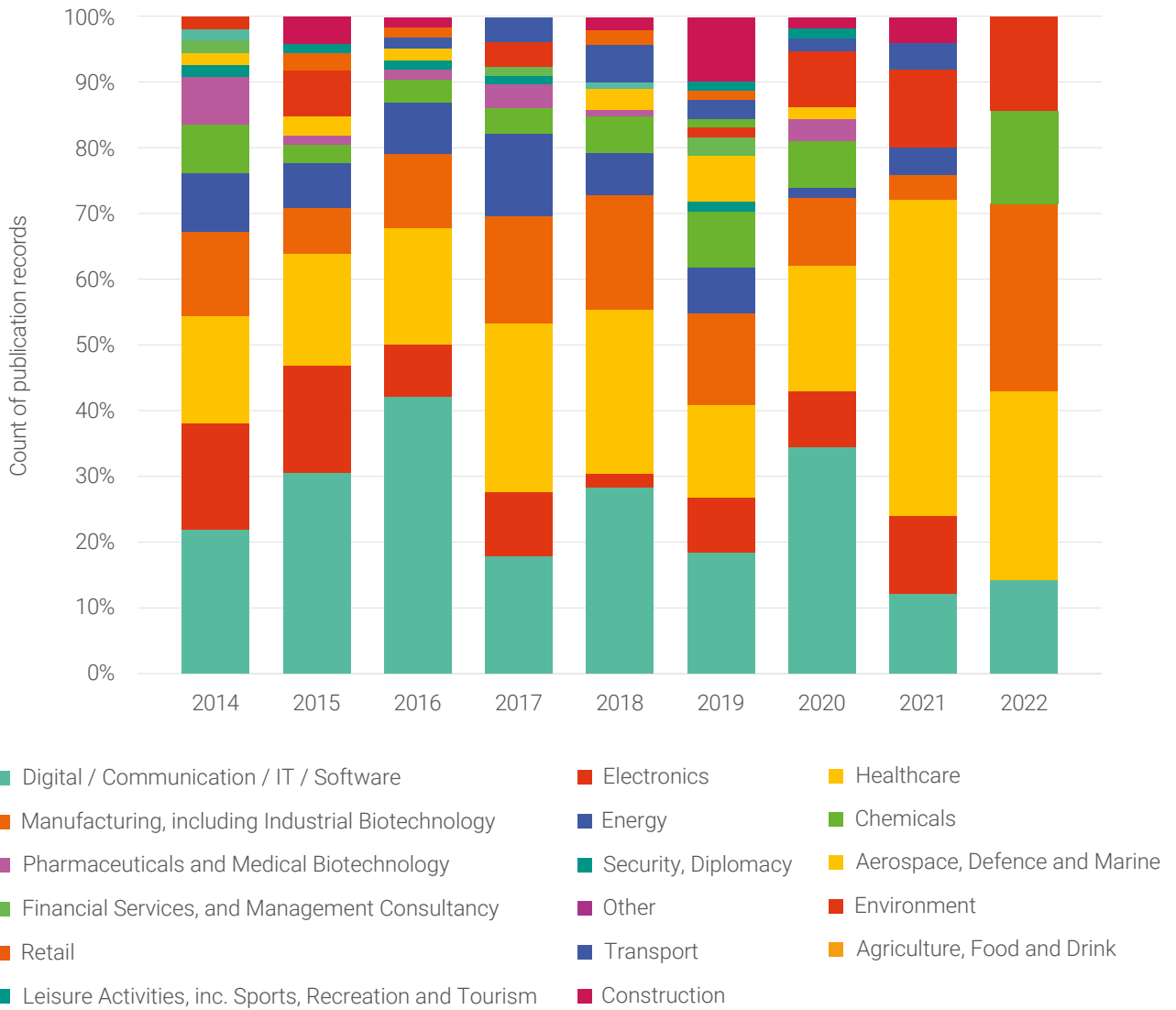| Sector	Active / Dissolved
Digital / Communications / IT / Software	266 / 198
Manufacturing inc Industrial Biotechnology	158 / 111
Healthcare	166 / 87
Electronics	119 / 52
Pharmaceutical and Medical Biotechnology	89 / 64
Energy	56 / 31
Chemicals	48 / 15
Environment	43 / 16
Other	3 / 29
Construction	20 / 9
Aerospace, Defence and Marine	22 / 3
Transport	15 / 5
Agriculture, Food & Drink	7 / 7
Retail	4 / 8
Financial Services and Management Consultancy	5 / 2
Leisure Activities, inc Sports, Recreation and Tourism	3 / 4
Security, Diplomacy	5
Auto Engineering	2 / 1
Creative Economy	1 / 2
Communities and Social Services / Policy	2
Education	2
Construction	1

■ Active   ■ Dissolved

Figure 36: A percentage breakdown of the number of companies incorporated each year by sector breakdown. The data collected is of all the spin-out/start-up data from incorporation year 1997 upwards and has been collected from Researchfish and other UKRI systems.

Spin-out companies from EPSRC grants by sector and year incorporated

Legend:
- Digital / Communication / IT / Software
- Electronics
- Healthcare
- Manufacturing, including Industrial Biotechnology
- Energy
- Chemicals
- Pharmaceuticals and Medical Biotechnology
- Security, Diplomacy
- Aerospace, Defence and Marine
- Financial Services, and Management Consultancy
- Other
- Environment
- Retail
- Transport
- Agriculture, Food and Drink
- Leisure Activities, inc. Sports, Recreation and Tourism
- Construction

For the spin-out companies reported to EPSRC via Researchfish, Figure 37 below shows that EPSRC is normally first informed about a spin-out the year following its incorporation; this is to be expected given the annual Researchfish reporting cycle falls in the first quarter of each year. However, Figure 37 also shows that there can sometimes be a significant delay between the date of incorporation of a company and EPSRC being first informed (via Researchfish) of the link to EPSRC-funded research.

Figure 37: A visual representation of the lag between when spin-out companies are incorporated and when they have been first reported to EPSRC via Researchfish (circle sizes reflect the numbers of companies). Typically speaking, EPSRC is informed the year a spin-out company is incorporated. NB: data has been filtered to only include incorporation years 2006-2022, and Researchfish reporting years 2017-2022.
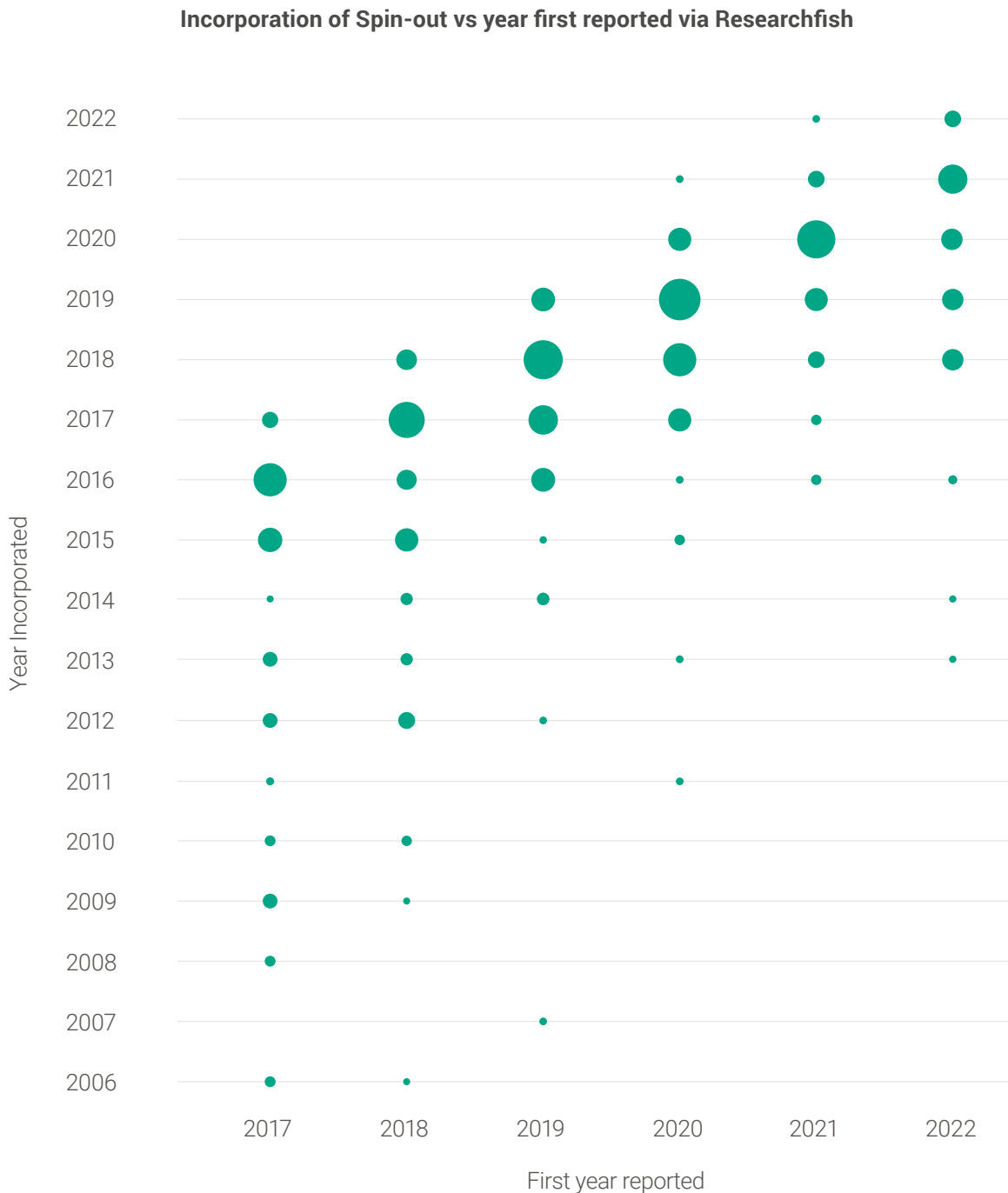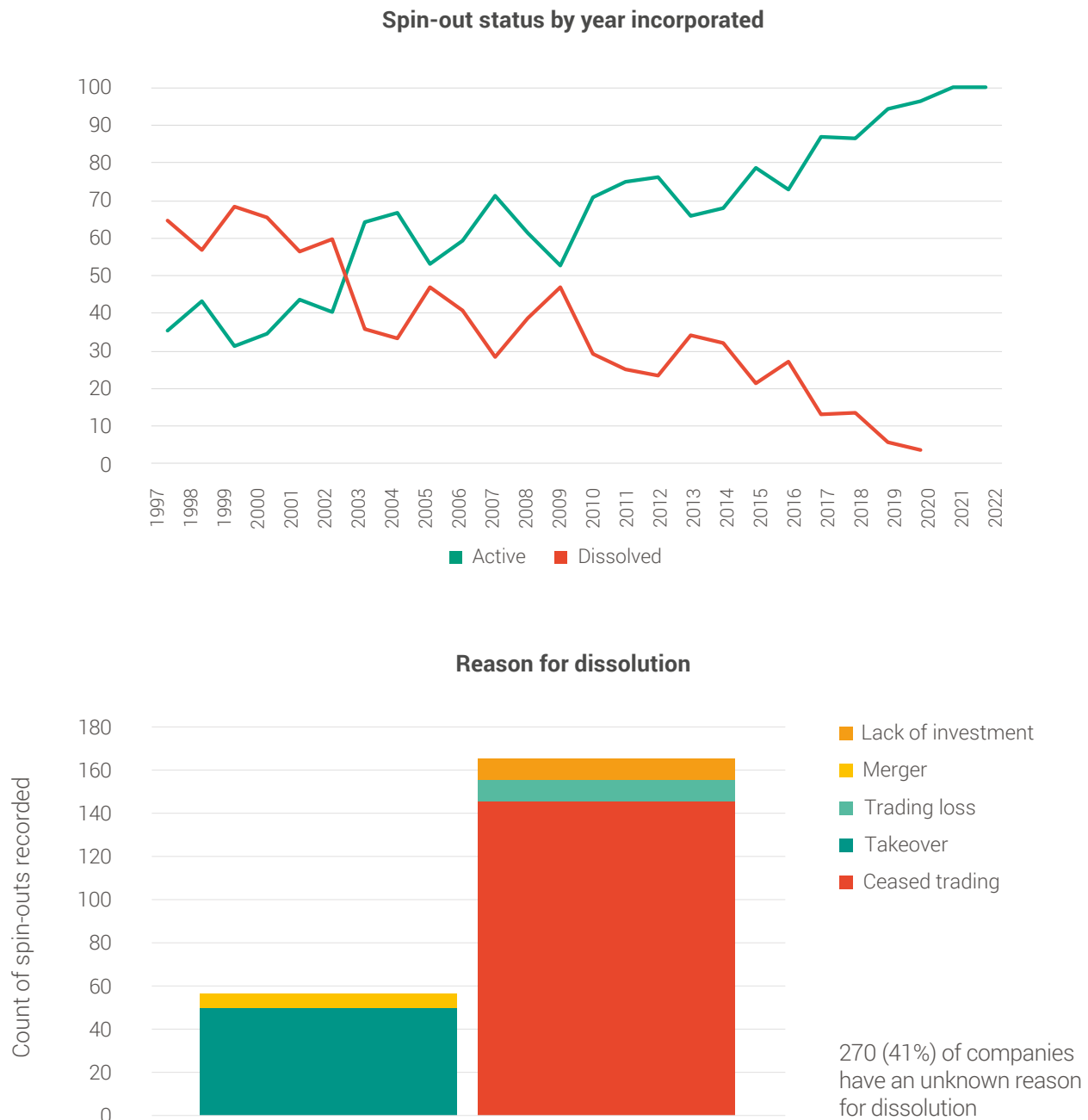

