



Rialtas na hÉireann  
Government of Ireland

# Higher Education Research & Development Survey

## 2018-2019

Prepared by the Department of Enterprise, Trade and Employment

The Department of Enterprise, Trade and Employment would like to thank all the respondents to the 2018-2019 HERD survey who have taken the time to gather information and complete the data requests for this key area of Government policy. The Department would especially like to thank Lisa Keating (IUA), Jennifer Brennan (THEA), Sean O'Reilly (THEA) and Liam Cleere (UCD) for their kind assistance throughout the process.

For further information on this survey please contact:

Eric Giguère  
Surveys Unit, Enterprise Strategy, Competitiveness and Evaluation Division  
Department of Enterprise, Trade and Employment  
23 Kildare Street  
Dublin D02 TD30  
Email: [eric.giguere@enterprise.gov.ie](mailto:eric.giguere@enterprise.gov.ie)

## Table of Contents

<b>Executive Summary.....</b>	<b>5</b>
Table 1 - Summary of key results, 2008-2018, current prices	5
<b>Methodology.....</b>	<b>8</b>
<b>Chapter 1: General trends in higher education R&amp;D expenditure .....</b>	<b>12</b>
Figure 1: Trend in HERD expenditure, 2008-2018, in current prices (€ millions)	12
Figure 2: Research expenditure by HEI (€m)	13
Figure 3: HERD as a percentage of GNP/GDP/GNI*, 2008-2018, Ireland, OECD and EU28	14
Figure 4: HERD as a percentage of GDP - Ireland's ranking GNP/GNI* (37 OECD Countries)	15
Figure 5: HERD as a percentage of GDP (& Ireland GNP/GNI*) - 2018 or latest available data	16
<b>Chapter 2: Human resources allocated to higher education research .....</b>	<b>17</b>
Table 2: Total researchers by performer, 2008-2018 (headcount)	18
Figure 6: Researchers by qualification, 2008-2018 (headcount)	19
Figure 7: Researchers and support staff, 2008-2018 (headcount)	20
Table 3: Researchers by occupation and field of science (Headcount), 2018	21
Figure 8: Ireland's ranking, researchers per 1,000 of the labour force, 2008 -2018	22
Figure 9: HE researchers (HC) per 1,000 of the labour force, 2018 (or latest available data)	23
Figure 10: Ireland's ranking, Female researchers as a % of total researchers (HC), 2008-2018	24
Figure 11: Female researchers as a % of total researchers (HC), 2018 or latest available data	24
Figure 12: Total researchers in the higher education sector, 2008-2018 (FTE)	25
Table 4: Researchers by occupation and FOS in the higher education sector, FTEs, 2018	26
Figure 13: Female and male FTE researchers, 2018	27
<b>Chapter 3: Source of funding of HERD expenditure .....</b>	<b>28</b>
Figure 14: Sources of research funding, 2008-2018, in current prices (€ millions)	28
Table 5: Sources of research funding, 2008-2018, in current prices (€ millions)	29
Figure 15: Sources of direct government research funding (€ millions) 2018 and 2019 (estimate)	31
Figure 16: Percentage of HERD financed by industry - OECD Countries, 2018 or latest data	32
Table 6: Sources of research funding by field of science (€ millions), 2018	33
<b>Chapter 4: HERD Expenditure by Field of Science .....</b>	<b>34</b>
Figure 17: HE expenditure on R&D by field of science in current prices, (€millions), 2008-2018	34
Figure 18: Share of total R&D expenditure by field of science, 2008 and 2018	35
<b>Chapter 5: Types of research.....</b>	<b>37</b>
Figure 19: Percentage of total HERD budget by research type, 2018 (Total = €876.1m)	37

Figure 20: Distribution of total HERD budget by research type, 2008 – 2018	38
<b>Chapter 6: Type of Costs .....</b>	<b>39</b>
Figure 22: Distribution of research expenditure by type of costs, 2008-2018 (€ million)	39
Figure 23: Percentage share of type of costs, 2008 and 2018	40
Table 7: Types of costs by fields of science, 2018 (€ million)	41
<b>Appendix 1: Detailed Fields of Science Tables .....</b>	<b>42</b>
<b>Appendix 2: Note on GDP, GNP and GNI* .....</b>	<b>44</b>

## Executive Summary

This report presents the results of the survey of research and development (R&D) activities in the higher education sector – the Higher Education R&D Survey (HERD) – for the academic year 2018/19. Expenditures and human resources devoted to research work in the higher education sector are measured biennially in the HERD survey. The sector includes the publicly-funded higher education institutions in Ireland.

The Department undertook a review of the methodology, guidelines and questionnaires of the 2018 HERD Survey to align with the Frascati Manual 2015 and to better assist the Higher Education Institutions (HEIs) in providing data that was as accurate as possible by expanding and clarifying the guidelines to ensure the questionnaires were interpreted consistently and appropriately by the institutions.

Comprehensive engagement therefore took place with representatives from the Irish Universities Association (IUA), the Technological Higher Education Association (THEA) and the HEIs themselves, with the result that this report is, for all intents and purposes, a new report: one with enhanced accuracy and inter-institutional consistency of inputs compared with previous reports. Caution is therefore advised when comparing personnel data and financial data with previous years. More details are available in the Methodology chapter.

The main findings of the HERD 2018 survey are summarised below:

Table 1 - Summary of key results, 2008-2018, current prices

	2008	2010	2012	2014	2016	2018
Higher education expenditure on R&D (HERD)	749.8	708.3	664.4	730.1	748.8	876.1
HERD as a % of GNP	0.47	0.51	0.48	0.45	0.34	0.34
Ireland's rank out of 36 countries	14	14	18	20	24	23
Total researchers in HE Sector (FTE)	11,246	12,140	12,117	12,836	12,627	9,964
Researchers per 1000 labour force - Ireland's rank out of 32 countries	5	7	9	7	8	7
Percentage of HERD financed by industry	3.8%	3.9%	3.3%	4.4%	4.5%	5.5%

Source: DETE HERD Data and OECD, Main Science and Technology Indicators, November 2020

The findings show that total expenditure on R&D in the higher education sector amounted to €876.1 million, an increase of 17% over 2016 and also of 17% over the last decade. It is important to point out that this increase is mainly due to the new methodology and resultant increase in the reported number of permanent academic staff numbers which

made a significant contribution to the increase in the “indirect funding source” element of HERD in 2018.

- The new methodology and guidelines resulted in a more accurate account of academic research staff in 2018. Researchers had been recorded as Principal Investigators in previous years and they are now being recorded as mostly Permanent Academic Staff<sup>1</sup>. This resulted in a 40% increase in the staff numbers used to calculate indirect funding sources which rose from €230m to €308m between 2016 and 2018. The true value of indirect funding was under-reported in previous HERD surveys due to the mis-categorisation of research staff in previous years.
- Ireland’s relative performance compared to its Gross National Product (GNP), also referred to as the HERD intensity, has remained at 0.34% since 2016. It should be noted that despite the increase in HERD expenditure, the HERD intensity rate continued to slip over the past decade due to significant GDP/GNP growth (i.e. a denominator effect). GDP increased by 74% and GNP increased by 59% between 2008 and 2018. See Appendix 3 for note on GDP, GNP and GNI\*.
- Ireland's position relative to other OECD countries has been deteriorating in the last decade, although it improved somewhat in 2018. Ireland now ranks 23<sup>rd</sup> for the HERD as a percentage of GDP (GNP for Ireland).
- The total number of full-time equivalent (FTE) researchers (excluding technical and administrative support staff) was 9,964 in 2018. The drop in 2018 is due to a correction in the methodology which now classifies research staff more accurately.
- Ireland ranked 7th out of 39 OECD countries on headcount researchers per 1,000 of the labour force in 2018.
- In respect to female researchers in the Higher Education sector, Ireland has been steadily moving up in the last ten years, ranking 8th out of 31 OECD countries in 2018.
- TCD had the largest spend on R&D at €154.1m in 2018, followed by UCD at €141.1m, NUIG at €121.8m and UCC at €114.6m. These four institutions together account for 61% of HERD expenditure in 2018.
- Funding from Science Foundation Ireland to the higher education sector amounted to €169.2m in 2018, accounting for 46% of total direct government funding.
- The percentage of HERD financed by Industry increased one whole percentage point over 2016 from 4.5% to 5.5%. This amounted to €48m, reaching the Innovation 2020 target of €48m investment by private companies in the education sector in 2018.

---

<sup>1</sup> Academic research staff numbers had previously been split across two categories – Academic Staff and Principal Investigators. The data in the latter category is not used in the calculation of indirect funding sources. This meant that the true value of indirect funding was under-reported in previous HERD surveys.

- Pay costs have increased by over 19% between 2016 and 2018, from €516m to €616m while non-pay costs have increased by 12% to €232m.
- Capital costs have decreased by almost 74% over a ten-year period, from €108m in 2008 to €28m in 2018.

## Methodology

This survey was carried out following the OECD Frascati Manual (2015) guidelines for estimating levels of research and development in the higher education sector and the results for Ireland are comparable to those from other OECD countries. The Frascati Manual is the internationally recognised methodology for collecting and using R&D statistics. Data captured in the survey relates to the 2018 academic year (September 2018 to September 2019).

There were two elements to this survey of research and development in Higher Education Institutes:

- An analysis of financial data from each institution;
- An analysis of personnel data and time-use data based on the amount of research per person employed from each institution.

For the 2018 HERD Survey, we engaged in extensive consultation with representatives from the Irish Universities Association (IUA) and the Technological Higher Education Association (THEA). Together with these associations we reviewed the questionnaires that were sent to the Higher Education Institutes (HEIs) and we expanded and clarified the guidelines to ensure the questionnaire was interpreted consistently and appropriately by the institutions. The most notable changes took place in the Personnel questionnaire where the terminology for researcher categories was revised to reflect more accurately the higher education environment in Ireland.

2016 HERD	2018 HERD
Permanent Academic Staff	Permanent Academic Staff
Principal Investigators	Permanent Research Staff
Post-doctoral Fellows	Post Doc Researchers
Other Contract Researchers	Other Contract Researchers
Contract Lecturers	Contract Lecturers

It is worth noting that “Principal Investigators” is not a formal researcher category commonly used by higher education institutes in Ireland in terms of personnel data. Its inclusion in the HERD Personnel questionnaire pre-2016 is likely to have resulted in mis-categorisation of research staff in the questionnaires as permanent members of academic staff and post-docs could be classified as Principal Investigators. This is because “Principal Investigator” is the term used by research funders to indicate the lead researcher on a research grant i.e., the grant holder.

