

# Survey of R&D in the Higher Education Sector 2014-2015



An Roinn Post, Fiontar agus Nuálaíochta  
Department of Jobs, Enterprise and Innovation

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## 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 2014/15. Expenditures and human resources devoted to research work in the higher education sector are measured biennially in the HERD survey. The sector includes the universities, institutes of technology, and other institutes that are in receipt of public funding and engaged in research and development activities.

The main findings of the HERD 2014 survey are now summarised.

Table 1 - Summary of key results, 2004-2014, current prices

	2004	2006	2008	2010	2012	2014
Higher education expenditure on R&D (HERD) (€millions)	492.0	600.5	749.8	708.3	664.4	730.1
HERD as a % of GNP	0.37	0.47	0.51	0.47	0.47	0.45
Ireland's rank out of 42 countries	19	19	15	15	18	20
Total researchers in HE sector (FTE)	7,899	7,353	11,246	12,140	12,117	12,836
Researchers (HC) in the HE sector per 1000 labour force - Ireland's rank out of 37 countries	6	8	5	7	8	6
Percentage of HERD financed by industry	4.6%	2.7%	3.8%	3.9%	3.3%	4.4%

Source: OECD, Main Science and Technology Indicators, February 2017

- Total expenditure on R&D in the higher education sector in 2014 amounted to €730.1 million. HERD increased by 52% between 2004 and reached its peak in 2008 at €749.8m. Since 2008 HERD declined to €664.4m in 2012, but increased by 9.9% to €730.1m in 2014.
- HERD as a percentage of GNP has fallen from 0.51% in 2008 to 0.45% in 2014.
- Ireland's rank out of 42 OECD countries for HERD as a percentage of GNP has declined from 18<sup>th</sup> place in 2012 to 20<sup>th</sup> place in 2014.
- The total number of full-time equivalent (FTE) researchers (excluding technical and administrative support staff) has increased by 6% to 12,836 in 2014.
- Ireland's ranked 6<sup>th</sup> out of 37 OECD countries on headcount researchers per 1,000 of the labour force in 2014.
- UCC has the largest spend on R&D in the country at €122m in 2014, followed by TCD at €119m, UCD at €117m, NUIG at €96m and UL at €80m. These five institutions together account for almost three quarters of HERD in 2014.
- The percentage of HERD financed by industry increased from 3.3% in 2012 to 4.4% in 2014

## Caveats

- PhD students have been included in the researchers category for the first time in the current survey in accordance with the OECD Frascati manual 2015 definitions. This explains the large difference in researcher numbers since the 2012 HERD survey.
- Higher Education Institutes were asked to include the portion of private fees from students that was allocated to R&D in the 'own higher education funds' category for the first time in the current survey.
- There was an increase in the number of Institutes of Technology providing Block Grant data in the current survey. DJEI calculates the R&D component of the Block grant based on the time spent on research for academic staff. In the previous HERD survey Block Grant data for all the IoTs was not included.
- The total HERD figure for 2012 has been revised to include Block Grant data for DIT, resulting in an upward revision from €640m to €664m.
- One of the Institutes of Technology did not provide a financial return so the 2012 data for that institute was used as a proxy in this 2014 survey.
- The Universities and the Institutes of Technology were asked to code the Field of Science for the relevant Departments/Schools. Prior to the 2012 survey DJEI classified the Field of Science based on the Department/School. This has led to differences in classifications in different years, and therefore direct comparisons between years for the Field of Science data should be treated with caution.
- 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.

The Department of Jobs, Enterprise and Innovation would like to thank all the respondents to this survey who have taken the time to gather information and complete the data requests for this key area of Government policy.

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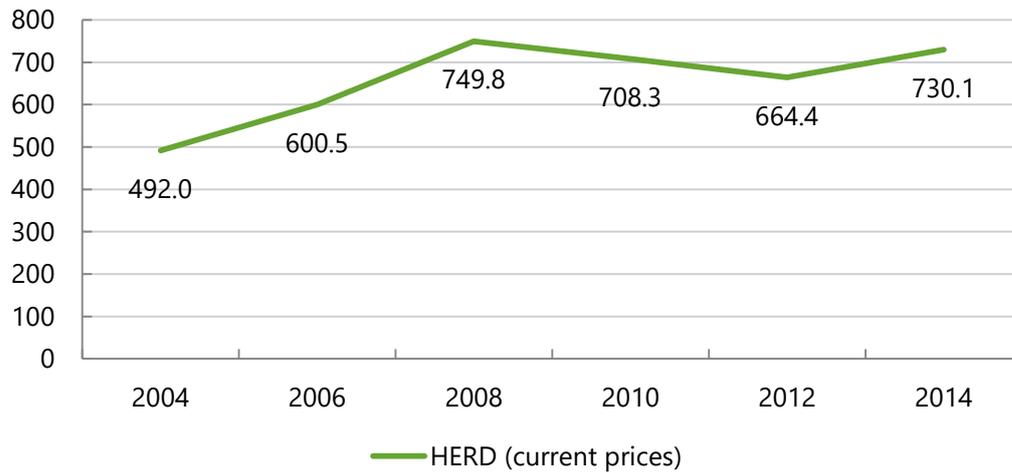
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## Chapter 1: General trends in higher education R&D expenditure