Incorporation of Spin-out vs year first reported via Researchfish

EPSRC spin-out companies reported via Researchfish
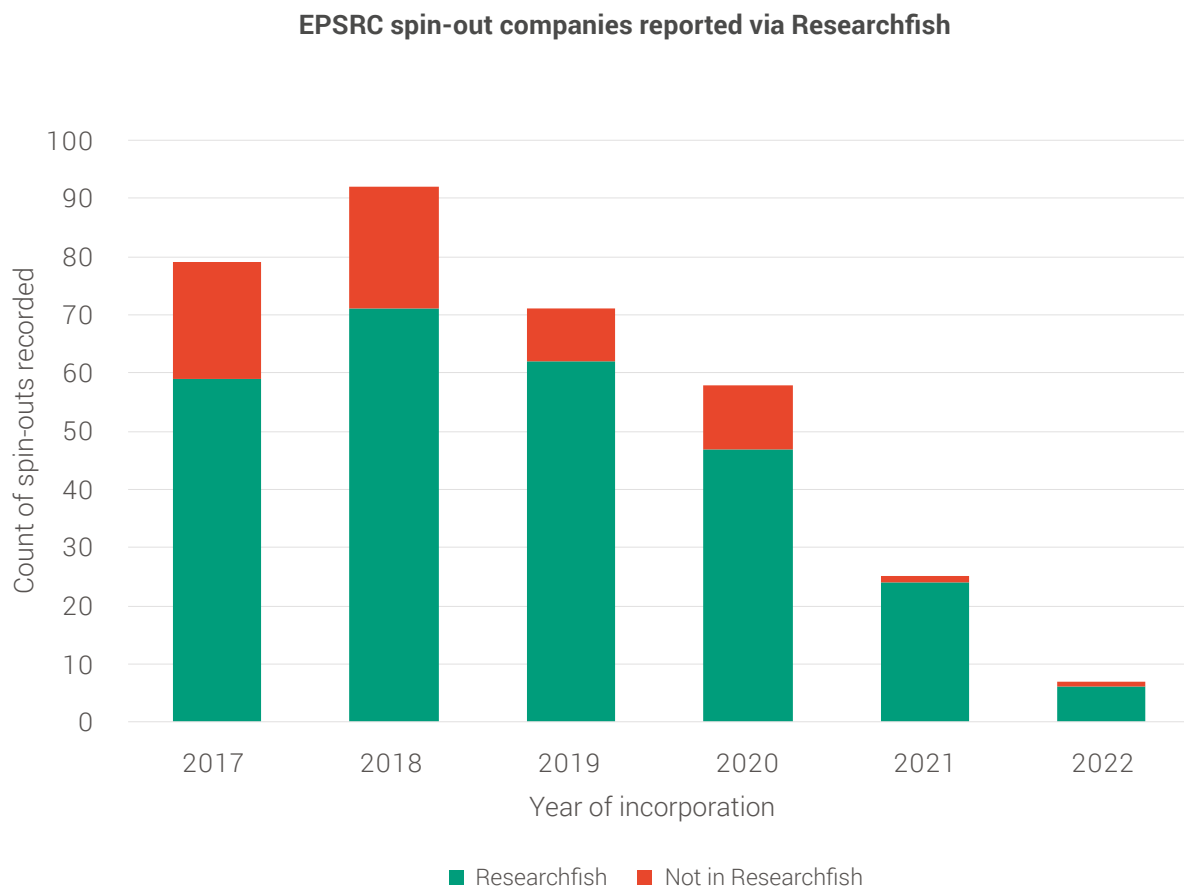
It is well known new start-up companies are often not long-lived, and that the proportion that go into liquidation increases over time. For example, Office of National Statistics (ONS) data for new companies incorporated in the period 2014-2020 indicates only 40%-44% were still active after five years; in contrast, start-ups linked to EPSRC research perform considerably better, with more than 50% of them still active up to 18 years after incorporation as shown in the top chart in Figure 39 below.

The bottom chart in Figure 39 shows that becoming 'dissolved' is not necessarily an indication of failure: while accurate information about the reason for a company being wound up is only available for those dissolved since 2017, the data for them shows that almost a quarter (24%) were acquired by other businesses, while the rest were dissolved due to trading loss, lack of investment or a simple decision to cease trading.

Figure 39: Top chart: The percentages still active and dissolved of 'EPSRC spin-out' companies, by year of incorporation. Status was as of 08/06/2022 when the analysis was performed. 'Dissolved' status includes mergers and take-overs. The data covers all known 'EPSRC spin-outs' incorporated in or after 1997. Bottom chart: Analysis or reasons for dissolution of 'EPSRC spin-outs' since 2017. Categories 'merger' and 'takeover' are technically still active in the sense that the company was taken over by another company, but it is not trading under its original company name/number.

Spin-out status by year incorporated

Reason for dissolution

270 (41%) of companies have an unknown reason for dissolution

It's notable that the upper chart shows 80% of 'EPSRC spin-outs' incorporated in 2015 are still active, contrasting sharply with the UK average 5-year survival rate for business born in 2015 of 39.6% (as reported by The Office of National Statistic website[18]).

Figure 40 below shows how long all the 'dissolved' spin-outs (incorporated in or after 1997; excluding any known takovers/mergers) traded for. Further analysis shows that that 70% traded for more than 5 years.

(18) Shaw B. 2021. Business demography, UK: 2020. Office for National Statistics. 1-14.
https://www.ons.gov.uk/businessindustryandtrade/business/activitysizeandlocation/bulletins/businessdemography/2020

Figure 40: Overview of lifespan of dissolved 'EPSRC spin-outs' incorporated in or after 1997. The data excludes companies that were dissolved due to merger with or takeover by another company.

Trading timespan of dissolved companies associated with EPSRC funding

The UK regional distribution all 'EPSRC spin-outs' (as of 09/06/2022) is shown on the left-hand map in Figure 41 below; the right-hand map shows the counts of those still active as of 09 June 2022. The regions with the most active spin-outs are the South East of England (22%), London (18%), Scotland (12%) and the East of England (11%).

Figure 41: UK regional distribution of all spin-outs (left map) and active spin-outs (right map) registered to-date that have been attributed to EPSRC funded research (data is correct as of November 2022). Data collected via Researchfish and from other sources and subsequently augmented using the Bureau Van Dijk 'FAME' database.

Distribution of all UK Spin-outs to Date Attributed to EPSRC Funding (Nov 2022)

224
53
51
11 Unspecified UK location
137
139
66
62
74
188
332 291
120

XX Count of all UK Spin-outs created in region and attributed to EPSRC-funded research

Distribution of active UK Spin-outs to Date Attributed to EPSRC Funding (Nov 2022)

113
26
26
11 Unspecified UK location
74
67
40
37
36
113
210 170
73

XX Count of active UK Spin-outs created in region and attributed to EPSRC-funded research
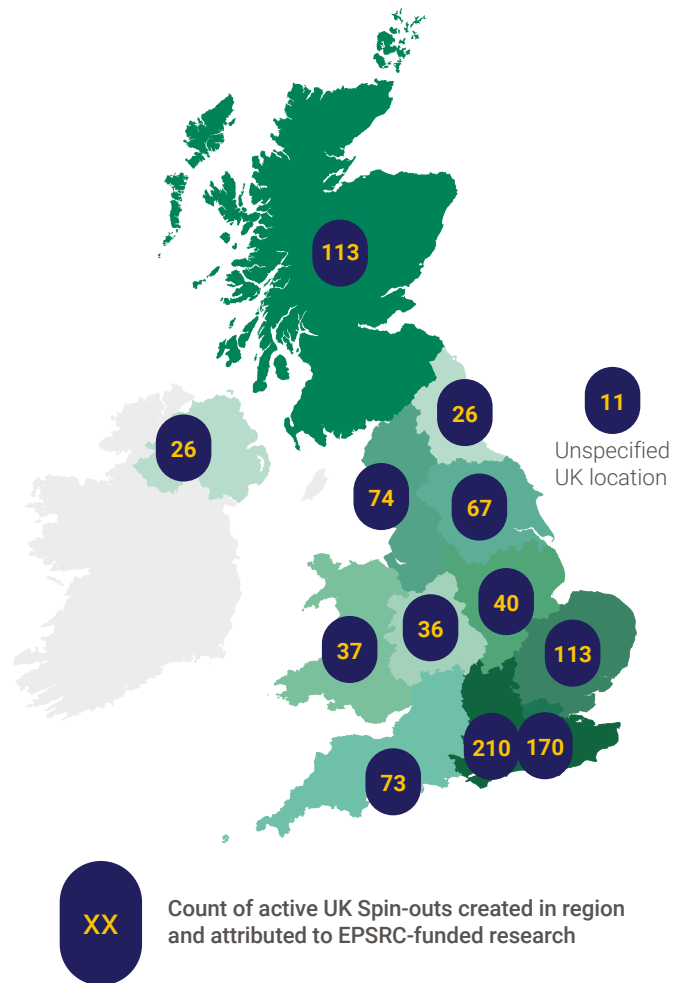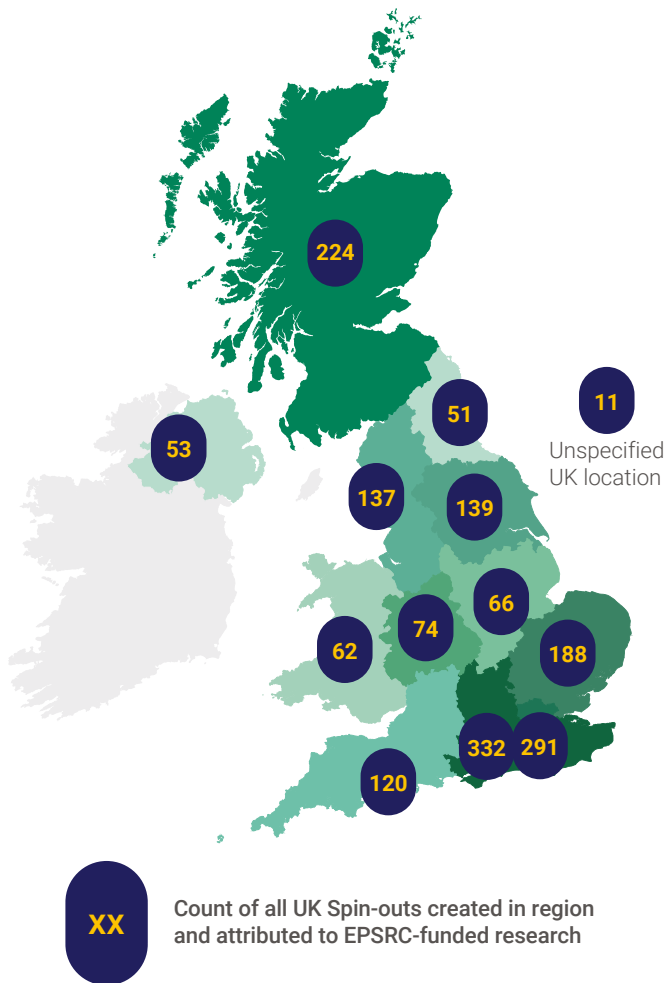
Table 4 below displays for each UK region the number of spin-outs incorporated since 1997 together with the percentages that have been merged/taken over or closed and the average lifespan of those that have been dissolved.