This revision of the Personnel questionnaire impacts on both the staffing data and on the financial data, most notably the indirect funding source data. Indirect funding source data is calculated as



a function of the total recurrent grant and the time-use data of the academic staff. The new and more accurate HERD methodology resulted in a 40% increase in academic staff numbers, many of whom had been previously categorised as Principal Investigators. This had a knock-on effect on the indirect funding source calculations and resultant “indirect funding source” figures.

To ensure consistency, “Principal Investigators” was replaced in the Personnel questionnaire by “Permanent Research Staff” and HEIs were instructed to use this field for the following:

- researchers not yet categorised or;
- researchers who are leading research teams and have permanent contracts or CIDs (contracts of indefinite duration) but are not members of academic staff.

In addition, the terminology for Doctoral/Masters students was also revised and clarified. In previous years, HEIs included some self-funded Doctoral and Masters students under “Employed Students”, whereas in 2018 following the revised method they were correctly categorised.

The new categories conform to the requirements of the Frascati Manual 2015 and they reflect more accurately the situation on the ground in Ireland and make it easier for the HEIs to provide accurate data.

## Reform within the Higher Education sector

There has been a significant process of landscape reform underway within the Higher Education sector during this reporting period, including the designation of Technological Universities that have involved the mergers of previous Institutes of Technology.

This period of flux in the higher education sector makes comparability of statistics challenging. These changes require alterations to the ‘Universities’ and ‘IoTs’ groupings that were traditionally used in the HERD survey.

As the reform process has not yet concluded, this edition of the HERD survey presents the data as one grouping called “Higher Education Institutions”.

## Headcount and Full-time equivalent data

Detailed departmental headcounts were obtained from the personnel offices, categorised by research academic staff and research support staff. In order to calculate full-time equivalent numbers, the percentage of time spent on research was also obtained. In addition, the headcounts were split between male and female to allow for gender comparisons.

Each academic department was also asked to estimate the time spent on research activities by each member of staff in their department. The guidelines were circulated to the HEIs outlining a single agreed methodology. This methodology is as recommended by the international OECD Frascati Manual.

The following matrix was used to determine the percentage of time spent on research.

<b>The following activities are deemed as “research activities” for the purpose of this survey:</b> ✓	<b>The following activities are not deemed as “research activities” for the purpose of this survey:</b> X
<ul style="list-style-type: none"> <li>• Personal research</li> <li>• Team research</li> <li>• Writing research proposals</li> <li>• Writing research reports</li> <li>• Supervision of PhD students</li> <li>• Other research-based activities including admin and planning</li> </ul>	<ul style="list-style-type: none"> <li>• Teaching</li> <li>• General Admin</li> <li>• Supervision of non-PHD students</li> <li>• Other non-research-based activities</li> <li>• External activities</li> </ul>

**NOTE:** In light of the changes outlined above, 2018 is effectively a new baseline line year and caution is advised when comparing Personnel and Financial data with previous years.

## Survey coverage

The coverage included all academic departments in the publicly-funded higher education institutions in Ireland.

1. Dublin City University
2. NUI Galway
3. Maynooth University
4. University College Cork
5. University College Dublin
6. Trinity College Dublin
7. University of Limerick
8. Royal College of Surgeons of Ireland
9. Technological University Dublin (TU Dublin)
10. Mary Immaculate College
11. Athlone IT
12. Cork IT
13. Dundalk IT
14. Dun Laoghaire Institute of Art, Design and Technology
15. Galway-Mayo IT
16. IT Carlow
17. IT Sligo,
18. IT Tralee
19. Letterkenny IT
20. Limerick IT
21. Waterford IT

Questionnaires were sent out in June 2020 to the Higher Education Institutions.

Detailed departmental figures were obtained from the finance office in each HEI.

This information comprised total capital and current expenditure from the HEIs' recurrent grant for all departments, from which a research proportion was derived, based on the number of Permanent Academic Staff and the amount of research-time reported by the respondents.

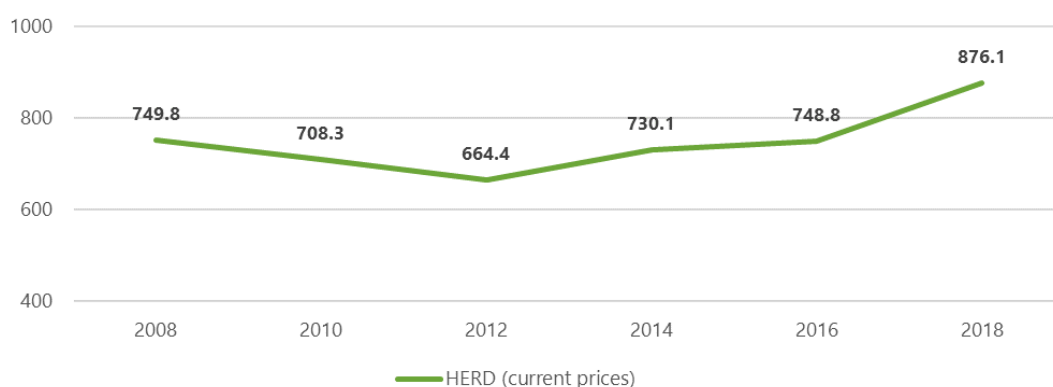
Research income for each department was provided by source of funds and types of costs.

## Chapter 1: General trends in higher education R&D expenditure

The following information on research and development spending by higher education institutions was collected from the accounts and research departments of all higher education institutions engaged in R&D. The survey was carried out under the statistical rules and international definitions as outlined in the OECD Frascati Manual 2015.

The period 2016-2018 saw an increase in expenditure on research and development (R&D) by third level institutes in Ireland. In 2018 higher education expenditure on R&D reached €876.1m, an increase of 17% in current terms.

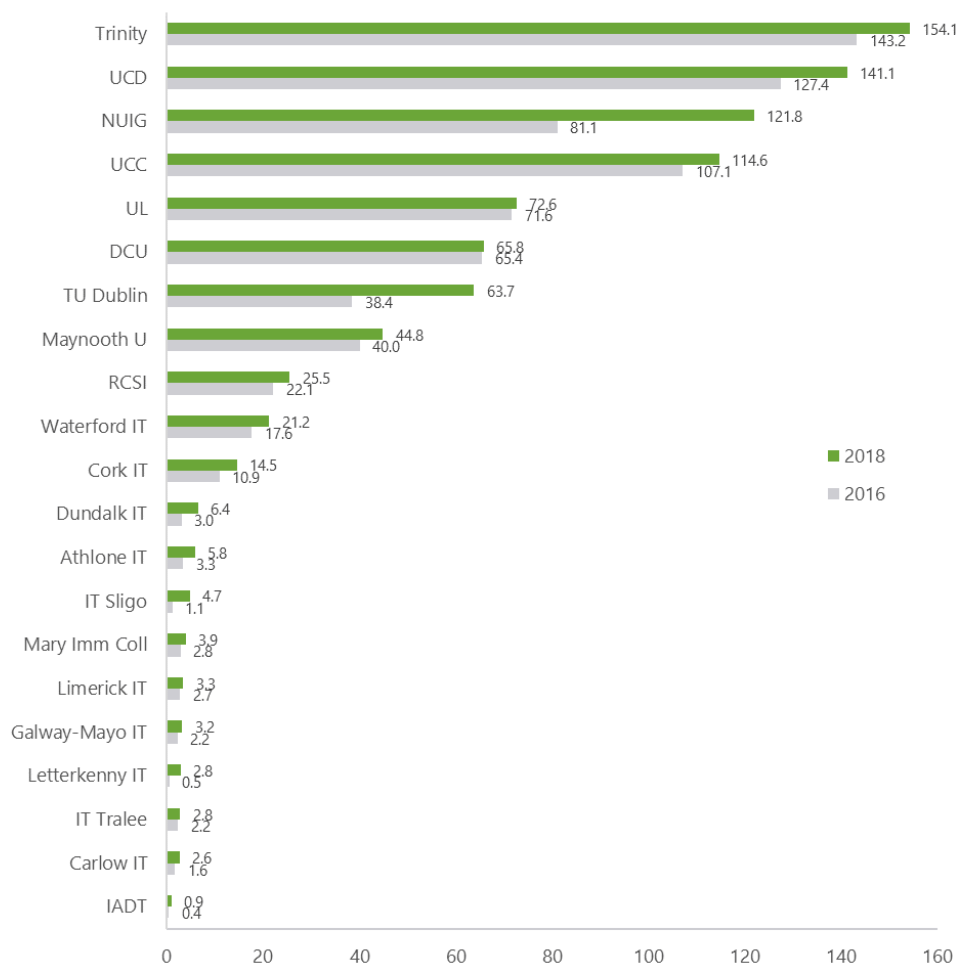
Figure 1: Trend in HERD expenditure, 2008-2018, in current prices (€ millions)



Source: DETE HERD data

- Total expenditure on R&D in the Higher Education sector increased by 17% in the 10-year period 2008-2018, from €749.8m to €876.1m. As noted previously, the new methodology and resultant increase in the reported number of permanent academic staff numbers has made a significant contribution to the increase in the “indirect funding source” element of HERD in 2018.

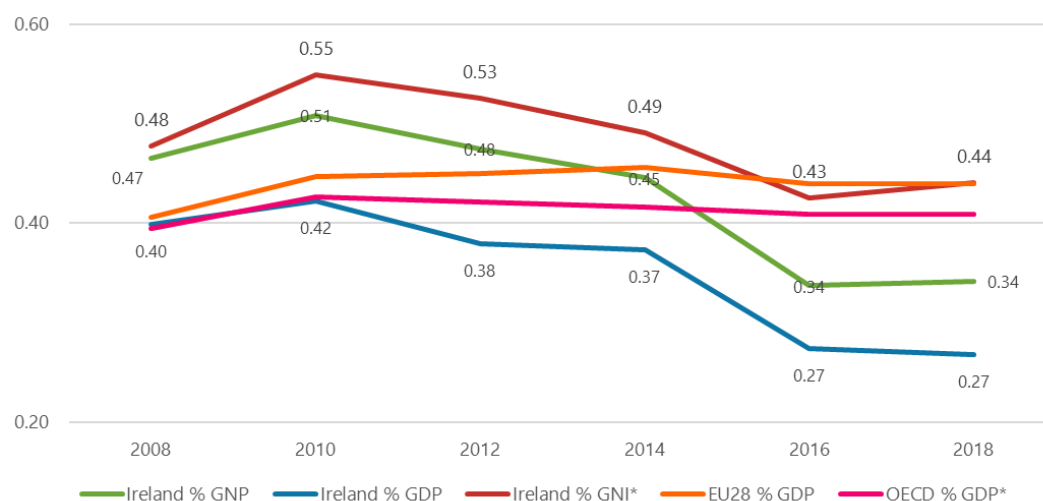
Figure 2: Research expenditure by HEI (€m)



Source: DETE HERD data

- TCD spent €154.1m in 2018, making it the highest spending institution in R&D since 2016.
- UCD and NUIG had expenditures of €141.1m and €121.8m respectively in 2018.