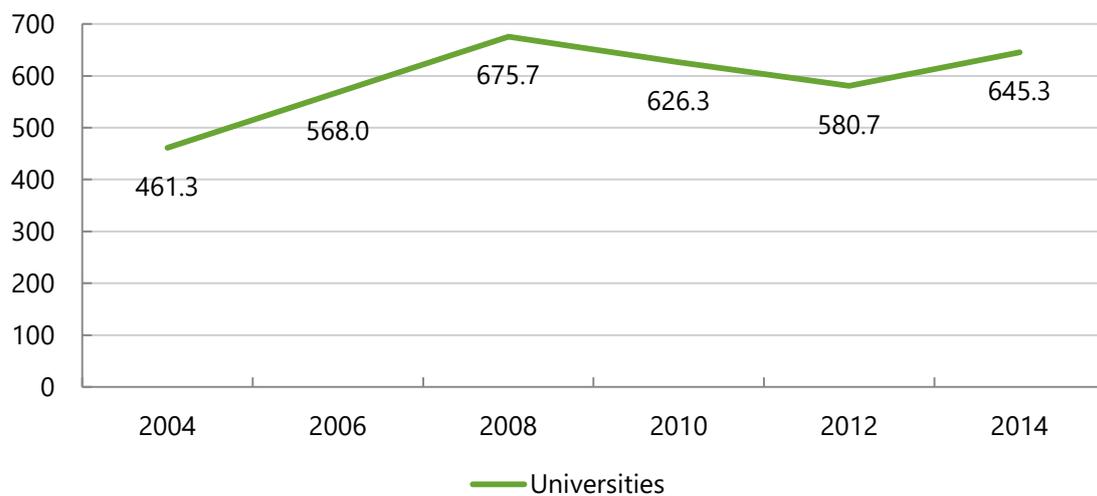
Figure 1: Trend in HERD expenditure, 2004-2014, in current prices, (€ millions)



Source: DJEI HERD data

- Total expenditure on R&D in the Higher Education sector (HERD) increased by 52% between 2004 and 2008, from €492m to €749.8m respectively, reaching a peak over the 10 year period in 2008 and declining by 2.6% to €730.1m in 2014.
- HERD has increased by 48% between 2004 and 2014.

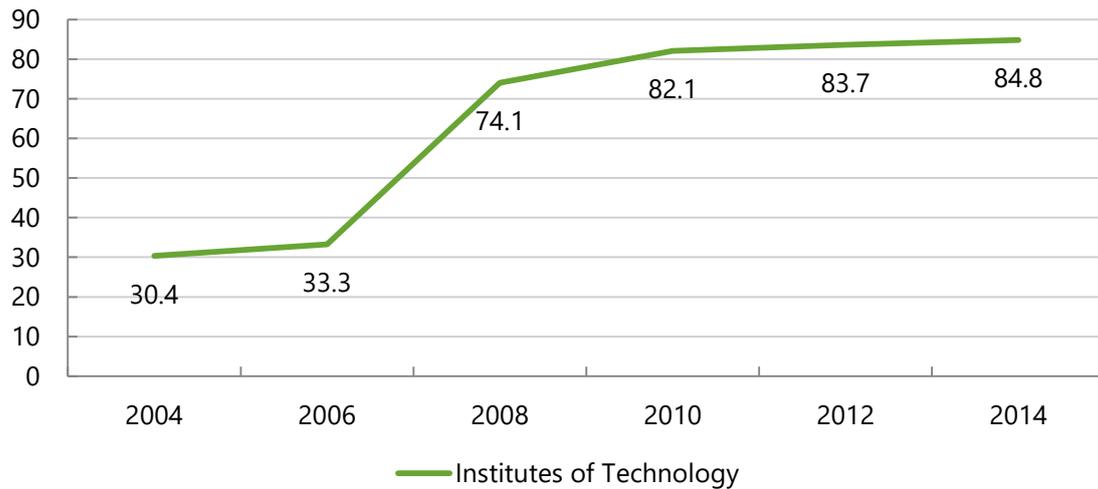
Figure 2: Research expenditure by Universities 2004-2014, in current prices, (€ millions)



Source: DJEI HERD data

- Expenditure on R&D in the university sector increased from €461.3m in 2004 to €675.7m in 2008, an increase of 46%. HERD in this sector was at its highest point over the 10 year period in 2008 and declined by 4.5% to 645.3m in 2014.
- Spend on R&D in the university sector has increased by 40% over the 10 year period.
- The university sector accounted for 88% of total HERD in 2014.