Table 4: UK distribution of all spin-outs registered to date that have been attributed to EPSRC funded research, by count of spin-outs, % of spin-outs that have merged or been taken over, % of spin-outs that have closed, and the mean trading time in years of those closed spin-outs.

|	Count of Companies formed	Avg. Trading length (Years)	% Closed	% merged or taken over	% Unknown reason for dissolution
East Midlands	65	11	1.5%	6.2%	36.9%
East of England	180	12	2.8%	5.6%	35.6%
London	277	10	1.8%	8.7%	35.0%
North East	49	9	0.0%	10.2%	46.9%
North West	134	11	0.7%	5.2%	41.8%
Northern Ireland	53	11	0.0%	11.3%	47.2%
Scotland	216	11	2.3%	6.9%	45.8%
South East	309	12	1.3%	5.5%	29.1%
South West	117	10	1.7%	6.0%	37.6%
Wales	60	9	1.7%	6.7%	38.3%
West Midlands	71	10	7.0%	5.6%	49.3%
Yorkshire and The Humber	132	11	0.8%	5.3%	46.2%
Overall	**1,663**	**11**	**1.8%**	**6.6%**	**38.5%**

4.12 Intellectual property & licensing

The IP & Licensing section in Researchfish asks researchers to record when their research leads to a patent or patent application. Often, multiple applications covering a single 'invention' are filed in different countries/regions, with such applications (and any subsequent patents) being referred to as a 'patent family'. However, researchers need only record details of one application in Researchfish as EPSRC uses the online PatSnap platform to identify the jurisdictions, ownership and current status (e.g. whether granted or rejected) of all members in that application's patent family. This section of the report focusses on patent families because they each represent a unique 'invention'.

Figure 42 below shows the aggregate status of all patent families with at least one patent application or granted patent attributed in Researchfish to an EPSRC research grant or Fellowship. The chart groups patent families by their 'earliest application year' and, to give an indication of their subsequent 'success', assigns each family to one of three categories based on the status of all its applications (as at June 2022):

a) No patents granted or pending (i.e. all applications are either withdrawn, expired, lapsed or terminated

b) no patents yet granted, but at least one application is still under examination

c) at least one granted patent

The Appendix 'Patent Family Classification' gives a more detailed description of patent family categories.

Figure 42: Status of unique patent families with at least one member attribut ed to EPSRC funded research, by year of application of the first family member (filtered from 2006-2020); status determined using PatSnap, June 2022. Refer to Appendix for the rules governing the categorisation of patent families.

Status of patent family
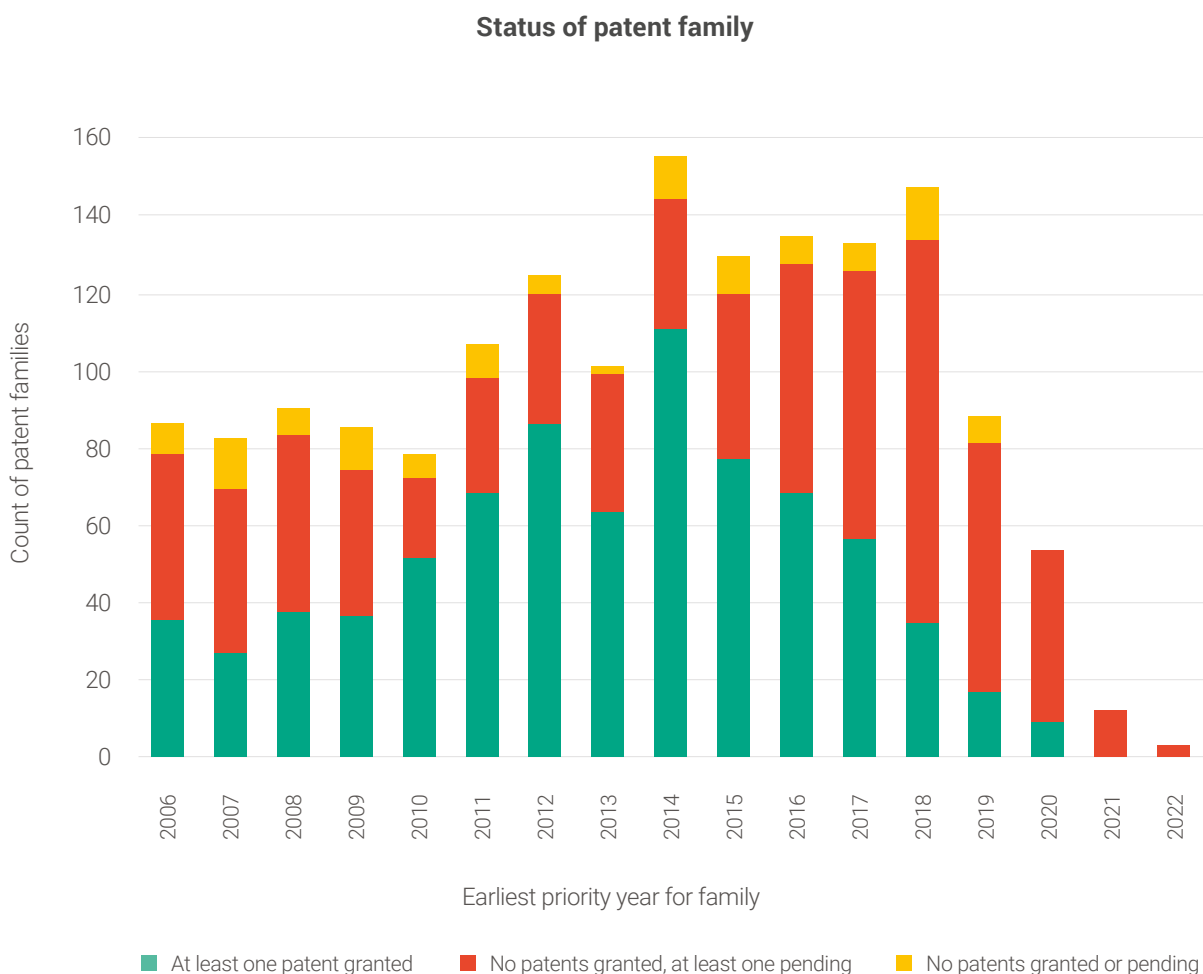
Note: there is a delay between filing a patent application and that application being published. During that period the application is confidential, and researchers are reminded not to disclose confidential information via Researchfish. It is therefore probable that the data under-counts the actual number of recent new patent families that can be linked to EPSRC-funded research. Also, given that concerns around confidentiality are likely to have an impact on when we are told about IP, this section focusses on what we can learn from what we have been told rather than when (i.e. in which outcomes submission period) we were told it. Overall, 1631 patent families with an earliest priority year in or after 2006 have been attributed to EPSRC-funded research. Of these, 48% of patent families have had one or more granted patents, 44% are still pending review, and 7% of patent families have either expired, lapsed, or have been terminated. Given that it can take many years to reach a final decision on a patent application, it is to be expected that a proportion of applications classified as pending will in due course also become granted.

Of the patent families covered above in which at least one granted patent has been assigned to EPSRC research and in terms of remaining lifespan, 1% have up to 5 years left, 26% have between 5 to 10 years left, 54% have between 10 to 15 years left and 19% have from 15 to 20 years left (Figure 43 below).

Figure 43: Estimated maximum remaining lifespan of patent families attributed to EPSRC-funded research and with earliest application year in or after 2006.

Number of years left to run for patent grants attributed to EPSRC research grants and fellowships
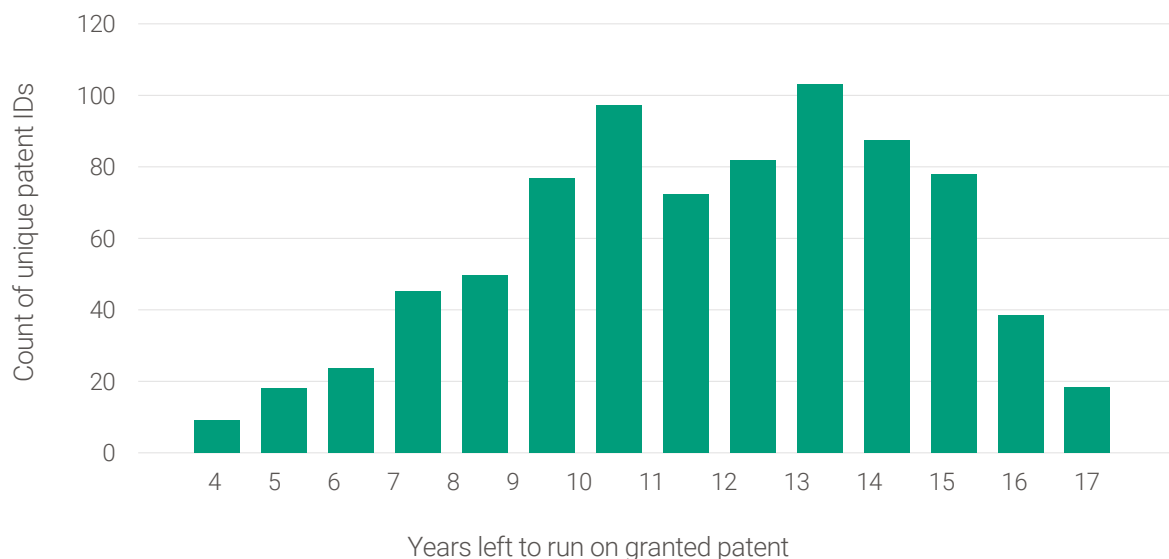
IP data needs interpreting with care, and although forward-looking algorithms are available to predict the net present value of a patent family, it is extremely challenging to assign a 'value' to the actual economic impact of a current or past patent family, not least because the information is usually highly confidential. Filing a patent application in any jurisdiction, or obtaining rights to exploit existing IP, is an investment; whether that investment yields a commercial return depends on many factors and the importance of specific IP may be obscure when it is part of a large portfolio.

Most 'granted' IP attributed to EPSRC research remains assigned to the Universities/research organisations that conducted the research; the Higher Education - Business and Community Interaction (HE-BCI) survey data[19] published by the Higher Education Statistics Agency (HESA) gives an indication of the income Universities receive from IP,

(19) See https://www.hesa.ac.uk/data-and-analysis/business-community/ip-and-startups

although it is unclear to what extent this is influenced by IP specifically linked to EPSRC-funded research. However, given the inherent costs of applying for and keeping IP protection in force, patent families which industry negotiates to own are, arguably, of more tangible valuable to industry than those retained by Universities/research organisations – but this will not necessarily apply in cases if the University believes the IP represents a significant asset and prefers to licence it rather than agree to an outright transfer.

Notwithstanding the above uncertainties, it is interesting to consider how the patent families (with earliest priority in or after 2006) attributed to EPSRC research are assigned: 64% of the patent families remain assigned to universities; 15% are assigned to private sector organisations, and in 12% of families the assignment is shared between Universities and the private sector; just less than 1.5% are assigned to government departments (see Figure 44)[20]. In terms of organisation numbers, IP linked to EPSRC funding is assigned to 288 private companies, of which 202 are UK companies. Across the whole patent family portfolio 16% record at least one patent as having been licensed, 41% state no licence agreements are in place and 14% indicate that licence information is 'commercial in confidence' (note, however, that because Researchfish records are seldom updated it is probable that more 'university-owned' IP is licenced than the submitted data suggests).

Figure 44: Sector allocations of patent owners of patent families and whether or not one or more patent in a family has been licensed or not, for patents which have been attributed to EPSRC funded research grants and fellowships. For instance, a sector allocation of 'Commercial, Person, Academic' is the result of several patents in a family being assigned to more than one owner.

Active patents by sector of asignee
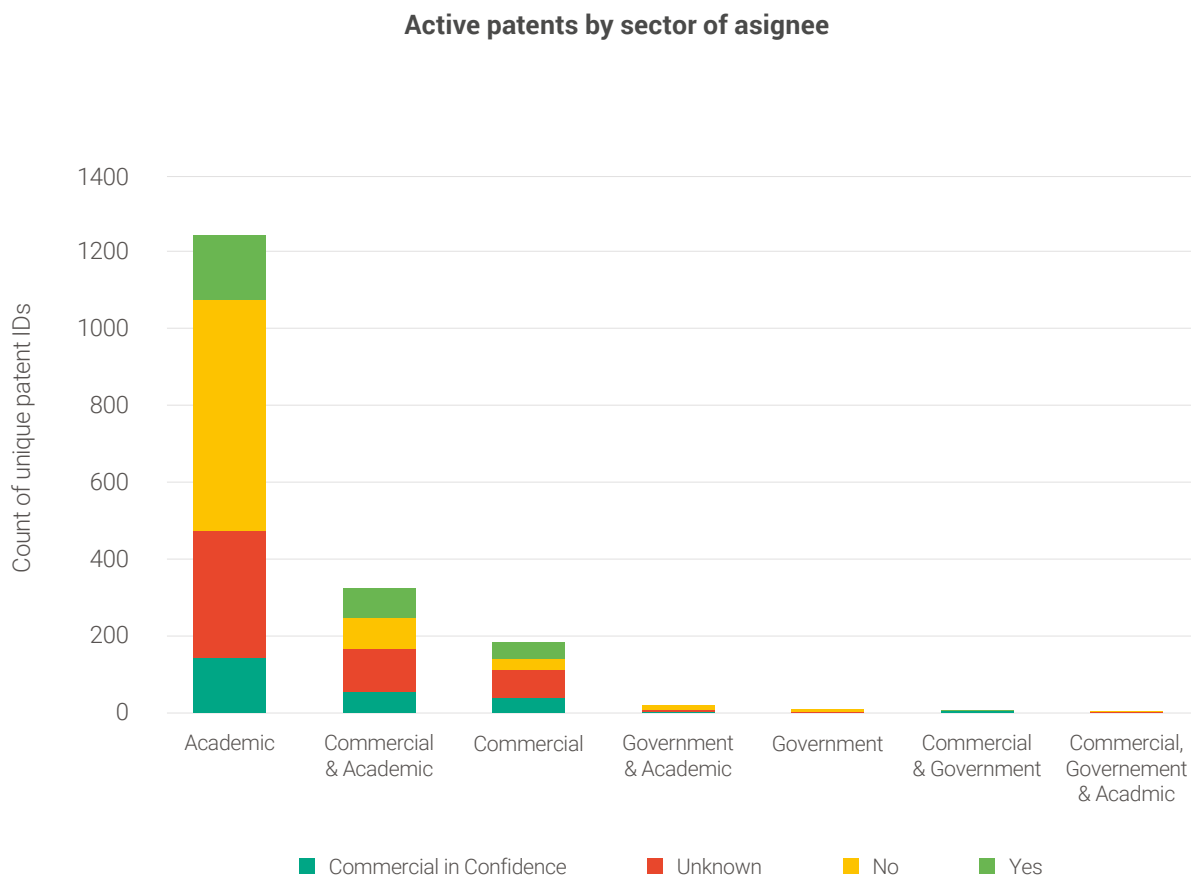
(20) The percentages given include families which include private individuals among the assignee.