Figure 3: HERD as a percentage of GNP/GDP/GNI\*, 2008-2018, Ireland, OECD and EU28

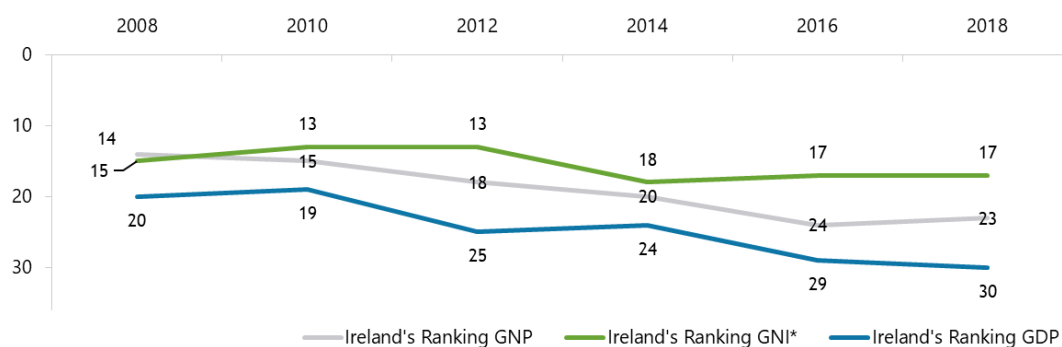


Source: CSO, OECD, Main Science and Technology Indicators and DETE calculations, November 2020

- HERD as a percentage of GNP (2018) for Ireland peaked in 2010 with 0.51% and then declined to 0.34% in 2016 and has remained at that level in 2018.
- As a percentage of modified Gross National Income (GNI\*), Ireland fared better compared to the EU 28 and the OECD, but HERD as a percentage of GNI\* has decreased since 2010 (see Appendix 3 for a note on GDP, GNP and GNI\*).
- When we look at the HERD as a percentage of GDP, we see that it has been declining steadily in the last ten years, from 0.42% to 0.27%.
- It should be noted that the HERD intensity rate fell sharply since 2014, despite the increase in HERD expenditure, owing to significant GDP/GNP growth in recent years.<sup>2</sup>

<sup>2</sup> Between 2008 and 2018, GDP increased by 74%, GNP increased by 59% and GNI\* increased by 27%.

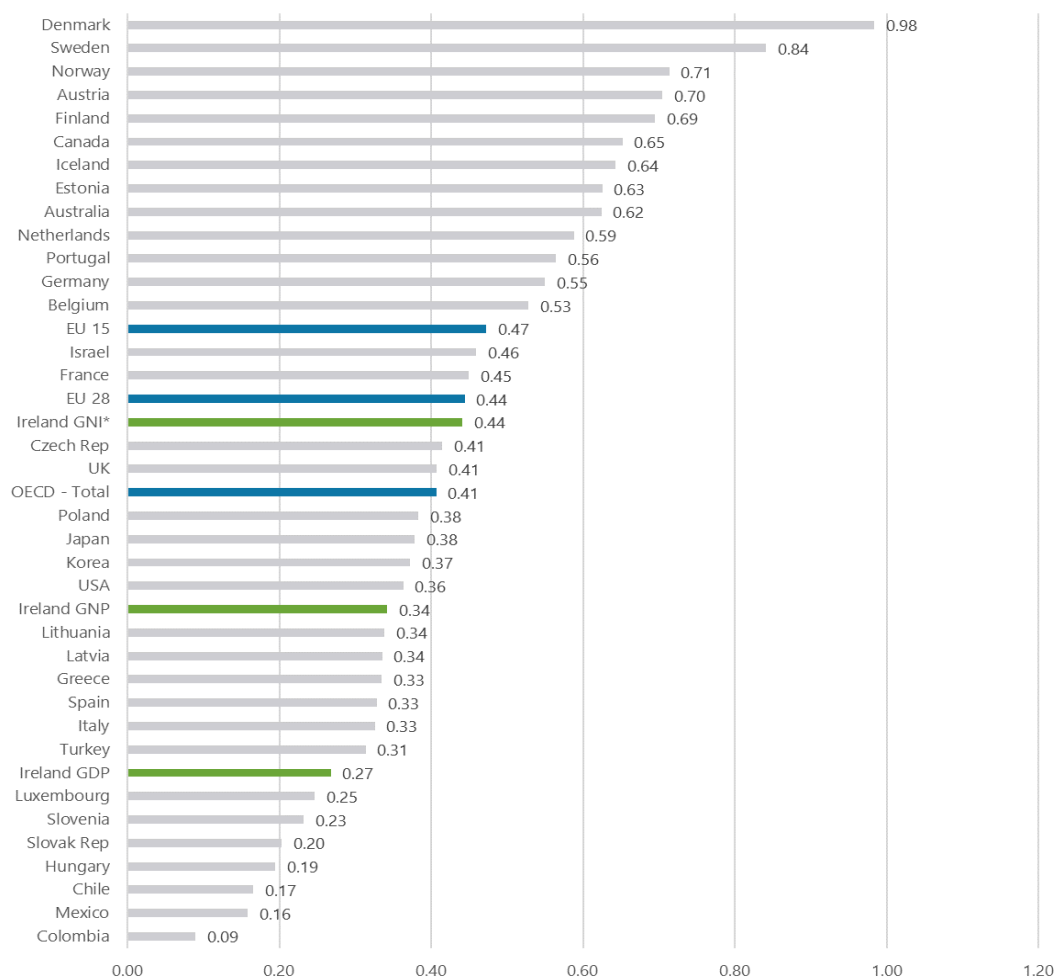
Figure 4: HERD as a percentage of GDP - Ireland's ranking GNP/GNI\* (37 OECD Countries)



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

- Using the GNP as the denominator, Ireland scored 23<sup>rd</sup> out of 37 OECD countries on HERD as a percentage of economic activity in 2018, up one place since the last survey. The fall in ranking can be explained by a 'denominator effect' with growth of Ireland's GNP of 59% between 2012 and 2018 which outstripped the growth in the HERD. (see Appendix 2 on GDP, GNP and GNI\*).
- Using the GNI\* as the denominator, Ireland ranked 17<sup>th</sup> in 2018, and using GDP, Ireland ranked 30<sup>th</sup> (see Appendix 2 for a note on GDP, GNP and GNI\*).

Figure 5: HERD as a percentage of GDP (&amp; Ireland GNP/GNI\*) - 2018 or latest available data



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

- In 2018, the top performers were Denmark and Sweden, spending 0.98% and 0.84% of GDP on R&D in the higher education sector. Norway, at 0.71%, scored 3rd place. Ireland is in 16th place at 0.44% when using GNI\* as the denominator, between the EU28 and the OECD average. The UK spent 0.41% of their GDP on R&D, slightly higher than the Irish level of GNP HERD intensity at 0.34% of GNP, while the USA spent 0.36%.



## Chapter 2: Human resources allocated to higher education research

### Headcount Figures

The HERD survey gathers information on the numbers and type of personnel involved in R&D within Ireland's third level sector.

The number of researchers by total headcount is shown in Table 2 below. This includes academic staff, post-doctoral researchers, contract researchers and lecturers as well as Doctoral and Research Masters Students. The latter have been included as researchers since 2014, as required by the Frascati Manual 2015. The students who are funded by their institution's internal scheme (generally paid for by the Recurrent Grant) are included in the survey, as well as those who are externally funded (competitively-secured scholarships). Doctoral and Research Masters students who are entirely self-funded are included in the survey under a separate category to capture the full number of registered research students.

The survey also requested data on research support staff including technicians and other support staff.

**Note:** There has been a break in the series after 2016 following a revision of the methodology for HERD personnel which now classifies research staff more accurately. Therefore, caution is advised when comparing data with previous years.

The use of the category "Principal investigator" pre-2018 is likely to have resulted in mis-categorisation of research staff in the questionnaires as permanent members of academic staff and post-doctoral researchers could be classified as a Principal Investigator. This is because "Principal Investigator" is the term used by research funders to indicate the lead researcher on a research grant i.e., the grant holder. For this reason, "Principal Investigators" was replaced in the Personnel questionnaire by "Permanent Research Staff" and HEIs were instructed to use this field for the following:

- researchers not yet categorised or;
- researchers who are leading research teams and have permanent contracts or CIDs (contracts of indefinite duration) but are not members of academic staff.

Table 2: Total researchers by performer, 2008-2018 (headcount)

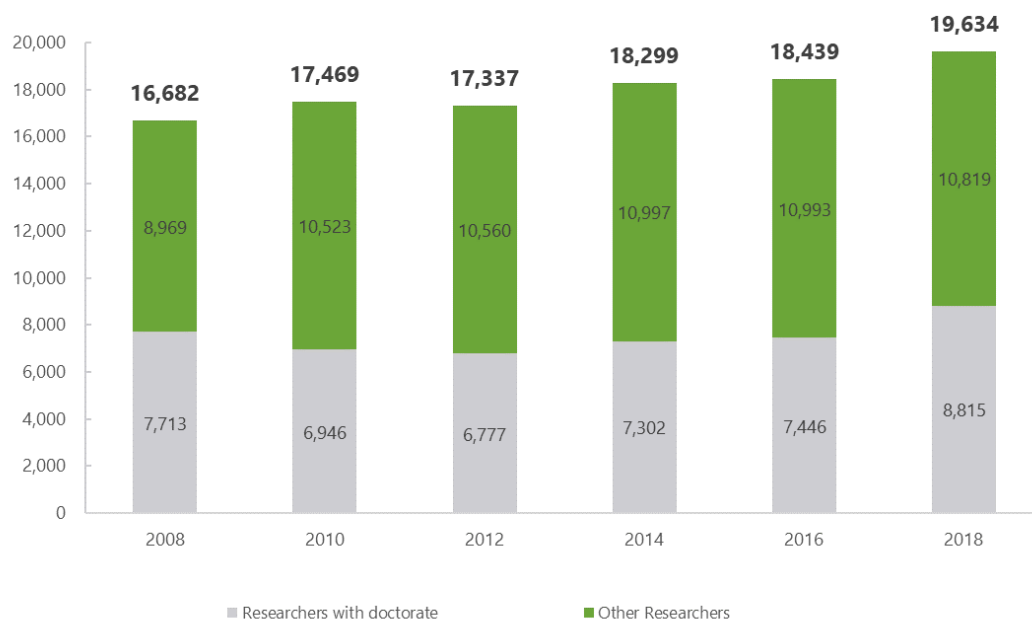
Sector	2008	2010	2012	2014	2016	Total 2018
Permanent Academic Staff	5,994	6,155	5,642	6,124	6,198	8,626
Permanent Research Staff / Other Contract Researchers	1,943	2,349	2,688	2,976	3,420	1,388
Post Doc Researchers	2,278	1,771	1,818	1,740	1,514	2,294
Contract Lecturers	1,396	783	1,074	1,045	928	1,183
Doctoral and Research Masters Students	5,072	6,411	6,115	6,413	6,379	6,143
Self-funded Doctoral and Research Masters Students	n/a	n/a	n/a	n/a	n/a	3,901
<b>Total Researchers (excl. Self-funded)</b>	<b>16,683</b>	<b>17,469</b>	<b>17,337</b>	<b>18,298</b>	<b>18,439</b>	<b>19,634</b>
<b>Total Researchers (incl. Self-funded)</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>23,535</b>
Technicians	1,079	1,115	1,007	976	828	590
Other staff	2,798	4,241	3,255	2,429	2,585	1,163
<b>Total Research Personnel (excl. Self-funded)</b>	<b>20,560</b>	<b>22,825</b>	<b>21,599</b>	<b>21,703</b>	<b>21,852</b>	<b>21,387</b>
<b>Total research Personnel (incl. Self-funded)</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>25,288</b>