Figure 3: Research expenditure by Institutes of Technology, 2004-2014, in current prices, (€ millions)

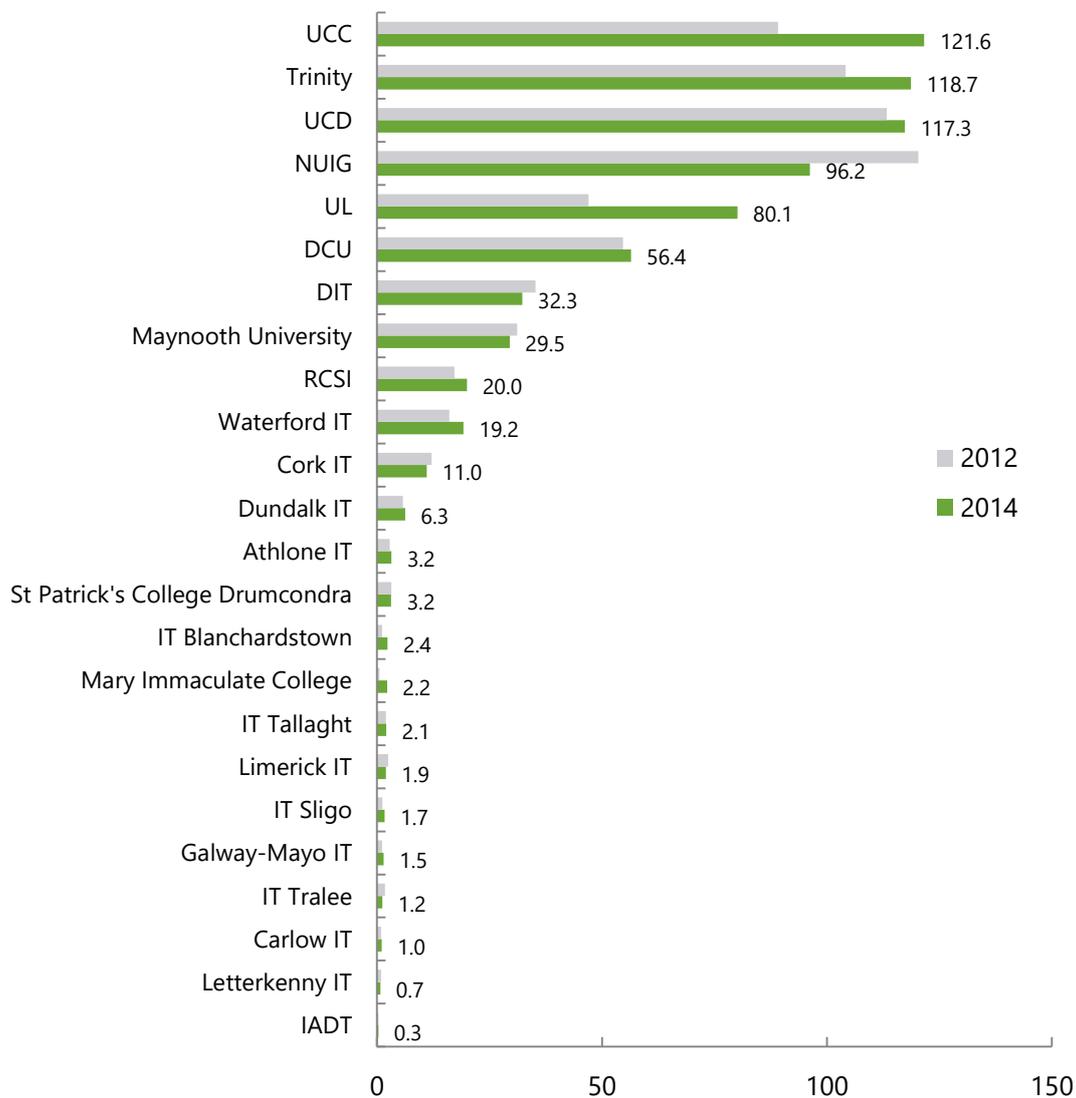


Source: DJEI HERD data

- R&D expenditure in the Institutes of Technology increased from €30.4m to €84.8m between 2004 and 2014, the highest level recorded so far.
- The data includes the portion of the Block grant allocated to R&D for the Institutes of Technology in 2014 and the 2012 HERD figures have been revised to include the R&D portion of the Block grant<sup>1</sup> portion for DIT. The inclusion of the Block grant data has kept the figures steady for the IoT sector whereas the Universities experienced a decline in R&D funding in 2012.
- Expenditure on R&D in this sector saw an almost threefold increase between 2004 and 2014.
- The Institutes of Technology sector accounted for 12% of total HERD in 2014.

<sup>1</sup> 2014 is the first year we included Block grant data for the IoTs and the 2012 data was revised to include Block grant data for DIT. Block grant data was received and included for 5 IoTs in 2014 survey.