4.13 Spin-outs with linked IP

As will be clear from the preceding two sections, it can be challenging to pin down the real impact of research leading to IP data and spin-out companies. The relevant datasets are inherently dynamic, and because the data gathered via Researchfish is also inherently of limited coverage it is very probable that actual numbers of patent families and spin-out companies linked to EPSRC funding are higher than the data suggest.

As noted in section 4.11 above, two hundred and two UK companies are assignees of patent families linked to EPSRC research. Over one third of them (72) are 'EPSRC spin-out' companies; assessing the publicly available records of those companies' IP holdings against the IP reported via Researchfish shows that 23 'EPSRC spin-outs' owe at least half their registered IP directly to EPSRC-funded research, and in most of the remaining cases the proportion is greater than 10% (by count of patent family).

Furthermore, it is notable that only a small proportion of known 'EPSRC spin-outs' are named as assignees on IP positively attributed to EPSRC research via Researchfish. Given that the great majority of other spin-outs must also depend on the intellectual property they were established to exploit, it follows it is very likely that a significant proportion of their registered IP holdings also derive directly from EPSRC-funded research - in other words, that a substantially larger number of patent families are actually attributable to EPSRC funding than those identified through Researchfish. This is not in itself surprising, as it is likely that IP applied for by a spin-out (as opposed to a university) is inevitably less likely to be reported via Researchfish.

As of November 2022, sixty-one of the named assignee 'EPSRC spin-outs' were categorised as 'Active' (including four categorised as 'Active (dormant)' and one as 'Active (in administration)'), two were 'In liquidation' and nine had been 'Dissolved'. Figure 45 below shows their UK regional distribution, and Figure 46 below show the primary industry sectors they are/were active in, with around half in the business services sector, a quarter in manufacturing and one sixth in ICT.
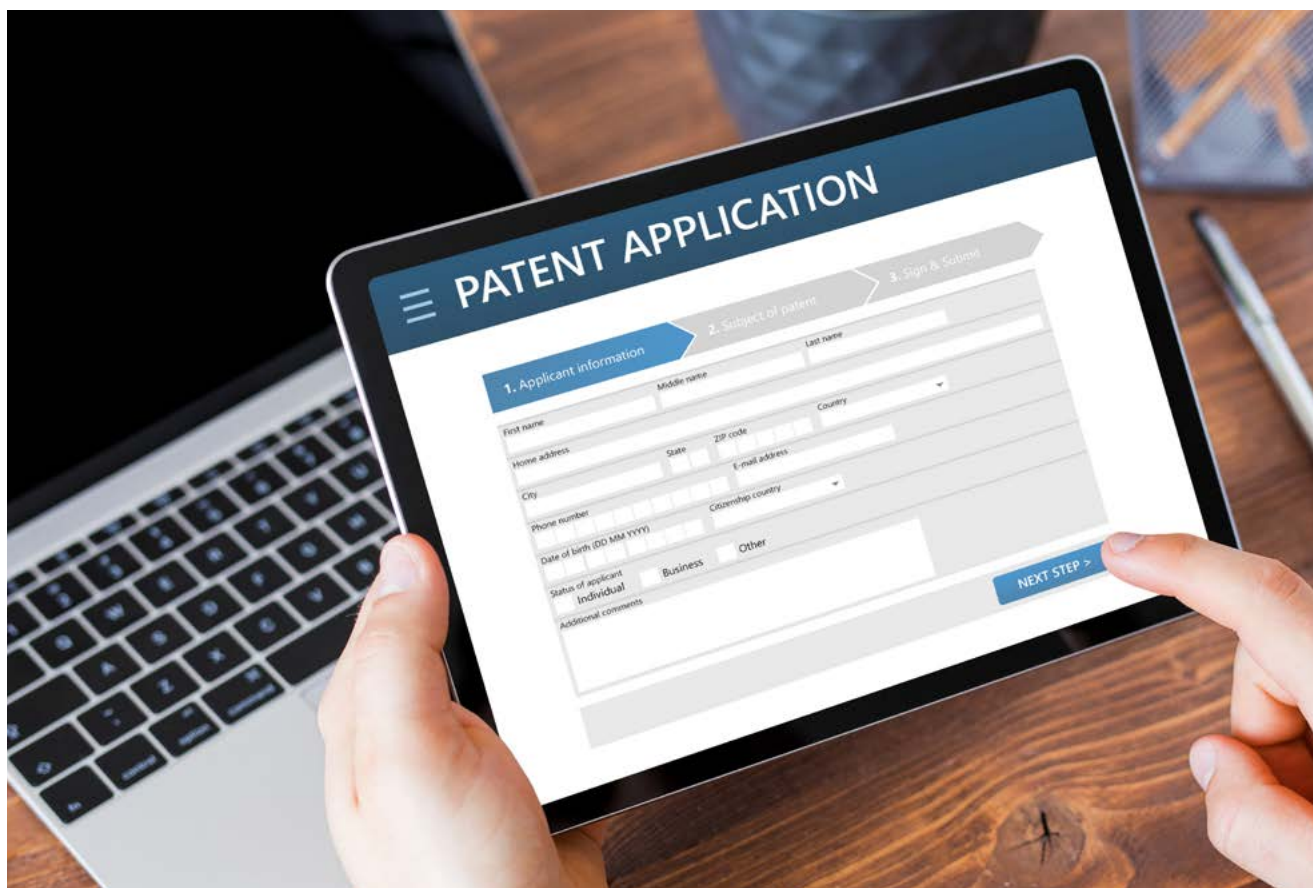
Figure 45: UK distribution of 'EPSRC Spin-outs' known to hold registered IP attributed to EPSRC research, showing local proportions classified as 'Dissolved' as at November 2022.

UK Spin-out companies in which the company, and some or all of its IP, are attributed to EPSRC research, by UK region and company status
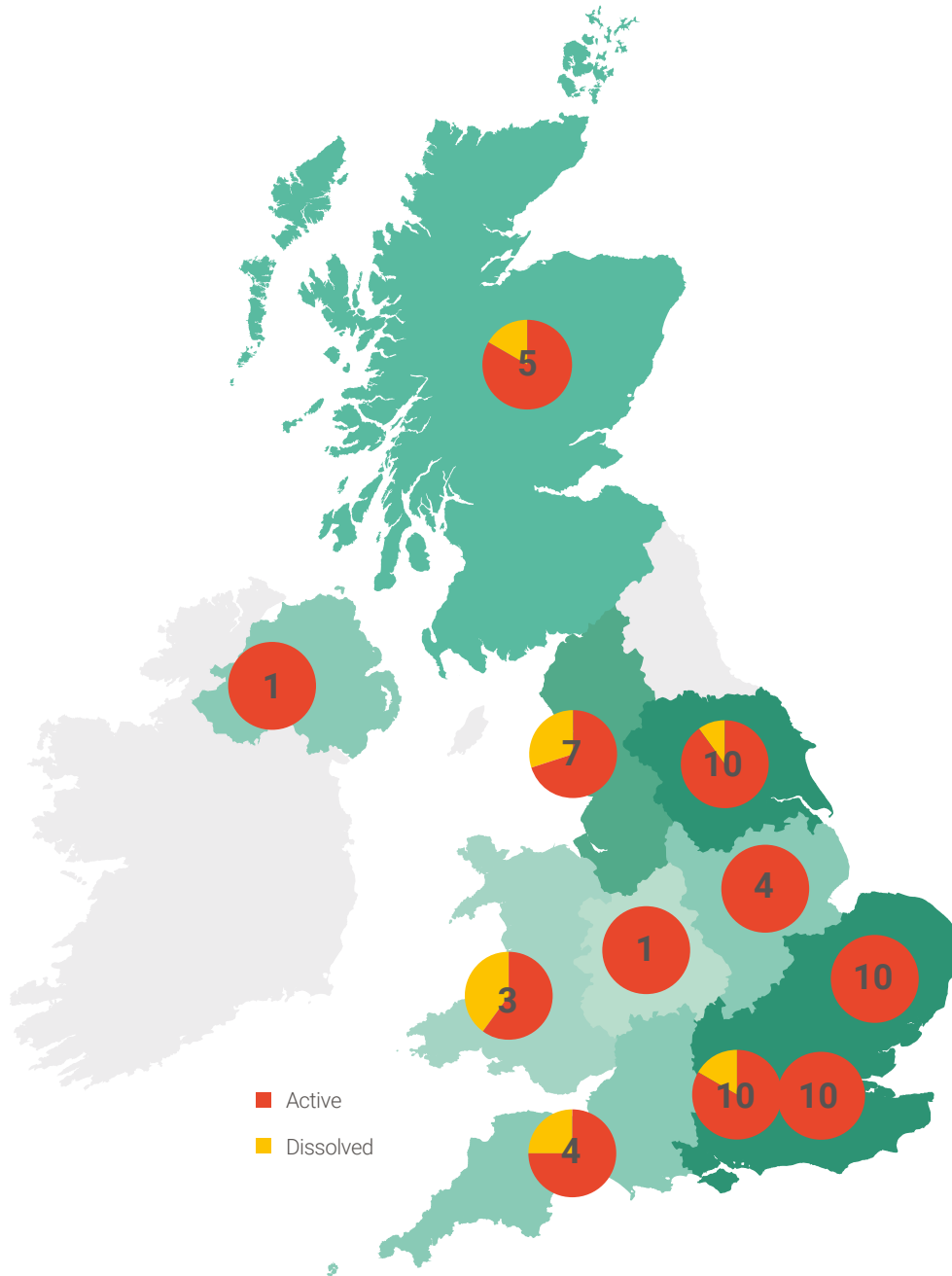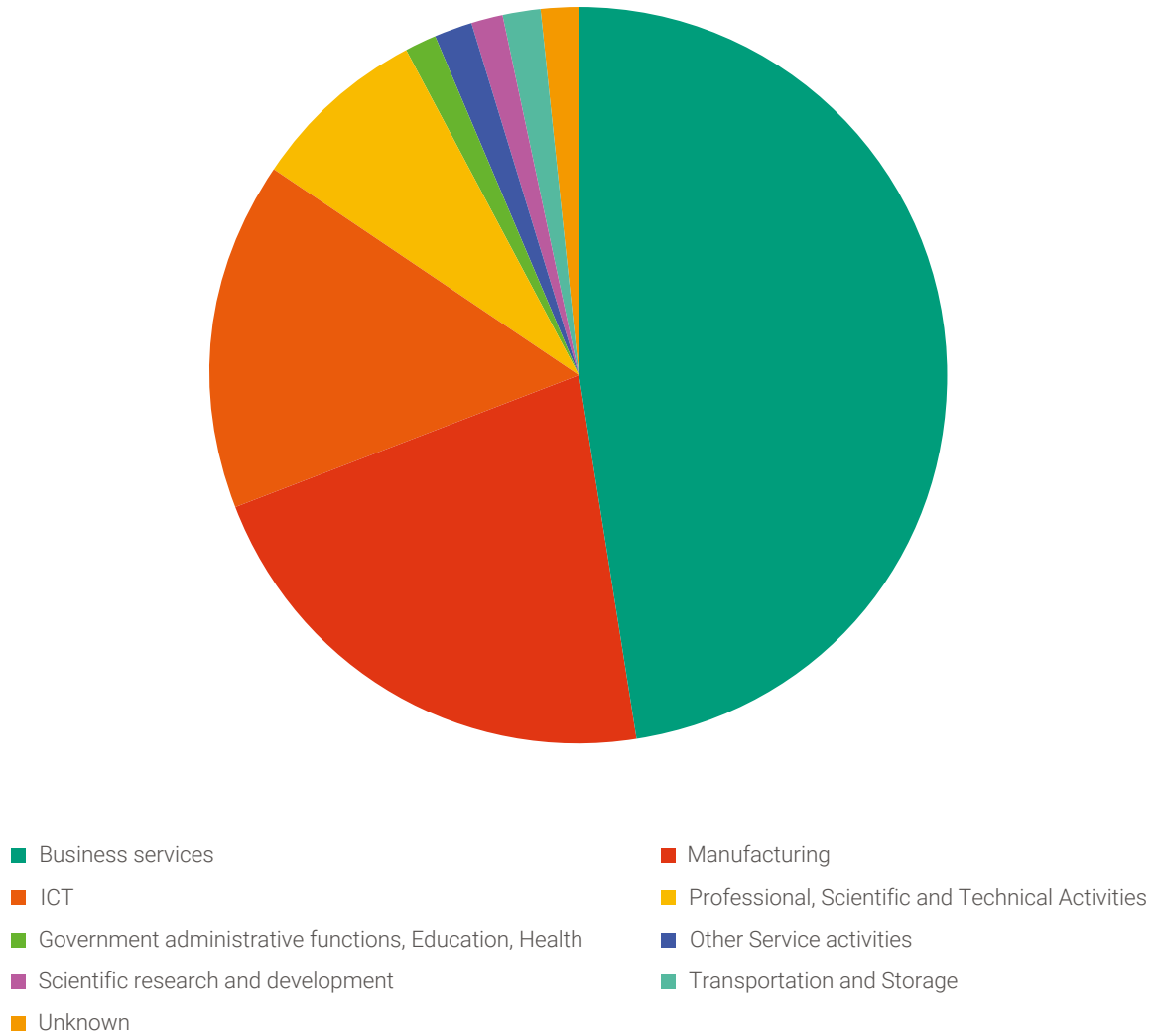