Source: DETE HERD data

- There were 19,634 researchers in the higher education sector (headcount) in 2018, accounting for 92% of total research personnel.<sup>3</sup>
- Technicians and Other Staff accounted for 3% (590) and 5% (1,163) respectively of total research personnel. The numbers are lower when compared with previous years because only “staff devoted to research work” were included, following clarification of the criteria for these categories
- Overall, there were 21,387 research personnel in the higher education sector in 2018.

<sup>3</sup> Paragraph 5.29 of the Frascati Manual 2015 requires that countries make a distinction between doctoral students receiving financial support and those who do not.

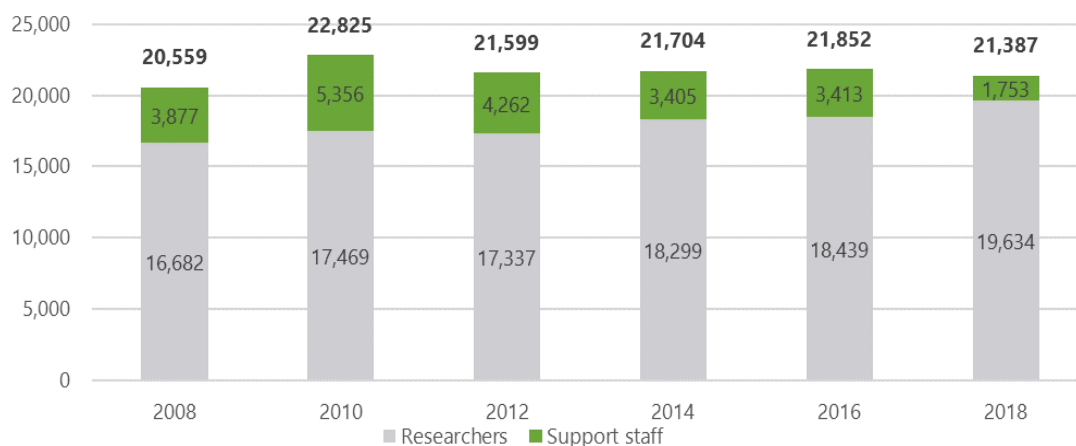
Figure 6: Researchers by qualification, 2008-2018 (headcount)



Source: DETE HERD Data

- 8,815 researchers were doctorate holders (45%) in 2018 in the higher education sector, an increase of 18% since 2016.
- There were 10,819 Other qualified researchers (55%) (with educational attainment below doctorate level) in the higher education sector in 2018. This is an increase of 21% since 2008.
- **Note:** This figure only includes the Doctoral and Masters' students who are funded by their institution's internal scheme and those who are externally funded. It is worth noting that the HEIs reported 3,901 "self-funded" Doctoral and Masters' students. If we include them, this brings the total number of research personnel to 23,535.

Figure 7: Researchers and support staff, 2008-2018 (headcount)



Source: DETE HERD Data

- There were 19,634 researchers (headcount) in the higher education sector, an increase of 6.5% over the previous year.
- There were 1,753 support staff (including technicians) in the higher education sector in 2018. This figure is lower in 2018 than in previous years because, following clarification of the criteria for these categories, HEIs only included staff that were devoted to research work which is required under the Frascati Manual 2015 (“employed by R&D Unit”).

Table 3 gives a breakdown of research personnel by occupation and field of science.

Table 3: Researchers by occupation and field of science (Headcount), 2018

Sector	Total Researchers	Total Support Staff	Total Research Personnel
Natural Sciences	4,620	489	5,109
Engineering and Technology	4,361	502	4,863
Medical and Health Science	3,558	431	3,989
Agricultural Sciences	302	5	307
Social Sciences	4,601	165	4,766
Humanities	1,906	29	1,935
Not classified <sup>4</sup>	286	132	418
<b>Total - 2018</b>	<b>19,634</b>	<b>1,753</b>	<b>21,387</b>
Total - 2016	18,439	3,413	21,852
Total - 2014	18,299	3,405	21,704
Total - 2012	17,337	4,261	21,598

Source: DETE HERD Data

- There was a total of 21,387 research personnel in the higher education sector in 2018, slightly less than in 2016.
- The fields of research with the highest proportion of researchers were Natural Sciences and Engineering and Technology which accounted for 24% and of all 23% respectively of total research personnel.
- Agricultural Sciences had the lowest proportions with 1% of total research personnel.
- Medical and Health Science and Social Sciences accounted for 19% and 22% respectively of the total research personnel.

---

<sup>4</sup> A 'Not Classified' category was added to the Field of Science breakdowns in the 2012 HERD report for the first time. A Department/School not readily classified into a field of science was included in the "Not classified" category e.g. Research Office, Office of VP for Research, President's Office, Admin and Support, Research and Commercialisation Support, etc. Prior to the 2012 survey these offices were coded under Social Sciences.

- Not Classified accounted for 2% of the total research personnel which is significantly lower than the 2016 figure of 8%. Note that the 'Not Classified' category includes the Research Office, Admin and Support, etc.

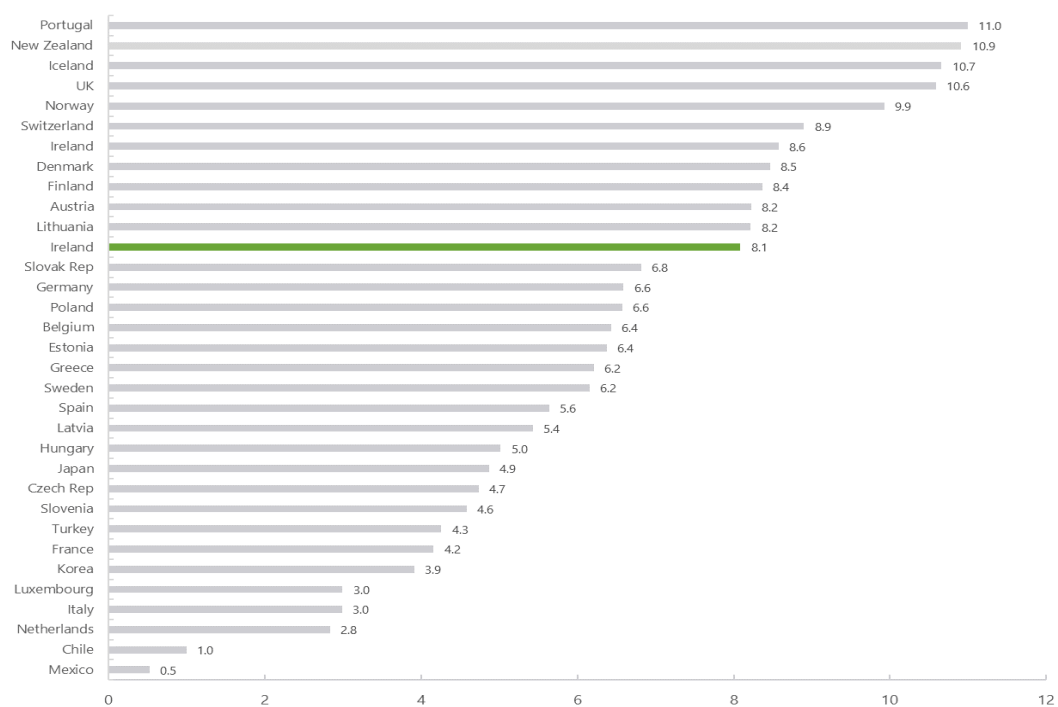
Figures 8 and 9 illustrate Ireland's ranking against other OECD countries in terms of the number of researchers in the higher education sector per 1,000 of the labour force. In 2018, Ireland was ranked 7<sup>th</sup> out of OECD countries. Portugal reported the highest number of researchers per thousand of the labour force at 11.