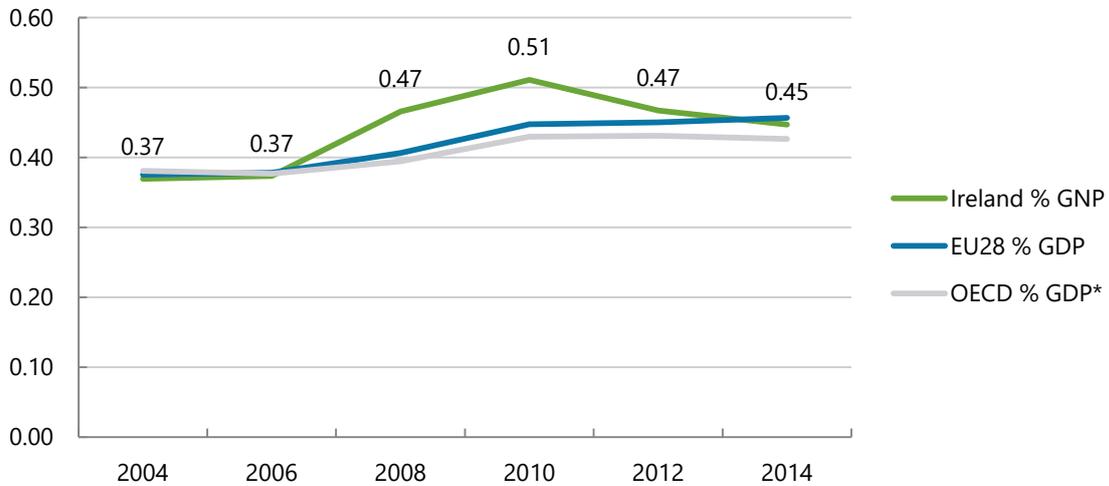
Figure 4: Research expenditure by Universities and Institutes of Technology 2012 &amp; 2014, (€ millions)



Source: DJEI HERD data

- UCC spent €121.6m on in-house R&D in 2014, making UCC the higher education institute with the highest spend on R&D in 2014. This included capital funding of almost €19m on research facilities including Beaufort Research.
- TCD and UCD had expenditures of €119m and €117m respectively in 2014.
- In the case of the Institutes of Technology, expenditure on R&D for DIT, WIT and CIT amounted to €32.3m, €19.2m and €11m respectively in 2014.
- The 2012 figures are also shown including the revised expenditure for DIT to include the R&D portion of the Block Grant.
- There is some volatility in expenditure in the top R&D performers which can be explained by R&D capital expenditure projects in a given year.

Figure 5: HERD as a percentage of GNP/GDP, 2004-2014, Ireland, OECD and the EU28



Source: OECD, Main Science and Technology Indicators, February 2017

- HERD as a percentage of GNP (2014) for Ireland increased from 0.37% in 2004 to a high of 0.51% in 2010 and declined to 0.45% in 2014. This is on a par with the EU28 average in 2014 of 0.46% and above the OECD average of 0.43%.
- It should be noted that the HERD intensity rate has slipped in 2014 owing to significant GDP/GNP growth in that year, despite the increase in HERD expenditure.