■ Active
■ Dissolved

Figure 46: The primary industry sectors of 'EPSRC spin-outs' named as assignees in patent families directly attributed in Researchfish to EPSRC-funded research (Data derived from companies' recorded SIC Main Codes).

IP Spin-out Sector

- Business services
- ICT
- Government administrative functions, Education, Health
- Scientific research and development
- Unknown
- Manufacturing
- Professional, Scientific and Technical Activities
- Other Service activities
- Transportation and Storage

4.14 Medical products, interventions & clinical trials

Researchfish has a category for PIs to submit records describing 'medical products, interventions and clinical trials' to EPSRC. However, due to the nature of the research that EPSRC funds, the overall counts of such records are considerably lower than other outcome types.

Figure 47 below and Appendix Table 3 provide an overview of the extent to which outcomes in this category have been attributed to EPSRC funded research grants and fellowships. A total of 154 unique medical product outcomes, linked to 112 unique grants/fellowships, have been reported to EPSRC

through Researchfish during the period 2017-2022. Of those, 42% have been categorised as diagnostic tools, 35% as therapeutic interventions, 12% as support tools, and the remaining 11% have been assigned to other categories as listed in Figure 47.

In 2022 a clinical trials search feature was added to the 'medical products…' section in Researchfish; although this feature may not bring significant benefit to many EPSRC-funded researchers, given the given the low likelihood of clinical trials being linked to EPSRC research, it is a further example of progress with systems interoperability.

The Researchfish records for EP/K030469/1 indicate the project led to one of the world's largest collections of online-accessible machine learning results, enabling SMEs such as Ex Scientia and Kinetic Discovery to further develop and apply artificial intelligence to drug development. The companies have grown substantially as a result and now employ ~50 people.

Figure 47: The counts and types of 'medical products, interventions or clinical trials' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the percentage of the types of outcomes per year that are submitted.

Medical products submitted as outcomes by year first submitted
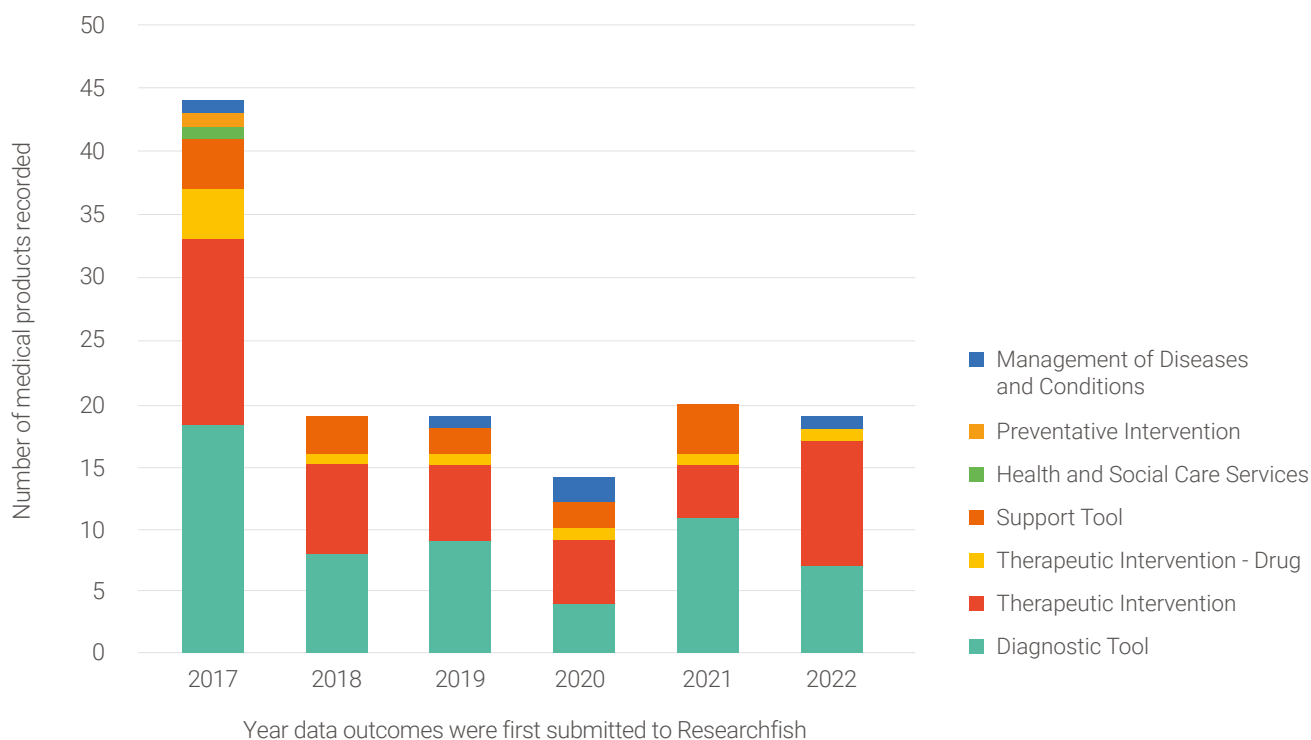
4.15 Artistic & creative products

An overview of all the 'artistic and creative product' records attributed since 2017 in Researchfish to EPSRC funded research-grants and fellowships is provided in Figure 48 below, which shows the breakdown by year of first submission to EPSRC and type of artistic/creative product.

Overall, 1,143 unique 'artistic and creative product' outcomes, attributed to 703 unique grants have been reported through Researchfish to EPSRC during the period 2017-2022. Film/video/animation products account for 41% of the total number of unique products reported, followed by 15% categorised as 'artefacts', 13% as 'artistic/creative exhibition', 10% as 'artwork' and the remaining 23% are in other categories as listed in Figure 48. Compared to previous years

2022 saw a significant increase in the number of Artistic and Creative records, accounted for mainly by Researchfish becoming able to harvest metadata from Datacite describing film/video/animation type outcomes - a further example showing how the use of agreed persistent identifiers and metadata schema[21] can reduce the reporting burden on researchers. The period reported on also overlapped with national and international COVID lockdown restrictions, which may have prompted some researchers to make greater use of film/video to share their research. Appendix Table 1 lists the yearly percentages and counts for the different output/outcome sub-types of newly submitted records in this Researchfish section.

Figure 48: The counts and types of 'artistic and creative products' outcomes attributed to EPSRC research grants or Fellowships and first submitted via Researchfish each year since 2017. The percentage values reflect the proportion of each type in each year.

Artistic and Creative outcomes by year submitted
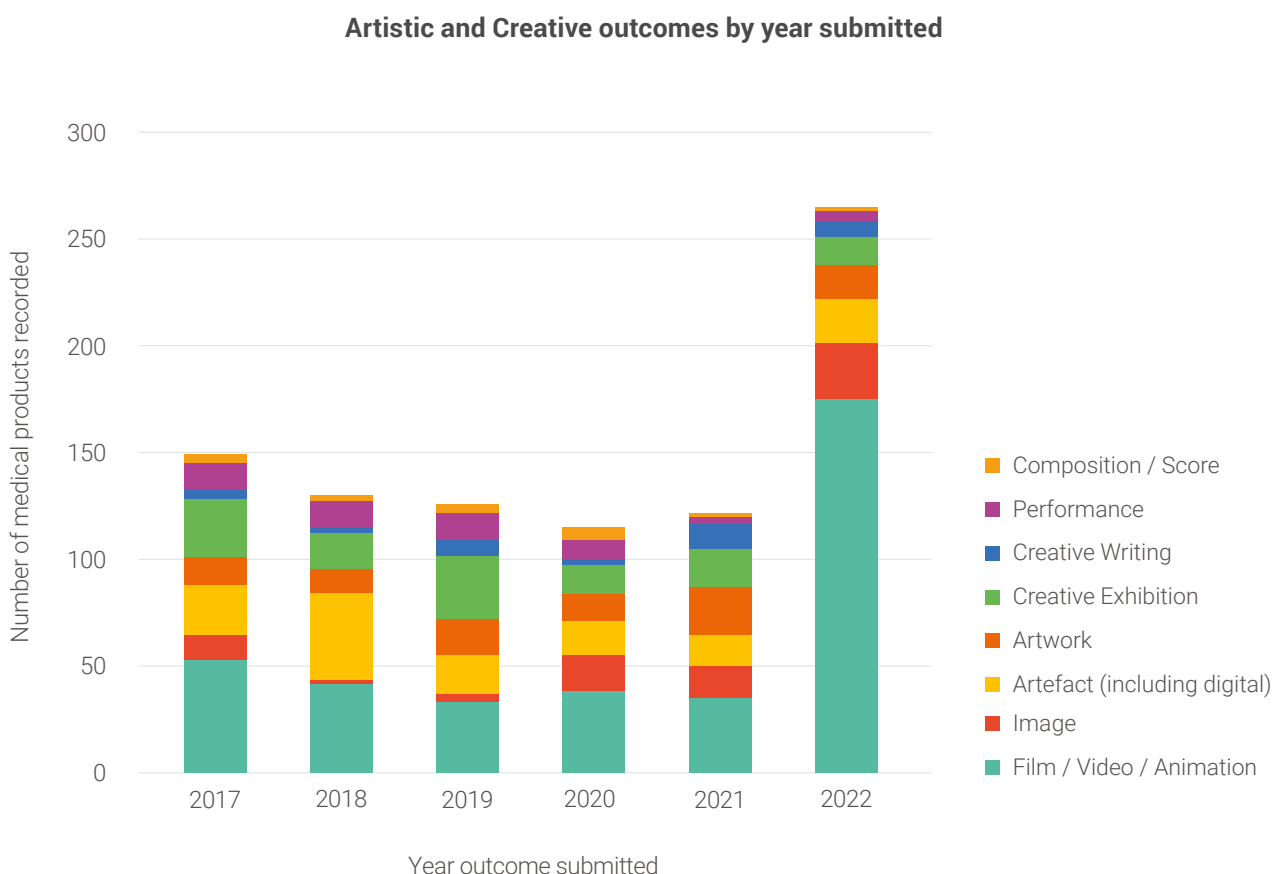
(21) Since 2021 thirty-four different research organisations have recorded unique DOIs and associated metadata describing film/video research outputs using DataCite Metadata Schema 4.0 or higher, enabling Researchfish to harvest the details by including in the metadata a valid EPSRC grant reference.

Records submitted by the PI's of grants EP/P006256/1, EP/R010919/1 and EP/N014871/1 have contributed to an EPSRC case study which includes the following information:

'The creative industries contributed more than £111bn to the UK economy in 2018. The technological innovations driven by EPSRC research benefits industries in this sector, contributing to UK growth. As an example, EPSRC funded research in new digital technologies enable BBC, a world leading public service broadcaster to progress in today's digital world.

The BBC has partnered with over 40 EPSRC funded research projects, ranging from small projects to involvement with research hubs and centres. EPSRC has leveraged contributions of over £6.2m (cash and in-kind) from the BBC in delivering innovative technologies. Project impacts include a desktop platform for producing interactive and adaptive films used by the BBC and independent filmmakers; a low-cost wildlife tracking camera used in the BBC's award-winning Springwatch series; a new spatial audio experience that is set to revolutionise home entertainment, now being commercialisation by a spin-out; and a tool for training schoolchildren to recognise fake news available in every UK secondary school.