Figure 8: Ireland's ranking, researchers per 1,000 of the labour force, 2008 -2018



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

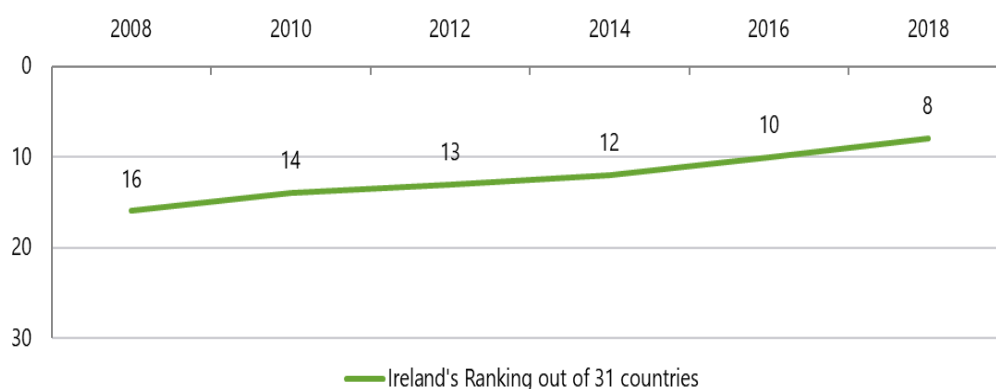
Figure 9: HE researchers (HC) per 1,000 of the labour force, 2018 (or latest available data)



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

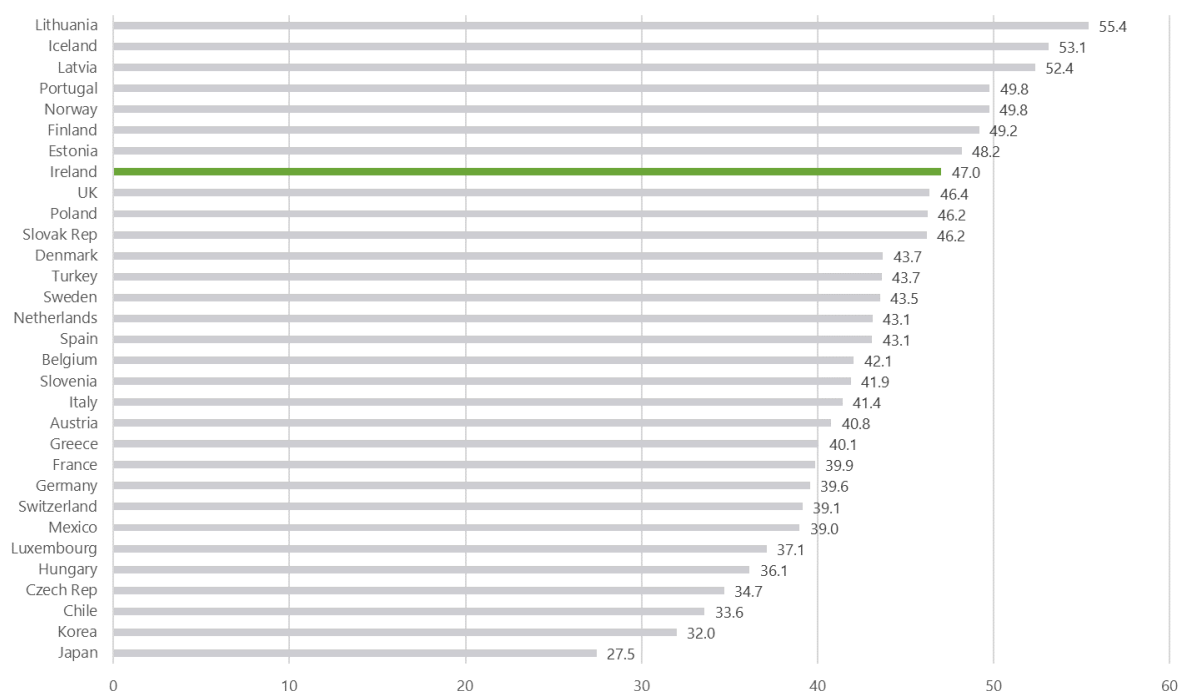
Figures 10 and 11 below capture Ireland's place internationally with respect to female researchers as a percentage of total researchers in the Higher Education sector. Ireland has been steadily moving up in the last ten years, ranking 8th out of 31 OECD countries in 2018 with 47% of all researchers in Ireland being female. Lithuania and Iceland reported the highest number of female researchers accounting for 55.4% and 53.1% respectively of all researchers in 2018.

Figure 10: Ireland's ranking, Female researchers as a % of total researchers (HC), 2008-2018



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

Figure 11: Female researchers as a % of total researchers (HC), 2018 or latest available data



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020



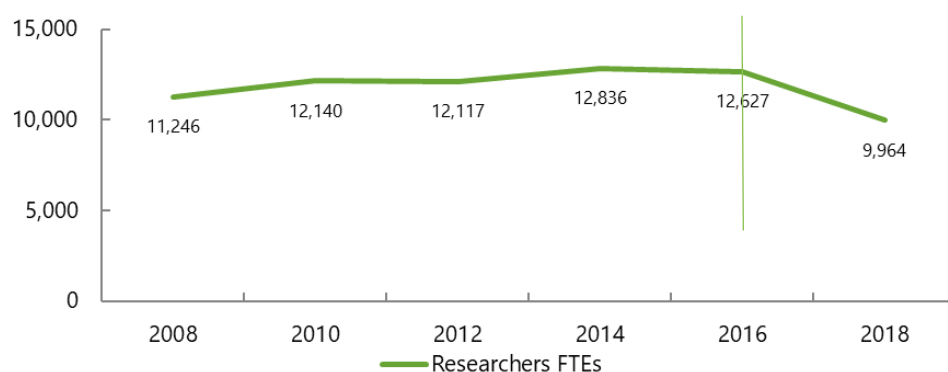
## Full time Equivalent Figures (FTE)

There has been a break in the methodology for HERD personnel for the 2018 Survey which has reduced the misclassification of R&D personnel across the different categories in previous surveys that occurred due to the inclusion of a “Principal Investigators” category. “Principal Investigators” is not a formal researcher category commonly used by higher education institutes in Ireland in terms of personnel data.

We see a significant decline in FTE researcher numbers in the higher education sector from 12,627 in 2016 to 9,964 in 2018. This is primarily due to researchers previously classified as “Principal Investigators” and now being classified as Permanent Academic Staff.

In previous years, in terms of estimating the percentage of time spent on R&D, each “Principal Investigator” was captured as 1 FTE whereas “Permanent Academic Staff” only spend a portion of their time on R&D, typically 30-40%. This differential accounts for the reduction in the FTE number in 2018.

Figure 12: Total researchers in the higher education sector, 2008-2018 (FTE)



Source: DETE HERD Data

Table 4: Researchers by occupation and FOS in the higher education sector, FTEs, 2018

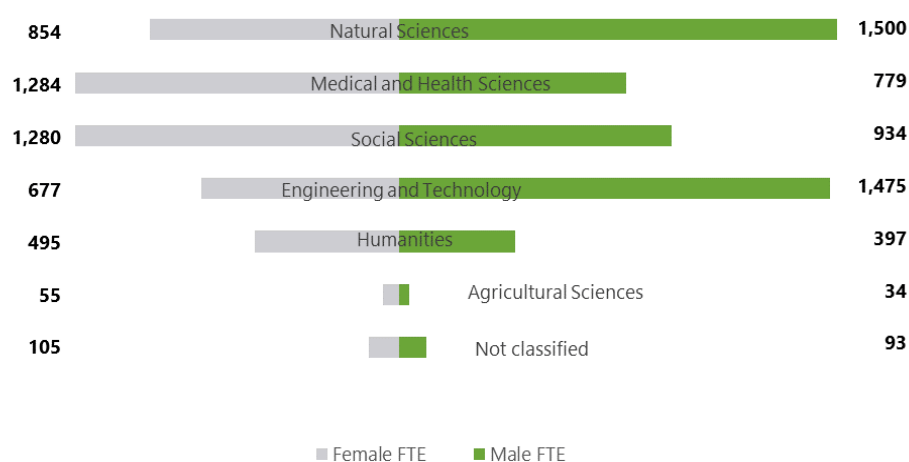
Sector	Total Researchers	Total Support Staff	Total Research Personnel
Natural Sciences	2,354	294	2,648
Engineering and Technology	2,153	370	2,523
Medical and Health Science	2,063	374	2,437
Agricultural Sciences	89	3	92
Social Sciences	2,214	130	2,344
Humanities	892	14	906
Not classified	198	95	293
<b>Total – 2018</b>	<b>9,964</b>	<b>1,280</b>	<b>11,243</b>
Total – 2016	12,627	2,551	15,178
Total – 2014	12,836	2,011	14,847

Source: DETE HERD Data

- Four fields of science accounted for 89% of the Total Research Personnel in 2018 and they were split almost evenly with Natural Sciences with 24%, followed by Engineering and Technology and Medical and Health Sciences both at 22% and Social Sciences at 21%.
- Agricultural Sciences had the lowest number of researchers with 1%, followed by Humanities with 8%.

Figure 13 below shows the 9,964 FTE researchers broken into male and female and by field of science in 2018. In the field of medical and health sciences, female researchers account for 62% of total researchers, contrasting with the field of engineering and technology where female researchers account for 31%.

Figure 13: Female and male FTE researchers, 2018



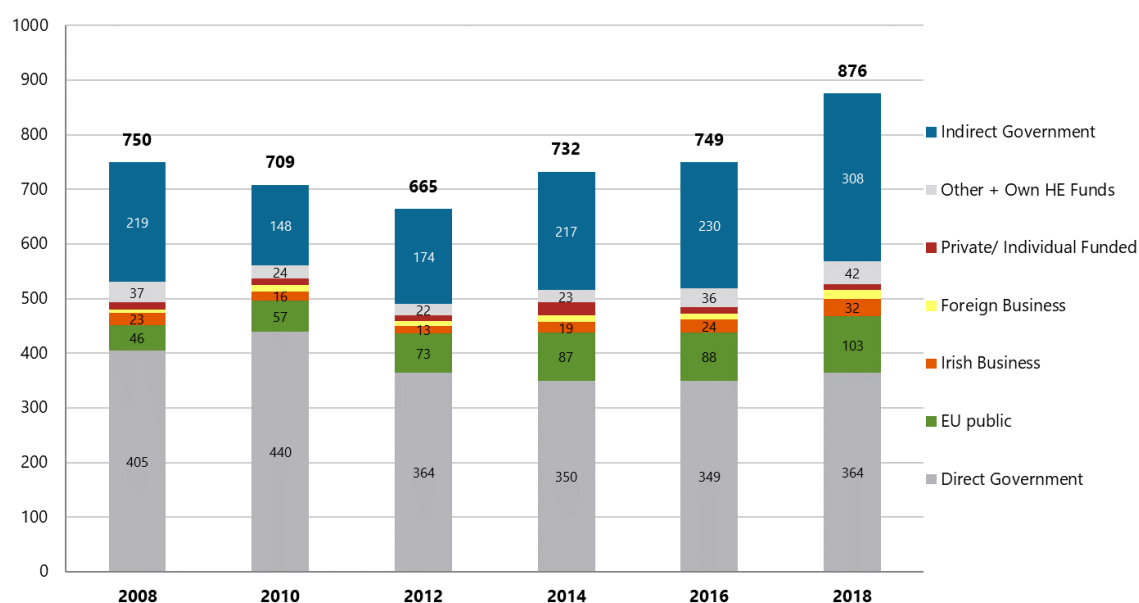
Source: DETE HERD Data

## Chapter 3: Source of funding of HERD expenditure

This chapter examines the main sources of funding for higher education R&D. Funding for research in higher education institutes is provided by a number of different sources. The main sources of funding come from three distinct areas: direct government, indirect government and other sources such as Irish industry, foreign industry and EU funding programmes.