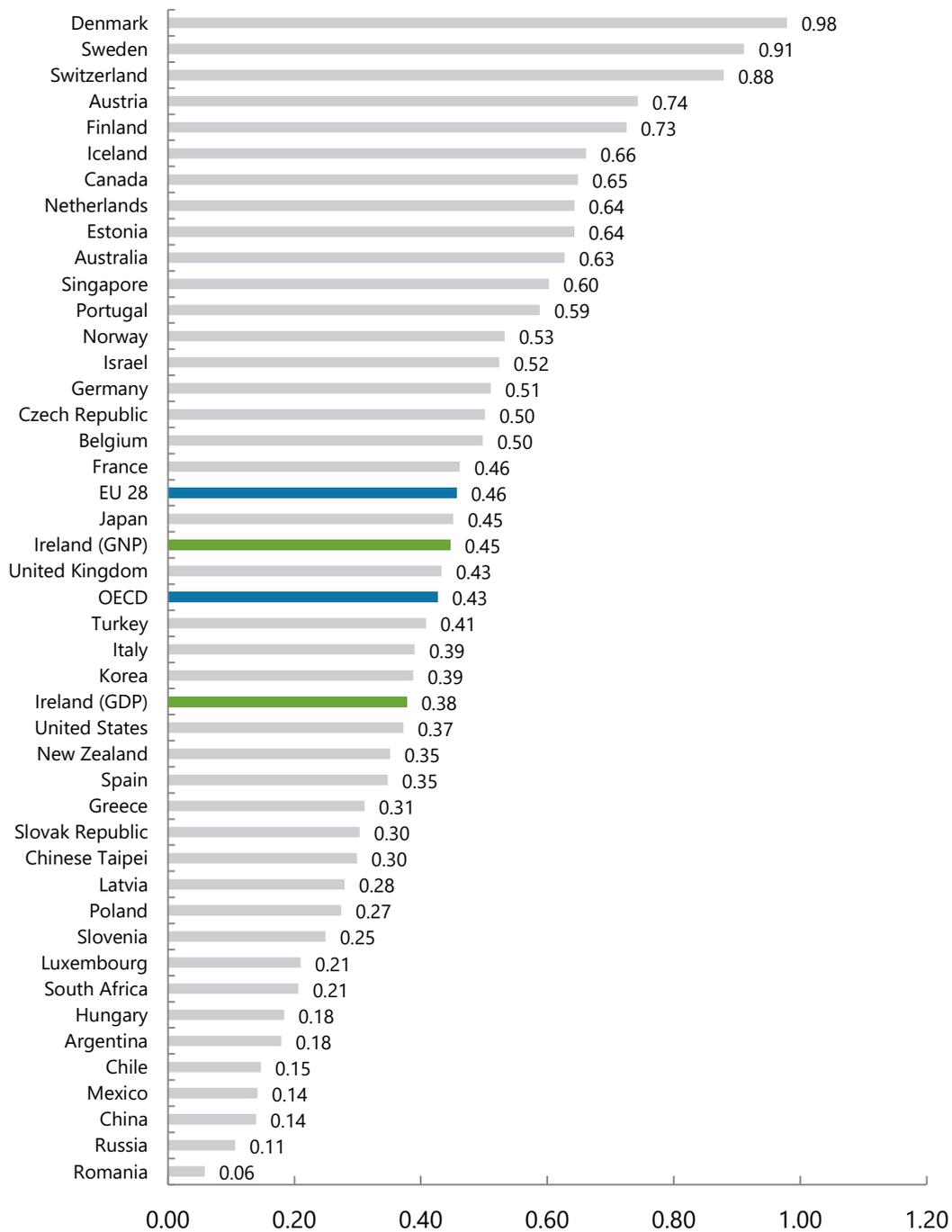
Figure 6: HERD as a % of GNP - Ireland's ranking in the OECD, 2004-2014



Source: OECD, Main Science and Technology Indicators, February 2017

- Ireland scored 20<sup>th</sup> out of 42 countries on HERD as a percentage of economic activity in 2014, dropping from 18<sup>th</sup> place in 2012. This is due to growth of 15% in GNP outstripping growth in HERD of almost 10% between 2012 and 2014.

Figure 7: HERD as a percentage of GDP (&amp; Ireland GNP) - 2014 or latest available data



Source: OECD, Main Science and Technology Indicators, February 2017

- In 2014, the top performers were Denmark and Sweden, spending 0.98% and 0.91% of their respective GDP on R&D in the higher education sector. Switzerland at 0.88% scored 3<sup>rd</sup> place. The UK spends 0.43%, close to the Irish level of HERD intensity at 0.45%, while the USA spends 0.37%.

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

Table 2: Total researchers by performer, 2008-2014<sup>2</sup> (headcount)

Sector	Academic Staff	Principal Investigators	Post-doctoral Fellows	Contract Lecturers	Contract Researchers	PhD/Masters students	Total Researchers	Technicians	Other staff	Total research Personnel
Institutes of Technology	2,955	54	112	225	370	841	<b>4,557</b>	172	168	<b>4,896</b>
Universities	3,169	1,503	1,628	820	1,050	5,572	<b>13,742</b>	805	2,261	<b>16,808</b>
Total - 2014	6,124	1,557	1,740	1,045	1,419	6,413	<b>18,299</b>	976	2,429	<b>21,704</b>
Total - 2012	5,642	1,265	1,818	1,074	1,423	6,115	<b>17,337</b>	1,007	3,255	<b>21,599</b>
Total - 2010	6,155	951	1,771	783	1,398	6,411	<b>17,469</b>	1,115	4,241	<b>22,825</b>
Total - 2008	5,994	1,032	2,278	1,396	911	5,072	<b>16,682</b>	1,079	2,798	<b>20,559</b>