4.16 Facilities & resources

Researchers are asked to use Researchfish to inform EPSRC when their research has made use of significant separately funded research facilities such as synchrotron beamtime, high performance computing resource, NMR equipment etc. The data provided helps EPSRC understand the important role facilities play in the delivery of research with impact, as well as the extent to which EPSRC-funded research makes use of facilities in other countries.

During the period 2017-2022 researchers reported 1,976 instances of using research facilities to support work funded by 1,002 EPSRC grants or fellowships.

Overall, the data for the period comprise 2,167 unique records of using facilities provided by 502 separate providers, 67% of which are in the UK and 17% are overseas. The annual counts of new records reporting facility use and facility hosting organisations, are given in Table 5 below. Figure 49 below shows most facilities accessed are based in the UK, as one would expect, but also that significant use is made each year of facilities based abroad; the geographic distribution of facility providers is shown in Figure 50 below (n.b. in some cases a single facility location could not be determined from the information provided).

Table 5: Annual counts of new records reporting facility use and the facility hosting organisations supporting research funded by EPSRC research grants and fellowships during the period 2017-2022.

Year outcomes were first submitted to Researchfish

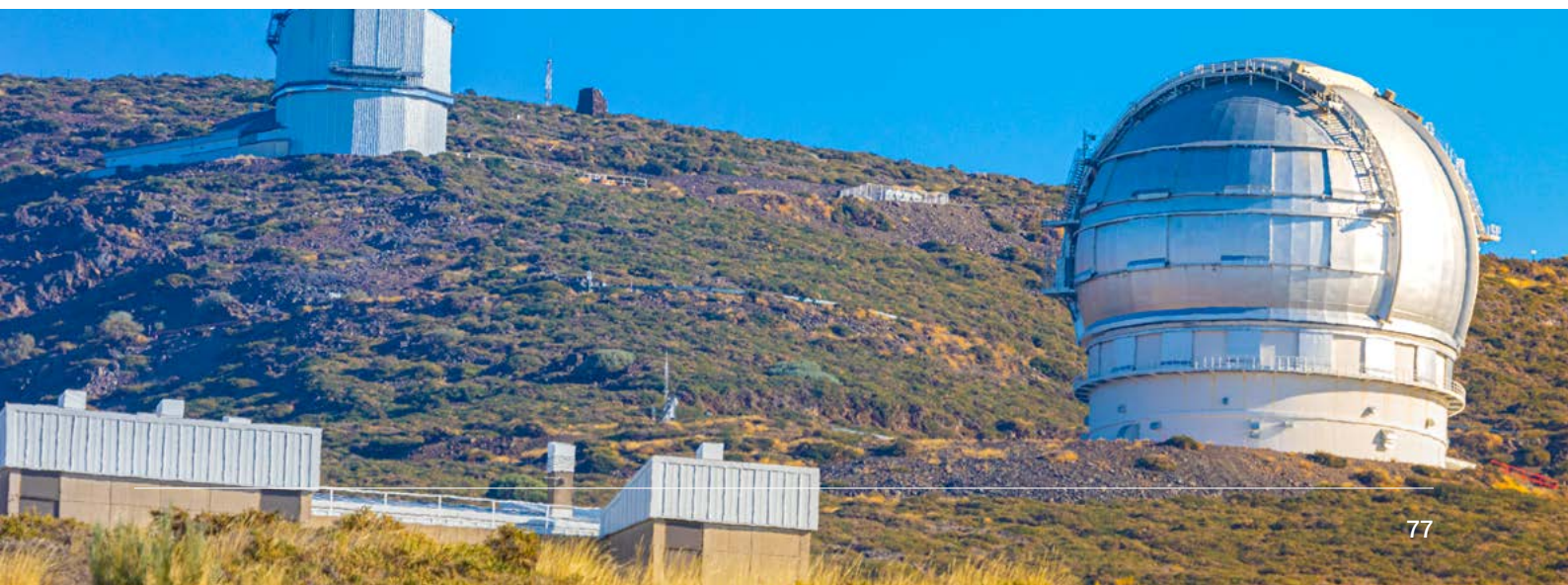|	2017	2018	2019	2020	2021	2022
Count of UK hosting organisations	78	70	79	63	49	100
Count of non-UK hosting organisations	64	33	69	44	39	44
Total hosting organisations	**140**	**101**	**146**	**105**	**86**	**142**
Reported facility use in UK	192	200	178	398	231	352
Reported facility use outside UK	100	49	87	74	64	64
Total reported facility use	**290**	**247**	**263**	**470**	**293**	**414**

Figure 49: The count of unique organisations that have hosted EPSRC researchers (working on research grants and fellowships) at their facilities, both within the UK and outside the UK.

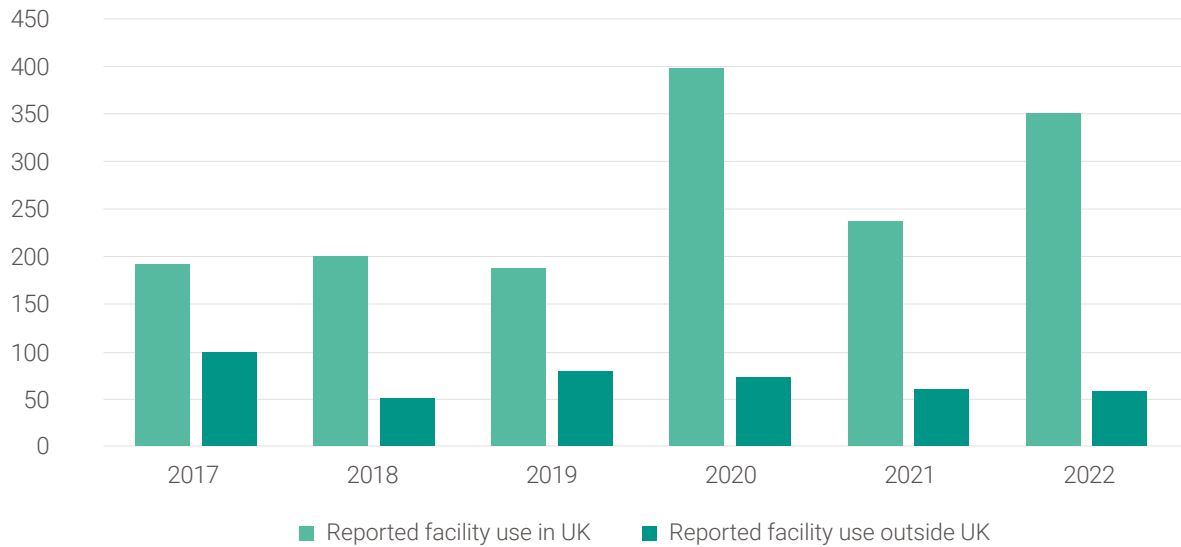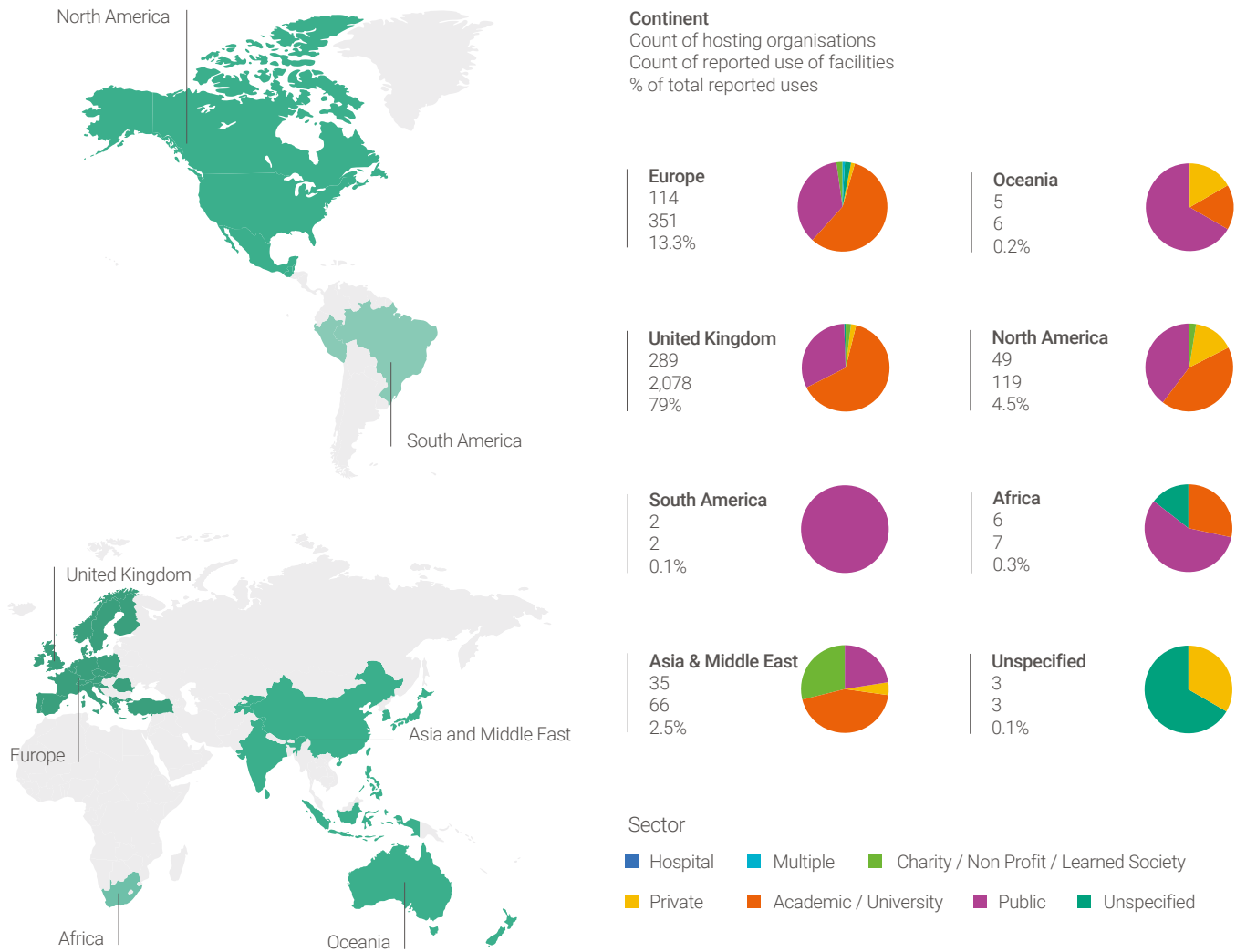**Count of hosting organisations at which facilities were used, by year and location**

Table 6 below shows how the organisations hosting the facilities have been classified by Researchfish.

Table 6: The sectors of facility providers made use by EPSRC funded researchers on research-grants or fellowships during 2017-2022. This information has been submitted and extracted from Researchfish.