Direct government funding comes via various government departments and agencies to fund research projects which are performed in the higher education sector. Direct government funding amounted to €364m in 2018, accounting for almost 41% of the total HERD. Since 2010, there has been a significant reduction in direct government R&D funding, however, the overall amount of funding has increased by 4% in between 2016 and 2018.

Figure 14: Sources of research funding, 2008-2018, in current prices (€ millions)



Source: DETE HERD Data

Table 5: Sources of research funding, 2008-2018, in current prices (€ millions)

	2008	2010	2012	2014	2016	2018
Direct Government	405	440	364	350	349	364
Indirect Government	219	148	174	217	230	308
EU public	46	57	73	87	88	103
Irish Business	23	16	13	19	24	32
Foreign Business	6	11	9	13	10	16
Private/ Individual Funded	13	12	10	23	12	11
Other + Own Funds	37	24	22	23	36	42
<b>Total</b>	<b>750</b>	<b>709</b>	<b>665</b>	<b>732</b>	<b>749</b>	<b>876</b>

Source: DETE HERD Data

The HEA, on behalf of the Department of Education & Skills (now the Department of Further & Higher Education, Research, Science & Innovation), distributes an annual recurrent grant to the higher education institutions that is used by them for a variety of purposes. Calculation of the R&D component of the recurrent grant for the purposes of this Survey is based on the proportion of time spent on research at the institution by Permanent Academic Staff and then by applying that proportion to the overall funding of departmental R&D activities. This is standard practice in all OECD countries that operate a dual system of higher education funding – direct and indirect (General University Funding). This system follows the guidelines set out in the OECD's Frascati manual.

According to the HERD survey results, the nominal amount of indirect government funding spent on research stood at €308 million in 2018 and this change from 2016 is mainly due to the change in methodology. It is important to note here that the amount arrived remains an imputed amount of expenditure on R&D and the actual usage of the core grant is the preserve of the institutions themselves.

As outlined previously, the Indirect funding source data is calculated as a function of the total recurrent grant and the time-use data of the permanent academic staff. The new and more accurate HERD methodology resulted in a 40% increase in permanent academic staff numbers, many of whom had been previously categorised as Principal Investigators and as such were not factored in to the indirect funding source calculations previous to 2018. This resulted in the Indirect Funding Source figures being undervalued in 2016 and earlier years.

Another factor that contributed to the increase in the 2018 HERD is that a larger number of institutions were able to provide the requested details on Recurrent Grant expenditure than in previous years.

These factors have therefore had a logical knock-on effect on the indirect Government funding calculation, as illustrated in its change between 2016 and 2018.

The most significant reductions in direct government funding in 2018 were:

- €1.0m – PRTL current funding
- €4.5m – Enterprise Ireland

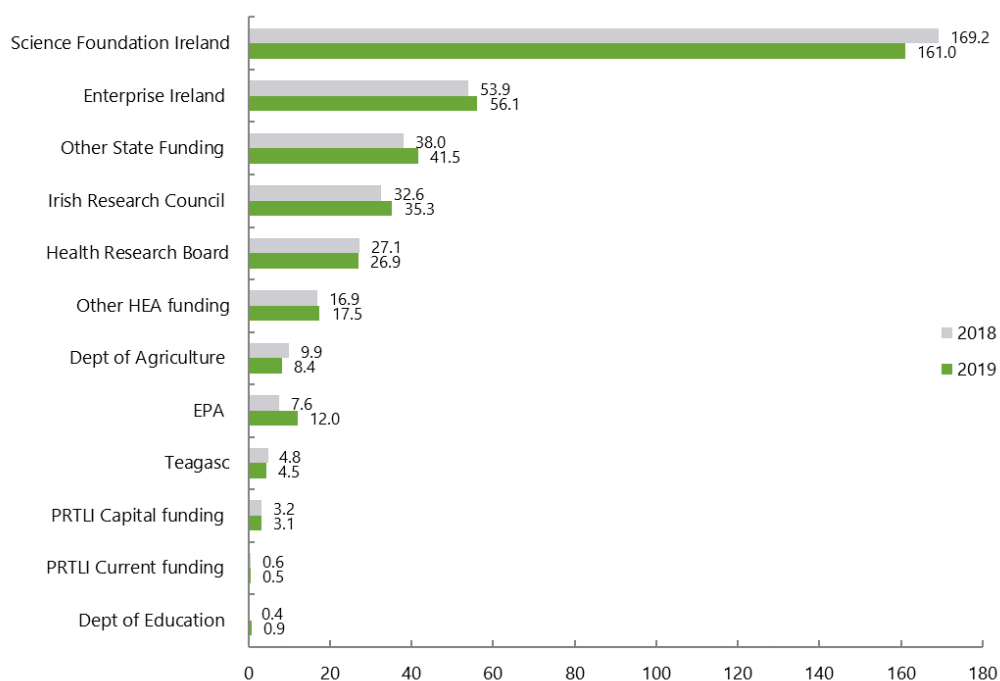
However, there was increased funding in the following areas:

- €1.4m – PRTL capital funding
- €7.1m – Science Foundation Ireland
- €1.3m – Irish Research Council
- €1.3m – Environmental Protection Agency
- €8.1m – Other State Funding

Other important points are:

- Direct government funding was €364m in 2018, 10% lower than it was in 2008 when it reached €405m.
- The portion of the recurrent grant allocated to research (indirect Government funding) has been steadily increasing since 2010. It increased by 34% between 2016 and 2018, from €230m to €308m. This is due to higher levels of academic staff being reported under the new methodology and more Institutes of Technology reporting recurrent grant details in the 2018 Survey. The true value of indirect funding was under-reported in previous HERD surveys due to the mis-categorisation of research staff in previous years. Indirect funding accounted for 35% of total funding for HERD in 2018, steadily increasing since 2010 when it was 29%.
- EU funding also continued to increase to reach €103m in 2018, a 17% increase over 2016.
- Funding by Irish and foreign business amounted to €32m and €16m respectively in 2018, together accounting for 5.5% of total HERD. This amounted to €48m, reaching the Innovation 2020 target of €48m investment by private companies in the education sector by 2020.
- Private funding (Individuals and Philanthropy) peaked at €23m in 2014 but since then dropped to €11m in 2018, and Other and Own Funds (which includes portion of private fees from students allocated to R&D) accounted for €42m in 2018.

Figure 15: Sources of direct government research funding (€ millions) 2018 and 2019 (estimate)

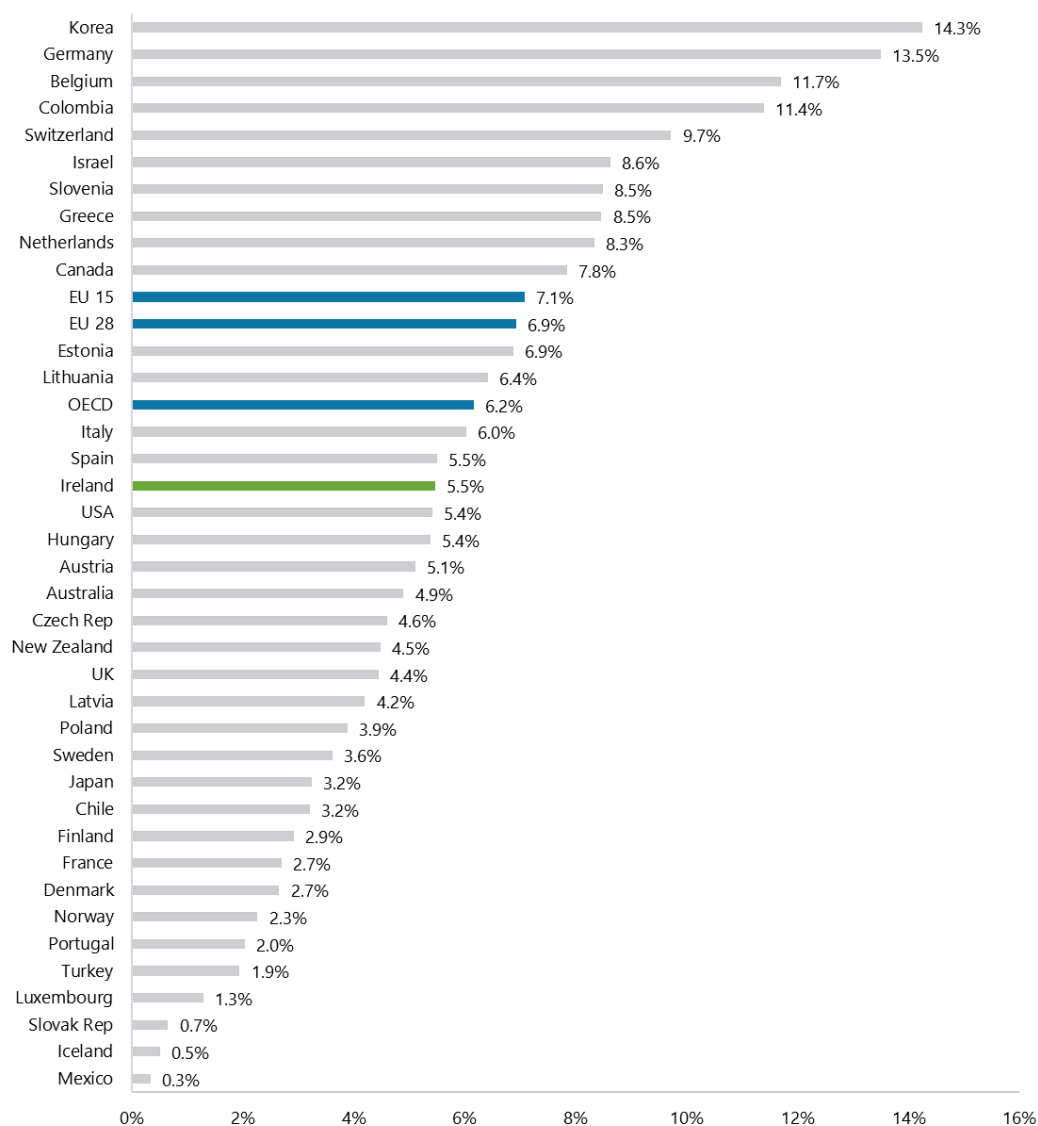


Source: DETE HERD Data

Figure 15 shows the breakdown of direct government funding by its main sources for the academic years 2018 and estimates for 2019.

- The largest amount of funding for research in the third-level sector in 2018 was SFI with 46% of total direct government funding (€169.2m).
- Funding from Enterprise Ireland amounted to over €53.9m in 2018, accounting for 15% of total direct Government funding.
- Research funded by the Irish Research Council amounted to €32.6m in 2018
- The Health Research Board funded R&D to the value of €27.1m in 2018.
- Other State funding amounted to €38m in 2018 while the Department of Agriculture and the EPA contributed €9.9m and €7.6m respectively.