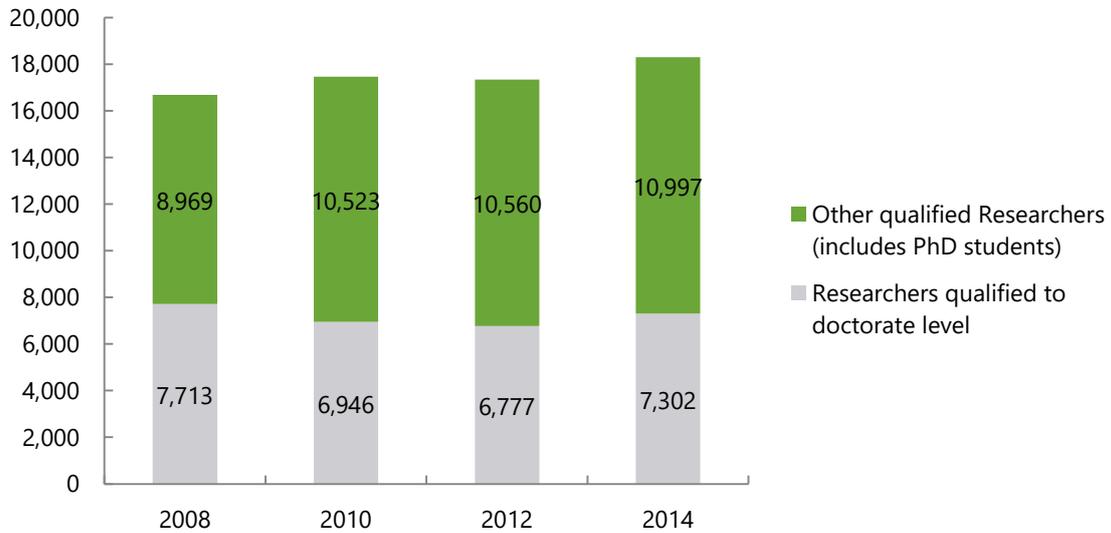
Source: DJEI HERD data

For the first time PhD/Masters students were included in the definition of researchers in the 2014 HERD survey. This is permitted according to the Frascati manual 2015 if they are receiving wages/salaries from the unit performing R&D. Data on PhD students were collected in the past but were not included in the 'total researchers' figure. The data has been revised for previous years as shown in Table 2.

- There were 18,299 researchers in the higher education sector (headcount) in 2014, an increase of 5.5% since 2012.
- There were 13,742 researchers in the university sector in 2014 (accounting for 75% of total researchers in the higher education sector) and 4,557 researchers in the Institutes of Technology.
- Overall, there were 21,704 research personnel in the higher education sector in 2014 which was relatively unchanged since 2012.
- While the number of researchers has increased slightly since 2012, the number of support staff (technicians, administration and other staff) has been declining since 2012.

<sup>2</sup> The data series starts in 2008 as Principal Investigators were added to the Researchers category in 2008 and data prior to this is not comparable.

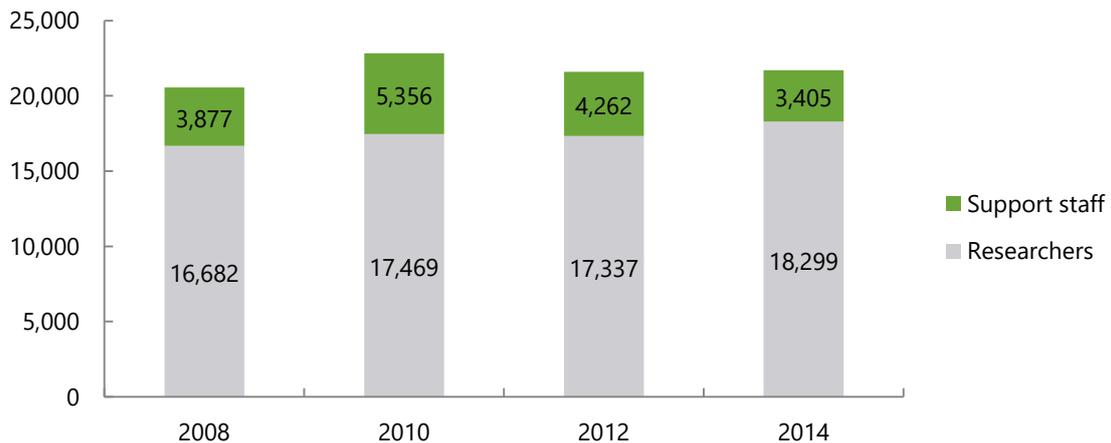
Figure 8: Researchers by qualification, 2008-2014 (headcount)



Source: DJEI HERD Data

- 7,302 researchers were doctorate holders in 2014 in the higher education sector, an increase of 8% since 2012 and a decline of 5% since 2008.
- 10,997 other qualified researchers (with educational attainment below doctorate level and including PhD students) were employed in 2014, an increase of 23% since 2008.