	Total hosting organisations	% of total hosting organisations	Reported use of facilities	% of reported use of facilities
Academic/University	272	54%	1,608	61%
Charity/Non Profit/ Learned Society	23	5%	70	3%
Hospitals	1	0%	1	0%
Multiple	3	1%	3	0%
Private	37	7%	65	2%
Public	160	32%	864	33%
Unspecified	19	4%	21	1%
Grand Total	**502**	**100%**	**2,632**	**100%**

Figure 50: The global distribution of organisations hosting research facilities recorded in Researchfish as having been used to deliver EPSRC funded research grants and fellowships during 2017-2022. For each global region the stated figures give percentage and count of unique records of use of research facilities hosted by organisations based in that region and (beneath) the unique count of actual facilities used, and the adjacent pie charts show the proportions by sector of the hosting organisations. regional locations of where facilities services were provided to EPSRC funded researchers on research-grants or fellowships to date.
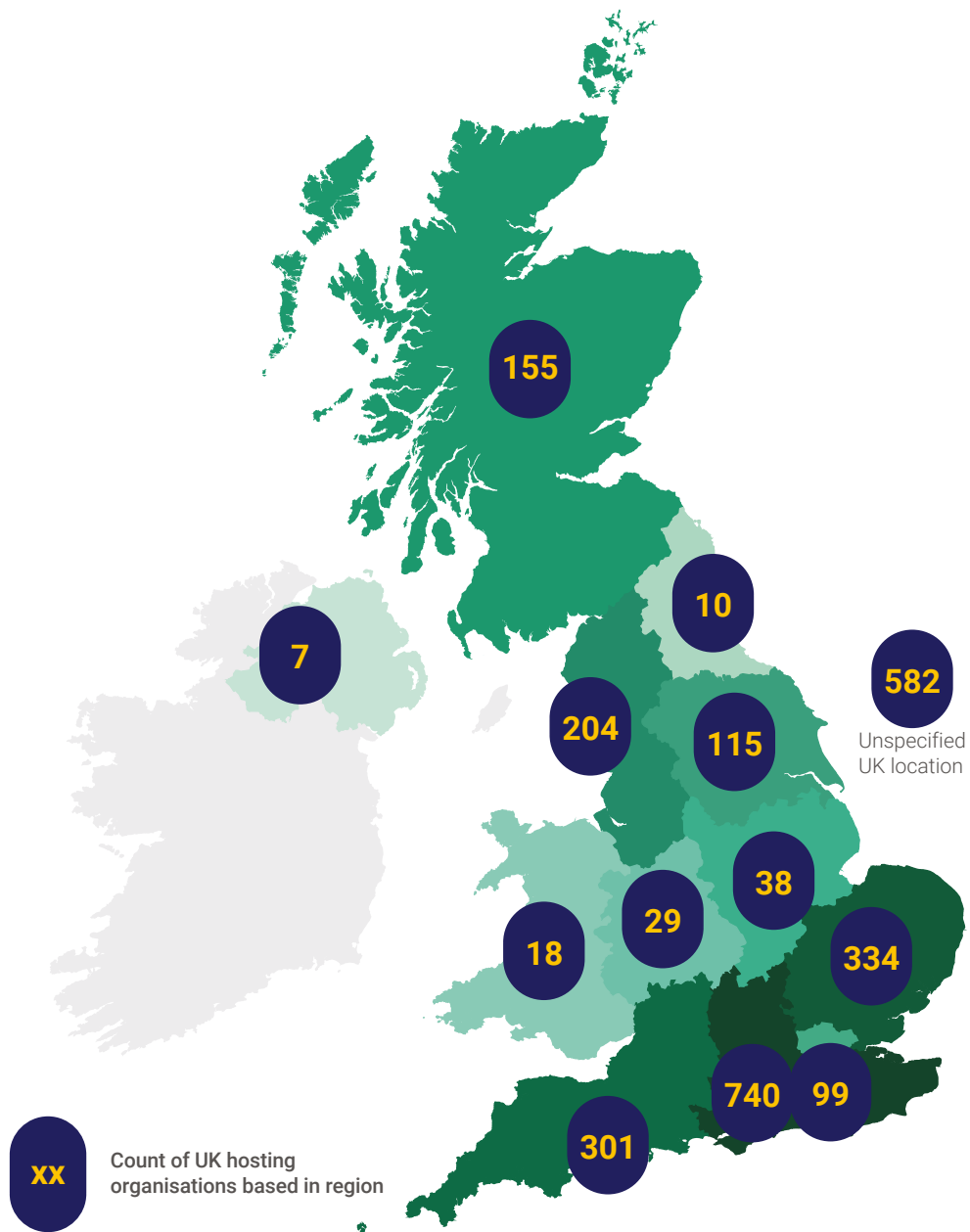
Location of facilities providers for EPSRC research

Continent
Count of hosting organisations
Count of reported use of facilities
% of total reported uses

Europe
114
351
13.3%

Oceania
5
6
0.2%

United Kingdom
289
2,078
79%

North America
49
119
4.5%

South America
2
2
0.1%

Africa
6
7
0.3%

Asia & Middle East
35
66
2.5%

Unspecified
3
3
0.1%

Sector
- Hospital
- Multiple
- Charity / Non Profit / Learned Society
- Private
- Academic / University
- Public
- Unspecified

Shades on the map are used to indicate regional areas and highlight countries indicated in the source data.

Figure 51: UK distribution research facilities accessed to support delivery of EPSRC-funded research grants or fellowships, as reported in Researchfish records first submitted to EPSRC during 2017-2022. The counts of unique records of facility use are provided in the circles in each region. 'Not specified' corresponds to facilities providers whose location was ambiguous (for example where an acronym which applies to several organisations is used).

Regional counts of UK organisations hosting facilities used for EPSRC research

155

10

7

582
Unspecified
UK location

204

115

38

18

29

334

740

99

301

XX Count of UK hosting
organisations based in region

4.17 Other Outputs

The common question set in Researchfish also includes an 'Other Outputs/Outcomes' section where researchers may create records which, for whatever reason, they consider don't fit the available outcome categories. Each year, since 2017, over some 350-500 new 'other' outcome records have been submitted; 40% of these records have been assessed to estimate the extent to which they should, preferably, have been recorded in an alternative section, with the following findings: just over half referred to common outcome types or contained information that would have been appropriate to record in the Key Findings or Narrative Impact sections – and records referring to publications accounted for almost 35% of these. Some 14% referred to future plans (until the 2022 submission period the section allowed PIs to briefly record planned 'Future steps' in relation to their research). The balance report information that isn't currently possible to record in the system – usually because it describes an activity such as 'conference attendance' that is not considered a research outcome per se.

A large proportion of the records describe publications, including preprints, that should preferably been recorded in the publications section; there are also many that describe other approaches to communicating research outcomes that would have been better recorded as engagement activities or collaborations with research users; numerous entries could have been suitable records in the 'Further Funding' section, and there were also several describing new products, processes, research tool/models or datasets all in some way attributable to EPSRC support; finally, a considerable number include excellent examples of 'impact' – showing how the research has in some way made a positive difference beyond academia (or within it but clearly across the original research area boundaries) that would be better placed in the responses to the 'Narrative Impact' section.

Appendix

Appendix 1 – Summary data

Appendix Table 1: A breakdown of the unique count, by sub-type and year of first submission, of the 'artistic and creative products' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

	2017	2018	2019	2020	2021	2022	Grand Total
Film / Video / Animation	31.1% 60	27.2% 56	26.1% 46	26.3% 45	25.5% 35	63.4% 182	**36.2%** **424**
Artefact (including digital)	17.1% 33	28.6% 59	14.2% 25	16.4% 28	12.4% 17	8.4% 24	**15.9%** **186**
Artistic, Creative / Exhbition	17.1% 33	13.6% 28	19.9% 35	14.6% 25	15.3% 21	5.6% 16	**13.5%** **158**
Artwork	13.0% 25	12.1% 25	10.8% 19	15.8% 27	20.4% 28	6.3% 18	**12.1%** **142**
Image	9.3% 18	7.3% 15	9.1% 16	13.5% 23	12.4% 17	11.5% 33	**10.4%** **122**
Performance (Music, Dance, Drama etc)	8.3% 16	7.3% 15	10.8% 19	7.0% 12	4.4% 6	1.7% 5	**6.2%** **73**
Composition / Score	2.1% 4	1.9% 4	3.4% 6	4.1% 7	0.7% 1	0.7% 2	**2.1%** **24**
Creative Writing	2.1% 4	1.9% 4	5.7% 10	2.3% 4	8.8% 12	2.4% 7	**3.5%** **41**
Grand Total	**193**	**206**	**176**	**171**	**137**	**287**	**1,170**

Appendix Table 2: A breakdown of the unique count, by sub-type and year of first submission, of the 'datasets, databases and models' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
Computer model / algorithm	32.8% 218	20.8% 179	21.7% 205	15.3% 202	14.3% 162	17.9% 206	**19.3%** **1,172**
Data analysis technique	9.0% 60	3.8% 33	5.0% 47	4.6% 61	4.3% 49	3.5% 40	**4.8%** **290**
Data handling & control	1.4% 9	0.5% 4	0.8% 8	0.6% 8	0.6% 7	0.9% 10	**0.8%** **46**
Database / Collection of data	56.8% 378	74.9% 646	72.5% 684	79.4% 1,047	80.8% 917	77.8% 879	**75.2%** **4,569**
Grand Total	**665**	**862**	**944**	**1,318**	**1,135**	**1,153**	**6,077**

Appendix Table 3: A breakdown of the unique count, by sub-type and year of first submission, of the 'medical products, interventions and clinical trials' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
Diagnostic Tool*	38.5% 20	43.3% 13	48.3% 14	36.0% 9	48.0% 12	36.8% 7	**41.7% 75**
Theraputic Intervention***	11.5% 6	6.7% 2	3.4% 1	4.0% 1	12.0% 3	26.3% 5	**10% 18**
Support Tool**	9.6% 5	13.3% 4	10.3% 3	12.0% 3	24.0% 6	5.3% 1	**12.2% 22**
Theraputic Intervention - Drug	7.7% 4	3.3% 1	3.4% 1	4.0% 1	4.0% 1		**4.4% 22**
Management of Diseases and Conditions	1.9% 1	3.3% 1	3.4% 1	12.0% 3		5.3% 1	**10.4% 7**
Preventable Intervention****	1.9% 1	3.3% 1	3.4% 1				**6.2% 3**
Health and Social Care Services	1.9% 1		3.4% 1				**1.7% 2**
Theraputic Intervention- Cellular and gene therapies		3.3% 1				5.3% 1	**1.1% 2**
Products with applications outside of medicine		3.3% 1					**0.6% 1**
Theraputic Intervention- Medial Devices	26.9% 14	20.0% 6	24.1% 7	32.0% 8	12.0% 3	21.1% 4	**23.3% 42**
Grand Total	**52**	**30**	**29**	**25**	**25**	**19**	**180**

* Diagnostic tool for imaging and non imaging
** Support tools for fundamental research and medical intervention
*** Physical, physcological/behavioural, radiotherapy, surgery and vaccine therapeutic interventions
**** Preventative intervention for behavioural risk or physical/biological risk modifications

Appendix Table 4: A breakdown of the unique count, by sub-type and year of first submission, of the 'software and technical products' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
Software	69.7% 439	75.2% 433	71.7% 407	73.7% 404	64.2% 281	63.1% 268	**69.6% 2,232**
Webtool / Application	17.5% 110	10.7% 64	10.6% 60	9.7% 53	18.9% 83	24.4% 91	**14.4% 461**
New / Improved Tecnhique / Technology	5.4% 34	10.2% 61	11.1% 63	7.7% 42	7.8% 34	8.5% 36	**8.4% 270**
Physical Model / Kit	3.3% 21	2.8% 17	2.3% 13	2.9% 16	4.1% 18	2.6% 11	**4.4% 22**
Systems, Materials & Instrumental Engineering	2.1% 13	2.3% 14	3.0% 17	4.9% 27	3.4% 15	2.8% 12	**3.1% 98**
Detection Devices	1.4% 9	1.0% 6	0.7% 4	0.5% 3	0.9% 4	1.2% 5	**1.0% 31**
New Material / Compound	0.6% 4	0.3% 2	0.7% 4	0.5% 3	0.5% 2	0.2% 1	**0.5% 16**
e-Business Platform					0.2% 1	0.2% 1	**0.1% 2**
Grand Total	**630**	**597**	**568**	**548**	**438**	**425**	**3,206**

Appendix Table 5: A breakdown of the unique count, by sub-type and year of first submission, of the 'research tools and methods' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
Improvements to research infrastructure	60.9% 279	65.6% 314	65.6% 263	64.6% 294	76.4% 197	72.2% 226	**66.5%** **1,573**
Technology assay or reagent	24.0% 110	15.7% 75	18.2% 73	15.8% 72	16.3% 42	15.7% 49	**17.8%** **421**
Model of mechanisms or symptoms	7.2% 33	7.9% 38	7.0% 28	7.7% 35	0.8% 2	3.8% 12	**6.3%** **148**
Physiological assessment or outcome measure	2.2% 10	5.4% 26	6.0% 24	7.9% 36	4.7% 12	5.8% 18	**5.3%** **126**
Biological samples	3.1% 14	2.3% 11	3.0% 12	2.9% 13	1.2% 3	1.3% 4	**2.4%** **57**
Cell line	1.3% 6	2.9% 14		0.9% 4	0.8% 4	1.0% 5	**1.2%** **31**
Antibody	1.3% 9	0.2% 1	0.2% 1	0.2% 1			**0.4%** **9**
Data analysis technique	0.2% 1					0.3% 1	**0.1%** **2**
Grand Total	**459**	**479**	**401**	**455**	**258**	**313**	**2,365**

Appendix Table 6: A breakdown of the unique count, by sub-type and year of first submission, of the 'engagement activities' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

Year Outcome First Submitted

Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
A talk or presentation	44.5% 4,865	41.9% 4,834	40.8% 4,717	41.7% 4,722	40.6% 3,092	39.7% 3,226	**41.7%** **25,456**
Technology Participation in activity, workshop or similar	31.6% 3,462	32.2% 3,712	32.0% 3,697	33.0% 3,735	24.3% 1,853	26.2% 2,129	**30.4%** **18,588**
A formal working group, expert panel or dialogue	8.6% 939	10.3% 1,191	11.6% 1,343	10.9% 1,231	15.9% 1,209	12.8% 1,039	**11.4%** **6,952**
A magazine, newsletter or online publication	2.9% 313	2.3% 271	2.3% 269	2.6% 292	4.1% 312	4.4% 358	**3.0%** **1,815**
A press release, press conference or response to a media enquiry / interview	4.0% 434	4.0% 458	3.4% 396	3.5% 392	5.8% 441	4.9% 396	**4.1%** **2,517**
Participation in an open day or visit at my research institution	3.5% 381	3.8% 444	5.0% 574	4.7% 530	1.5% 113	1.5% 112	**3.5%** **2,164**
Engagement focused website, log or social media channel	2.8% 311	3.4% 393	3.1% 355	2.1% 242	5.4% 414	7.6% 614	**3.8%** **2,329**
A broadcast e.g. TV / radio / film / podcast (other news / press)	1.7% 187	2.0% 228	1.7% 201	1.6% 181	2.4% 180	0.3% 243	**2.0%** **1,220**
Scientific meeting (conference / symposium etc)	0.4% 48	0.0% 2	0.0% 1	0.0% 1			**5.3%** **126**
Grand Total	**10,940**	**11,533**	**11,553**	**11,326**	**7,614**	**8,127**	**61,093**

Appendix Table 7: The UK regional distribution of further funders by the total value of further funding agreements, the unique count of funding providers and the total number of further funding agreements. The data excludes duplicate datasets and UK public funders. This table is linked to the data displayed in Figure 17.