Figure 16: Percentage of HERD financed by industry - OECD Countries, 2018 or latest data



Source: OECD, Main Science and Technology Indicators and DETE calculations, November 2020

- 5.5% of the total HERD in 2018 was financed by industry in Ireland, a full percentage point over the 2016 figure of 4.5%. Ireland is slightly below the EU28 average of 6.9% and the OECD average of 6.2%. Korea reported the highest proportion of R&D at 14.3%. It is worth noting that some of the countries with the highest R&D intensities e.g. Finland, Denmark and Norway had an even lower level of R&D financed by industry than Ireland.



Table 6: Sources of research funding by field of science (€ millions), 2018

Field of Science	Direct Sources of Funds				Indirect Government (HEA Recurrent Grant)	Total
	Irish Public Research	EU	Industry	Other and Own		
Natural Sciences	92.5	37.7	12.2	8.9	54.1	205.5
Engineering and Technology	113.0	27.4	12.1	8.5	52.4	213.2
Medical and Health Sciences	74.7	15.1	15.3	21.7	54.9	181.7
Agricultural Science	6.6	2.3	1.4	0.5	0.4	11.0
Social Sciences	35.3	16.0	5.1	5.2	91.5	153.1
Humanities	8.6	3.6	0.4	1.8	32.5	46.9
Not classified	33.6	1.2	1.4	5.9	22.6	64.7
<b>Total</b>	<b>364.2</b>	<b>103.3</b>	<b>47.9</b>	<b>52.4</b>	<b>308.2</b>	<b>876.1</b>
% of Total	41.6%	11.8%	5.5%	6.0%	35.2%	100%

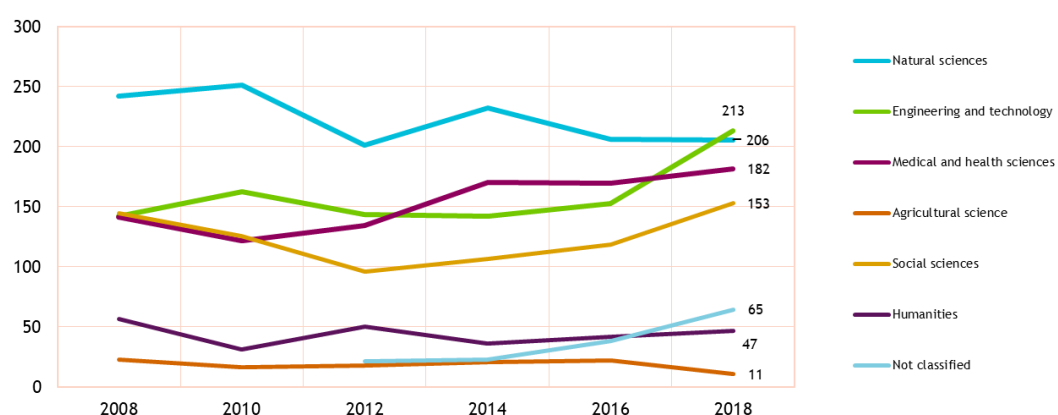
Source: DETE HERD Data

- Overall, 41.6% of total HERD is funded from direct Government sources, 35.2% from the HEA Recurrent Grant, 11.8% from EU funds, 6% from Other and Own and 5.5% from Industry.
- For most fields of science, the majority of funding for R&D was from Irish public research sources in 2018, with the exception of Social Sciences and Humanities where 60% and 69% respectively of funding came from the HEA.
- EU funding accounted for 21% of Agricultural Science which also received the highest proportion of Irish Public Research funding with 59.4% and of Industry funding with 21.5%. Engineering and Technology received 5.7% of its funding from EU sources.
- The largest amount of funding from Industry in 2018 was in Medical and Health Sciences with €15.3m.

## Chapter 4: HERD Expenditure by Field of Science

This chapter examines R&D expenditure by breaking the expenditure down by fields of science. Fields of science classifications are produced by the OECD to be used by member countries for international comparison purposes.

Figure 17: HE expenditure on R&D by field of science in current prices, (€millions), 2008-2018



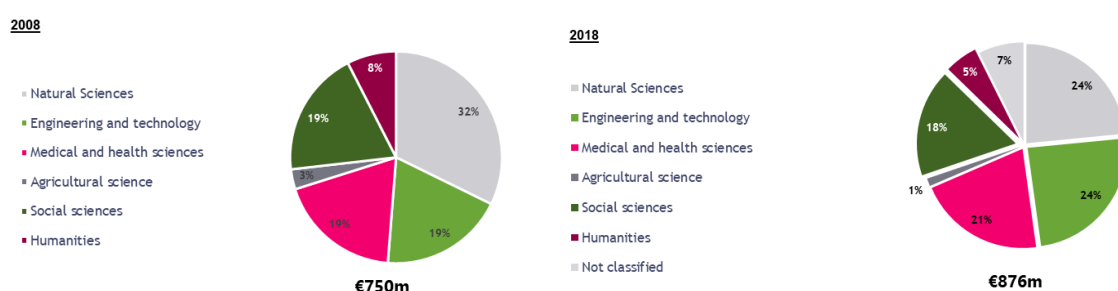
	2008	2010	2012	2014	2016	2018
Natural sciences	242	251	201	232	206	206
Engineering and technology	142	163	143	142	153	213
Medical and health sciences	142	122	134	170	169	182
Agricultural science	23	16	18	20	22	11
Social sciences	145	125	96	106	119	153
Humanities	56	32	50	36	42	47
Not classified <sup>5</sup>	No data	No data	21	23	38	65
<b>Total</b>	<b>750</b>	<b>708</b>	<b>664</b>	<b>730</b>	<b>749</b>	<b>876</b>

Source: DETE HERD Data

<sup>5</sup> Examples of 'Not Classified' include Research Office, Office of VP for Research, President's Office, etc. This category was added in the 2012 HERD Survey.

- The largest proportion of R&D expenditure was in the field of Engineering and technology in 2018 with €213m, a 39% jump since 2016.
- Natural Sciences accounted for the next highest proportion of total R&D expenditure in 2018 with €206m, the same as the 2016 figure.
- Medical and Health Sciences had the third largest R&D expenditure by field of science increasing by €13m between 2016 and 2018 for a total of €182m.
- R&D expenditure in the field of social science increased by 29% since 2016 to €153m in 2018. This should be regarded with caution, as previously the 'other' or 'not classified' category was coded under 'Social Sciences'.
- Expenditure on R&D in the Humanities field amounted to €47m, an increase of €5m since 2016.
- Agricultural Science has experienced the biggest drop, going from €22m in 2016 to €11m in 2018, a decrease of 50%.
- Note: HEIs have indicated that it can be difficult to assign one single field of science to particular Schools or Research Centres as the areas they are involved in can span across other fields. For the purpose of this survey, the HEIs chose the field of science that best matched their area of work.

Figure 18: Share of total R&amp;D expenditure by field of science, 2008 and 2018



Source: DETE HERD Data

- In absolute terms, the HERD has increased from €750m in 2006 to €876m in 2018. It should be noted that €78m of the increase in 2018 is due to the increase in the "indirect funding source" contribution to HERD that resulted from the new methodology, as referenced earlier in the report. 2018 should be viewed as a new baseline year.
- When comparing the share of HERD by field of science in 2008 and 2018:

- Natural Sciences dropped from 32% to 24%;
  - Engineering and Technology increased from 19% to 24%;
  - Medical and Health Sciences increased from 19% to 21%;
  - Agricultural Science dropped from 3% to 1%;
  - Social Sciences decreased by one percentage point from 19% to 18%;
  - Humanities dropped slightly from 8% to 5%;
- The 'Not classified' category refers to Department/Schools whose work span multiple disciplines and could not be assigned to one single Field of Science.

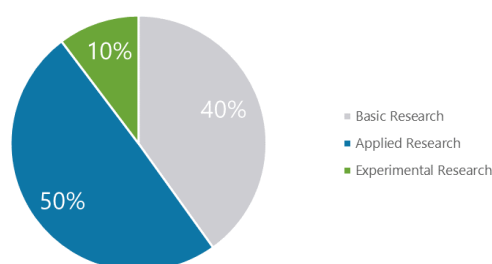
## Chapter 5: Types of research

To ascertain the type of research undertaken by the Higher Education Institutes, participants were asked to classify which type of research they were engaged in.

The Frascati Manual is the internationally recognised methodology for collecting and using R&D statistics. It provides the following definitions for the three areas of research:

- Basic research – experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.
- Applied research – also original investigation undertaken in order to acquire new knowledge, it is however, directed primarily towards a specific practical aim or objective.
- Experimental research – is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

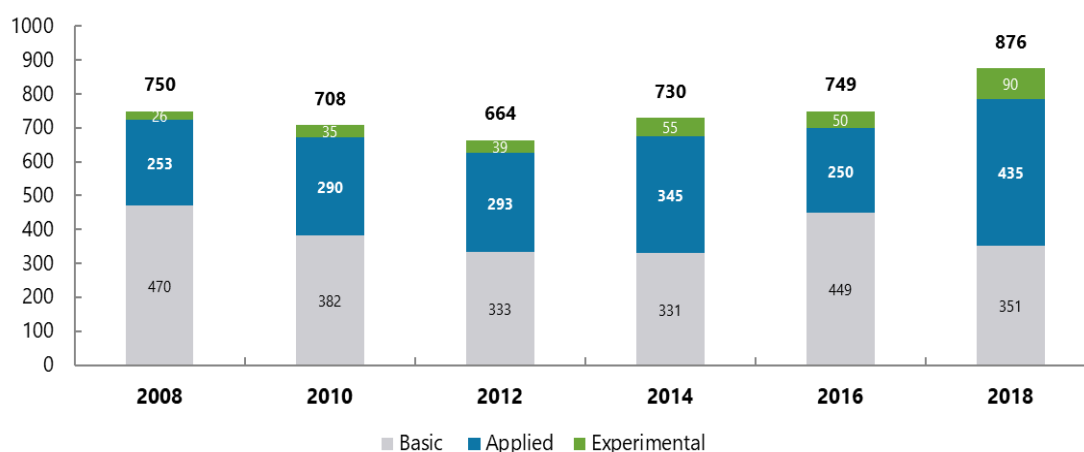
Figure 19: Percentage of total HERD budget by research type, 2018 (Total = €876.1m)



Source: DETE HERD Data

- In 2018, 40% was spent on Basic research activities. Applied research accounted for 50% of all research spend in the higher education sector, while Experimental research accounted for 10% of the total HERD budget.