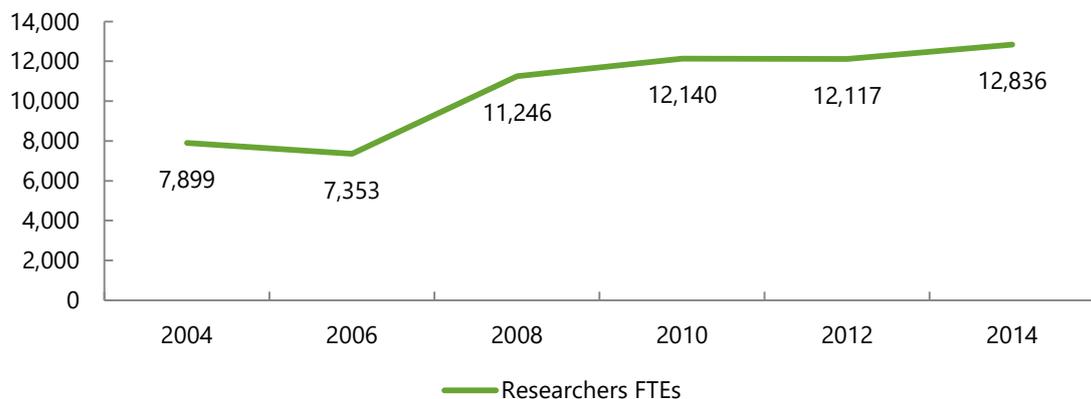
Figure 9: Researchers and support staff, 2008-2014 (headcount)



Source: DJEI HERD Data

- There were 18,299 researchers (headcount) in the higher education sector, an increase of 10% since 2008.
- There was 3,405 support staff in the higher education sector in 2014, a decline of 36% since 2010.

Figure 10: Total researchers in the higher education sector, 2004-2014 (FTE)



Source: DJEI HERD Data

- There were 12,836 full-time equivalent (FTE) researchers in the higher education sector in 2014, a 6% increase since 2012 and the highest number of FTE researchers over the 10 year period.

Table 3: Researchers by occupation and field of science in the higher education sector, FTEs, 2014

Sector	Total Researchers	Total Support Staff	Total Research Personnel
Natural Sciences	4,051	375	4,426
Engineering and Technology	2,284	228	2,512
Medical and Health Science	2,413	337	2,750
Agricultural Sciences	426	64	489
Social Sciences	2,573	345	2,917
Humanities	1,010	84	1,094
Not classified	80	579	659
Total - 2014	12,836	2,011	14,847
Total - 2012	12,117	933	13,050
Total - 2010	12,140	771	12,911

Source: DJEI HERD Data

- There were 14,847 FTE research personnel in the higher education sector in 2014, an increase of 14% since 2012.

- 4,426 FTE research personnel were employed in Natural Sciences in 2014. This field of science accounts for almost one-third of all research personnel.
- 2,917 FTE research personnel were employed in Social Sciences in 2014, accounting for 20% of research personnel.
- Medical and Health Sciences accounted for 19% of the total FTE research personnel, with 2,750 employed in 2014.
- There were 2,512 FTE research personnel employed (17% of total) in Engineering and Technology in 2014.

Table 4 gives the equivalent information by headcount and indicates a total of 21,704 research personnel in the higher education sector in 2014, up from 21,598 in 2012.

Table 4: Researchers by occupation and field of science in the higher education sector, headcount, 2014

Sector	Total Researchers	Total Support Staff	Total Research Personnel
Natural Sciences	4,937	705	5,642
Engineering and Technology	3,293	430	3,722
Medical and Health Science	3,177	583	3,761
Agricultural Sciences	528	113	641
Social Sciences	4,467	628	5,096
Humanities	1,803	147	1,950
Not classified	93	798	891
Total - 2014	18,299	3,405	21,704
Total - 2012	17,337	4,261	21,598
Total - 2010	17,469	5,356	22,825

Source: DJEI HERD Data

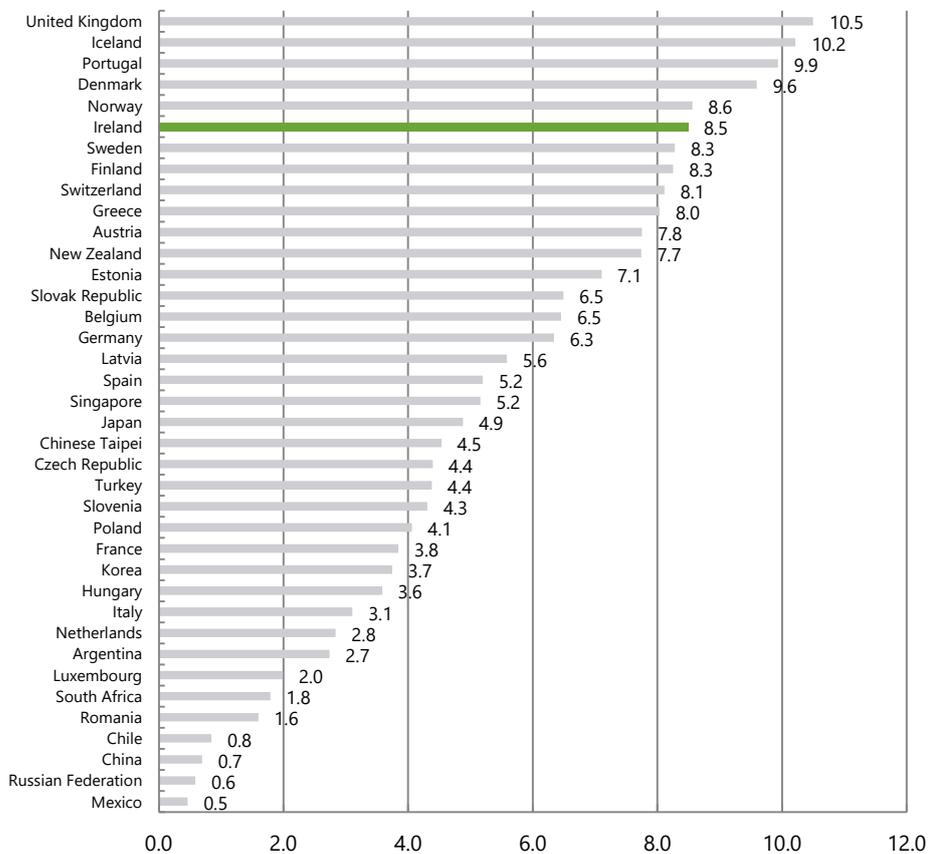
Figure 11: Ireland's ranking, higher education researchers (headcount) per 1,000 of the labour force, 2004 - 2014 (or latest available data)