Region	Count of (non-public) funders	Count of outcome reports received	% of reported outcomes	Total further funding	% of further funding
Unspecified	685	1,482	26.9%	£384.25M	25.3%
London	188	1,777	32.3%	£698.29M	45.9%
South East	71	382	6.9%	£94.31M	6.2%
East of England	56	380	6.9%	£74.64M	4.9%
Scotland	49	258	4.7%	£28.72M	1.9%
South West	41	312	5.7%	£63.55M	4.2%
Yorkshire and the Humber	39	219	4.0%	£27.07M	1.8%
North West	31	166	3.0%	£63.98M	4.2%
West Midlands	28	177	3.2%	£33.89M	2.2%
East Midlands	18	215	3.9%	£36.86M	2.4%
North East	13	58	1.1%	£9.87M	0.6%
Wales	11	55	1.0%	£3.24M	0.2%
Northern Ireland	7	29	0.5%	£2.77M	0.2%
Grand Total	**1,223**	**5,510**	**100.0%**	**£1,521.43M**	**100.0%**

Appendix Table 8: The top 20 UK private sector organisations recorded during 2017-2022 as providing further funding to take forward work initially funded by an EPSRC research grant or Fellowship, ranked by the aggregate value of the recorded further funding amounts. The Data excludes UK public sector sources and all duplication in the dataset.

Funding Organisation	
Rolls Royce Group Plc	Unilever
Safran Nacelles Ltd	Jaguar Land Rover Automotive PLC
Baillie Gifford	2D Tech Ltd
Total E & P	Digital Built Britain
Eli Lilly & Company Ltd	Huawei Technologies Research and Development UK Ltd
Cantab Capital Partners	National Grid UK
AstraZeneca	WAAM3D
UCL Business	Innova UK
Care UK	SPI Lasers UK
Health Data Research UK	Lumenisity

Appendix Tables 9(i)-9(iv): UK Regional distribution of UK-based collaborators supporting EPSRC research grants and fellowships with end dates after 01 January 2012.

For each UK region tables 9(i)-9(iii)show the value (by data source), regional proportion of value, regional proportion of collaborator count and count of related EPSRC projects. Table 9(iv) considers Researchfish collaboration records that have been matched to application records, and shows the difference at regional level between the values committed by collaborators and values reported in Researchfish. Please note that totals are not provided for the projects and collaborating organisations as these are not confined to single regions and any 'Totals' would involve double counting.

Table 9(i): Collaborations by Value, location and Count of ALL Collaborators
(proposed in application + additional reported via Researchfish)

Region	Value (application + Researchfish data)	% of value	Count of Collaborating organisations involved	% of Collaborating Organisations involved	Count of related EPSRC projects.
North West	£37,266,567	2%	175	2%	434
North East	£133,593,656	7%	345	4%	961
Yorkshire and the Humber	£44,912,062	2%	285	3%	717
East Midlands	£70,833,902	3%	235	3%	622
West Midlands	£62,099,920	3%	257	3%	705
East of England	£103,178,962	5%	429	5%	1,197
London	£337,679,486	16%	876	10%	2,230
South East	£245,017,185	12%	667	7%	1,878
South West	£173,213,799	8%	347	4%	1,180
Wales	£28,745,543	1%	183	2%	306
Scotland	£93,929,922	5%	342	4%	899
Northern Ireland	£28,621,109	1%	57	1%	116
UK Unspecified	£12,074,288	1%	149	2%	233
Rest of World	£675,638,936	33%	4,691	52%	4,317
Grand Total	**£2,046,805,338**	**100%**		**100%**	

Table 9(ii): Collaborations by Value, location and Count of Collaborators proposed in applications

Region	Value (applications only)	% of value	Count of Collaborating organisations involved	% of Collaborating Organisations involved	Count of related EPSRC projects.
North West	£23,934,915	2%	86	3%	241
North East	£85,989,413	7%	187	5%	587
Yorkshire and the Humber	£25,806,724	2%	143	4%	355
East Midlands	£22,597,436	2%	113	3%	276
West Midlands	£39,963,738	3%	133	4%	396
East of England	£80,327,122	6%	221	6%	775
London	£268,258,590	21%	438	13%	1,551
South East	£152,293,165	12%	369	11%	1,175
South West	£126,820,306	10%	180	5%	813
Wales	£20,555,246	2%	85	2%	153
Scotland	£57,488,489	5%	189	6%	513
Northern Ireland	£15,350,707	1%	29	1%	45
UK Unspecified	£27,303	0%	2	0%	5
Rest of World	£345,153,176	27%	1,246	36%	2,289
Grand Total	**£1,264,566,330**	**100%**		**100%**	

Table 9(iii): Collaborations by Value and location and Count of Collaborators reported in Researchfish and not listed in applications

Region	Value (in Researchfish only)	% of value	Count of Collaborating organisations involved	% of Collaborating Organisations involved	Count of related EPSRC projects.
North West	£13,681,919	2%	109	2%	213
North East	£56,597,287	6%	195	3%	442
Yorkshire and the Humber	£20,683,040	2%	179	3%	398
East Midlands	£48,193,349	6%	155	2%	368
West Midlands	£23,112,808	3%	153	2%	352
East of England	£21,682,888	2%	252	4%	463
London	£83,003,200	10%	549	8%	916
South East	£96,492,685	11%	385	6%	834
South West	£48,311,683	6%	213	3%	463
Wales	£8,488,297	1%	123	2%	170
Scotland	£39,116,526	4%	193	3%	432
Northern Ireland	£13,247,902	2%	31	0%	71
UK Unspecified	£12,201,985	1%	148	2%	228
Rest of World	£388,633,570	44%	3,951	60%	2,640
Grand Total	**£873,447,139**	**100%**		**100%**	

Table 9(iv): Collaborations by Value and location and Count of Collaborators reported in Researchfish and not listed in applications

Region	Value proposed in application	Value recorded in Researchfish	% value proposed but not reported in Researchfish
North West	£1,596,822	£450,272	72%
North East	£17,143,655	£8,759,428	49%
Yorkshire and the Humber	£4,515,902	£1,718,400	62%
East Midlands	£2,817,925	£652,725	77%
West Midlands	£4,077,626	£1,330,501	67%
East of England	£7,744,082	£2,410,813	69%
London	£35,674,452	£14,896,607	58%
South East	£30,225,336	£6,549,345	78%
South West	£8,391,345	£1,181,960	86%
Wales	£862,750	£398,000	54%
Scotland	£6,895,765	£2,716,293	61%
Northern Ireland	£273,600	£-	100%
UK Unspecified	£5,506,203	£2,547,726	54%
Rest of World	£81,302,521	£67,467,489	17%
Grand Total	**£207,027,984**	**£111,079,559**	

Region	Count of Collaborating organisations involved	% of Collaborating Organisations involved	Count of related EPSRC projects.
North West	12	2%	16
North East	28	6%	54
Yorkshire and the Humber	22	4%	25
East Midlands	13	3%	20
West Midlands	12	2%	31
East of England	25	5%	45
London	88	17%	126
South East	54	11%	107
South West	26	5%	51
Wales	8	2%	7
Scotland	30	6%	39
Northern Ireland	2	0%	2
UK Unspecified	7	1%	1
Rest of World	176	35%	206
Grand Total		**100%**	

Appendix Table 10: Aggregate values of collaborative support to recorded for EPSRC research-grants and fellowships with end dates after 01 January 2012, by location and type of collaborating organisations.

Locations categorised 'not specified' correspond to collaborators either based in more than one country, or where the data are ambiguous. For each location and organisation type, the stated figures give: the aggregate (value and proportion) of commitments in grant applications and support in Researchfish records from organisations not named in the grant applications; the number and proportion of collaborative projects involved; the aggregate value and proportion of support recorded only in Researchfish.

	Aggregate Value (Application + Researchfish data)	% of aggreate value	Aggregate of EPSRC-funded projects involved	% of EPSRC-funded projects involved	Aggregate Value attributed in Researchfish and not matched to Applications	% of value reported in Researchfish
International						
Academic/University	£281M	14%	2979	40%	£106M	14%
Charity/Non Profit/Society	£21M	1%	310	4%	£16M	2%
Hospital / NHS trust	£2M	0%	96	1%	£1M	0%
Private	£242M	12%	1688	23%	£129M	17%
Public	£130M	6%	704	10%	£69M	9%
Not Specified	£0M	0%	69	1%	£0M	0%
United Kingdom						
Academic/University	£370M	18%	2691	36%	£172M	23%
Charity/Non Profit/Society	£32M	2%	458	6%	£21M	3%
Hospital / NHS trust	£16M	1%	233	3%	£2M	0%
Private	£815M	40%	4010	54%	£205M	27%
Public	£139M	7%	827	11%	£41M	5%
Not Specified	£0M	0%	5	0%	£0M	0%
Grand Total	**£2,047M**	**100%**			**£762M**	**100%**

Note: The total count of collaborative projects in the dataset is 7,386. The project counts in the table do not aggregate to the total because a single project can involve multiple collaborators based in multiple locations.

Appendix Table 11: A breakdown of the unique count, by sub-type and year of first submission, of the 'Influence on policy, practice, patients and the public activities' records attributed to EPSRC research-grants and fellowships and submitted to EPSRC via Researchfish. The percentage values reflect the annual percentage of each sub-type recorded.

	Year Outcome First Submitted						
Outcome Sub-type	2017	2018	2019	2020	2021	2022	Grand Total
Citation in clinical guidelines	25.00% 1		25.00% 1	25.00% 1	25.00% 1		**100.00% 4**
Citation in other policy documents	17.19% 38	14% 30	19.00% 42	15.84% 35	19.00% 42	15.38% 34	**100.00% 221**
Citation in systematic reviews	10.53% 2	15.79% 3	15.79% 3	5.26% 1	21.05% 4	31.58% 6	**100.00% 19**
Contribution to new or Improved professional practice					2.99% 2	97.01% 65	**100.00% 67**
Gave evidence to a government review	17.32% 75	13% 56	16.40% 71	13.63% 59	20.32% 88	19.40% 84	**100.00% 433**
Implementation circular/ rapid advice/letter to e.g. Ministry of Health	12.94% 22	14.71% 25	10.59% 18	15.88% 27	35.29% 60	10.59% 18	**100.00% 170**
Influenced training of practitioners or researchers	13.91% 89	16.56% 106	23.59% 151	15.62% 100	16.25% 104	14.06% 90	**100.00% 640**
Membership of a guideline committee	16.07% 81	18.45% 93	16.67% 84	18.85% 95	15.28% 77	14.68% 74	**100.00% 504**
Participation in a advisory committee	14.68% 138	14.57% 137	22.23% 209	14.47% 136	19.79% 186	14.26% 134	**100.00% 940**
Participation in a national consultation	15.69% 102	21.54% 140	15.08% 98	13.08% 85	15.23% 99	19.38% 126	**100.00% 650**
Grand Total	**548**	**590**	**677**	**539**	**663**	**631**	**3,648**

Appendix 2 – Patent Family Classification

Each patent family was classified based on the status of the individual applications within the family; the status of individual applications was determined from its legal status and the different 'kind codes' incorporated in relevant document reference numbers, both as obtained via PatSnap.

The following rules were applied:

Category used in the chart	Categories in Researchfish
Contribution to professional practice	Contribution to a new or improved professional practice
Citation in policy document	Citation in clinical guidelines Citation in clinical reviews Citation in other policy documents Citation in systematic reviews
Gave evidence to a national consultation	Gave evidence to a government review Participation in a national consultation
Implementation circular / advice to Minister	Implementation circular / rapid advice / letter e.g. Ministry of Health
Influenced training within field	Influenced training of practitioners or researchers
Participation advisory / guidance committee	Membership of a guideline committee Membership of a guidance committee Participation in an advisory committee