Figure 20: Distribution of total HERD budget by research type, 2008 – 2018



Source: DETE HERD Data

- Figure 20 shows the trend in HERD by type of research since 2008. After nearly a decade of decline, Basic reached €449m in 2016 but dropped back to €351m in 2018 following clearer guidelines to help the HEIs classify more accurately the different type of research grants.<sup>6</sup>
- In 2018, 50% of all research undertaken in the HEIs was Applied research (€435m). In 2016, this share was 33% (€250m).
- The share of Experimental research has steadily increased in the last decade, from 4% (€26m) in 2008 to 10% (€90m) in 2018. Again, the clearer guidelines to help the HEIs classify more accurately the different type of research grants means that Experimental research represented 10% (€90 m) in 2018 as opposed to 6.7% (€50 m) in 2016.

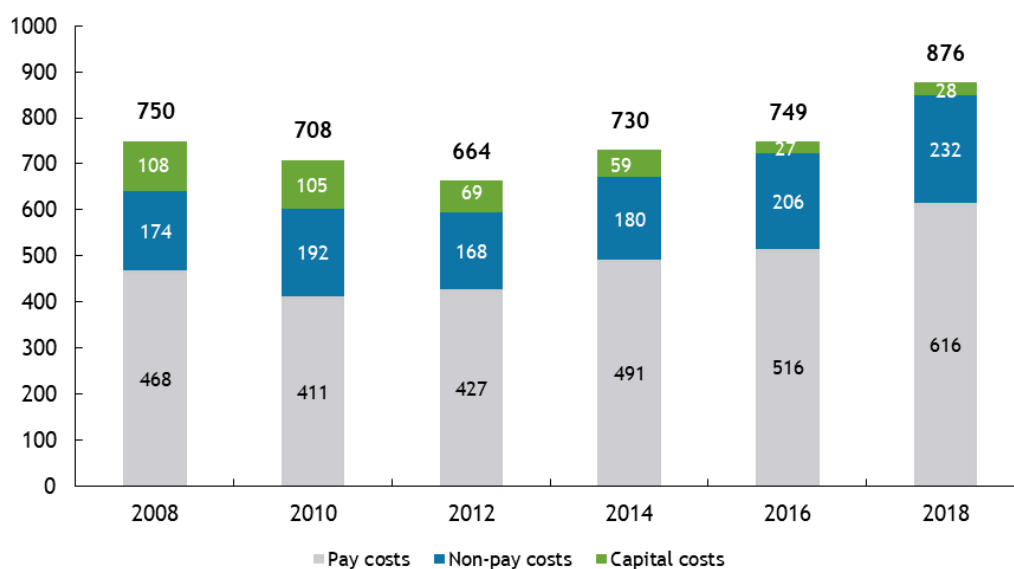
<sup>6</sup> Guidelines used Technology Readiness Levels (TRLs) to define types of research. The approach consisted of manually mapping the TRL levels to each funding agency's range of programmes. This method was developed by UCD and shared among the HEIs thereby ensuring consistency in the classification of the type of research.

## Chapter 6: Type of Costs

The type of research costs incurred by the HEIs were examined in detail in the HERD survey. These research costs are broken into three types of costs as defined in the OECD Frascati Manual 2015 as follows:

- Pay (or labour) costs "comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, holiday pay, contributions to pension funds and other social security payments, payroll taxes, etc".
- Non-pay (or other current) costs "comprise non-capital purchases of materials, supplies and equipment to support R&D performed by the statistical unit in a given year".
- Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units.

Figure 22: Distribution of research expenditure by type of costs, 2008-2018 (€ million)

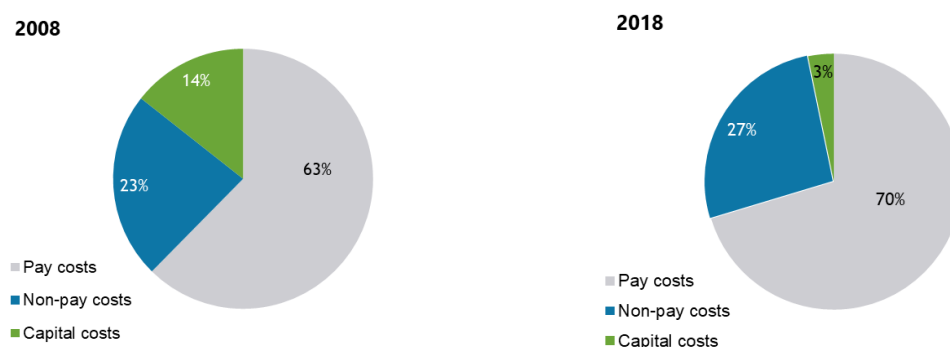


Source: DETE HERD Data

- Figure 22 shows that Pay expenditure has been increasing steadily since 2010. The majority of research expenditure went towards pay costs which accounted for €616m in 2018, an increase of over 19% since 2016.
- Non-pay costs increased by 12% in 2018 compared to 2016, amounting to €232m. Non-pay costs refer to non-capital purchases of materials, supplies and equipment to support R&D, and accounted for over a quarter of total costs in 2018.

- After peaking at €108m in 2008, capital expenditure on R&D has been declining ever since to reach €28m in 2018. This is primarily due to the reduction in funding under the Higher Education Authority's Programme for Research in Third Level Institutions (PRTLII).

Figure 23: Percentage share of type of costs, 2008 and 2018



Source: DETE HERD Data

- Figure 23 shows the breakdown of costs for R&D in the higher education sector in 2008 and 2018.
- The split has changed over the decade, with pay costs accounting for 63% in 2008 compared to 70% in 2018 and non-pay costs having a larger share of the total R&D budget in 2018.



Table 7: Types of costs by fields of science, 2018 (€ million)

	Pay costs	% of total	Non-pay costs	% of total	Capital costs	% of total	Total
Natural Sciences	138	67%	60	29%	7	3.4%	206
Engineering and Technology	149	70%	55	26%	8	4.0%	212
Medical and Health Sciences	128	70%	50	27%	4	2.2%	182
Agricultural Science	7	64%	4	36%	0	0.5%	11
Social Sciences	123	81%	29	19%	1	0.5%	153
Humanities	41	87%	6	12%	0	0.9%	47
Not classified	31	46%	28	42%	8	11.6%	66
<b>Total</b>	<b>616</b>	<b>70%</b>	<b>232</b>	<b>26%</b>	<b>28</b>	<b>3.2%</b>	<b>876</b>

Source: DETE HERD Data

- Within each field of science, pay costs account for the largest proportion of R&D costs in 2018; ranging from 87% for Humanities to 64% for Agricultural Science.
- Excluding the 'Not Classified' category, the fields of Agricultural Science (36%) accounted for the highest proportion of non-pay costs.
- The field of Engineering and Technology had the highest proportion of capital costs, accounting for 4% of the R&D spend in 2018.

## Appendix 1: Detailed Fields of Science Tables

	Fields of Science	€m
Natural Sciences	Mathematics	15.7
	Computer and information sciences	64.8
	Physical sciences	23.5
	Chemical sciences	32.8
	Earth and related environmental sciences	8.9
	Biological sciences	54.9
	Other natural sciences	4.9
		<b>205.5</b>
Engineering and Technology	Civil engineering	22.7
	Electrical, electronic and information engineering	29.2
	Mechanical engineering	35.6
	Chemical engineering	7.3
	Materials engineering	19.3
	Medical engineering	1.3
	Environmental engineering	19.4
	Environmental biotechnology	0.0
	Industrial biotechnology	1.3
	Nano-technology	52.7
	Other engineering and technologies	10.1
		<b>199.0</b>
Medical and Health Sciences	Basic medicine	56.9
	Clinical medicine	64.4
	Health sciences	53.6
	Health biotechnology	1.4

	Other medical sciences	5.4
		<b>181.7</b>
Agricultural Sciences	Agriculture, forestry and fisheries	17.4
	Animal and dairy science	3.9
	Veterinary science	8.3
	Other agricultural sciences	0.1
		<b>29.6</b>
Social Sciences	Psychology	10.5
	Economics and business	60.9
	Educational sciences	29.5
	Sociology	5.2
	Law	7.3
	Political science	8.3
	Social and economic geography	22.3
	Media and communications	2.7
	Other social sciences	2.1
		<b>148.9</b>
Humanities	History and archaeology	9.1
	Languages and literature	20.5
	Philosophy, ethics and religion	4.0
	Art (arts, history of arts, performing arts, music)	7.0
	Other humanities	6.0
		<b>46.7</b>
Not classified		<b>64.7</b>
HERD		<b>876.1</b>

Source: DETE HERD Data

## Appendix 2: Note on GDP, GNP and GNI\*

### Background

Globalisation presents significant challenges in terms of measuring economic activity. While this is the case in most advanced economies, the issues are particularly acute in an Irish context, given the large multinational footprint.

For policy-makers, there are additional challenges, most notably related to interpreting the real-time information embedded in standard, internationally recognised metrics such as Gross Domestic Product (GDP) and Gross National Income (GNI). Movements in these aggregates have become increasingly disconnected from actual trends in living standards in Ireland.

New Irish-specific measures of activity – most notably ‘modified Gross National Income’ or GNI\* – attempt to control for (part of) the impact of globalisation on Irish macro-economic statistics.

GDP measures the total output of the economy in a period i.e. the value of work done by employees, companies and self-employed persons. This work generates incomes - the total income remaining with Irish residents is the GNP and it differs from GDP by the net amount of incomes sent to or received from abroad. In Ireland's case, the amount belonging to persons abroad has exceeded the amount received from abroad, due mainly to the profits of foreign-owned companies, and therefore, GNP is less than GDP.

Gross National Income (GNI) is a very similar concept to that of GNP – the main difference between the two aggregates is that GNI adjusts domestic incomes for subsidies from and taxes paid to the EU.

Modified GNI (or GNI\*) is defined as GNI less the effects of the profits of re-domiciled companies and the depreciation of intellectual property products and aircraft leasing companies.

Because the modified GNI aggregate is a better approximation of the size of the Irish economy, it is an important indicator for fiscal purposes, especially for ‘ratio analysis’ where it provides significant added value. For example, the Department of Finance has frequently highlighted the shortcomings of the debt-to-GDP ratio as a measure of the debt burden. Now that the modified measure is available, the Department of Finance supplements the Government’s European budgetary requirements with debt-to-GNI\* figures. Similarly, in this report, R&D expenditures as a percentage of GNI\* are calculated to see the trend over time and to provide a more reliable benchmark against other countries. This is in addition to the calculations as a percentage of GDP and GNP.

See full explanatory note on GDP and GNI\* from the Department of Finance here:

<https://www.gov.ie/en/publication/6a7788-gdp-and-modified-gni-explanatory-note/>.