Source: OECD, Main Science and Technology Indicators, February 2017

Figures 11 and 12 illustrate Ireland's ranking against other OECD countries when comparing the number of researchers in the higher education sector per 1,000 of the labour force. In 2014, Ireland was ranked 6th out of 38 countries, up 2 places from 8<sup>th</sup> in 2012. The UK reported the highest number of researchers per thousand of the labour force at 10.5.

Figure 12: Higher education researchers (HC) per 1,000 of the labour force, 2014 (or latest available data)



Source: OECD, Main Science and Technology Indicators, February 2017

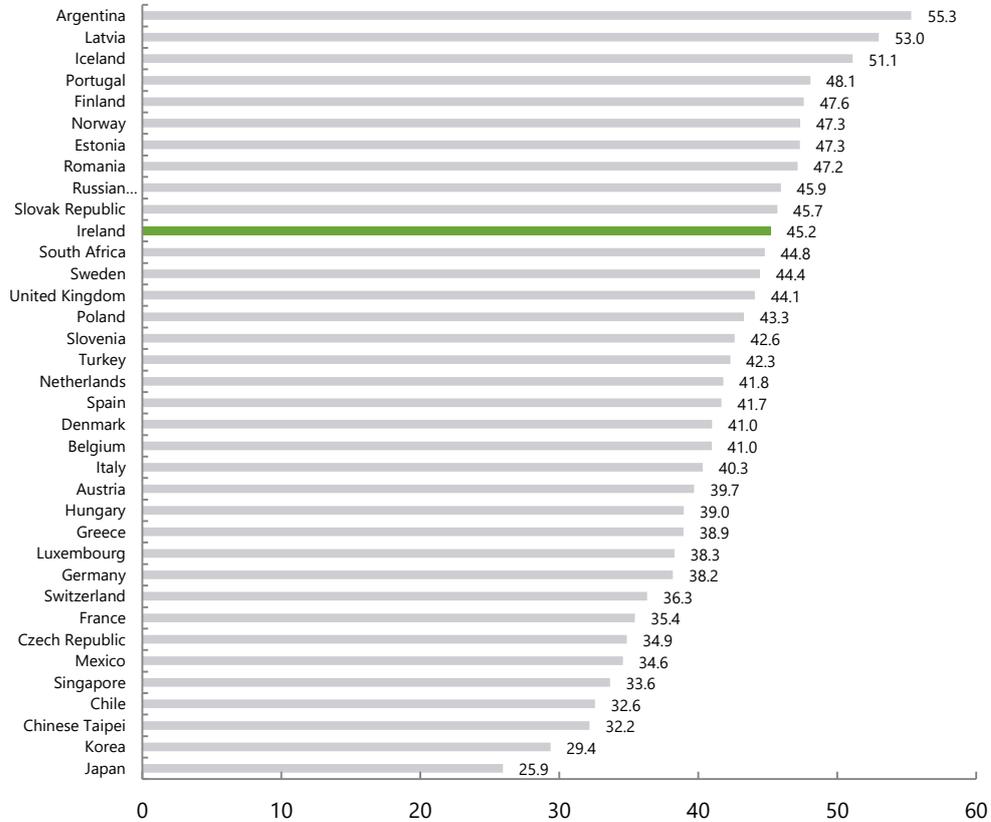
Figure 13: Female researchers as a % of total researchers (headcount), 2004-2014



Source: OECD, Main Science and Technology Indicators, February 2017

Figures 13 and 14 capture Ireland’s place internationally with respect to female researchers as a percentage of total researchers. Ireland performs well, ranking 11th out of 36 countries on this indicator. Some 45.2 per cent of all researchers in Ireland are female. Argentina and Latvia are the current leaders with female researchers accounting for 55.3 per cent and 53 per cent of all researchers in 2014 respectively.

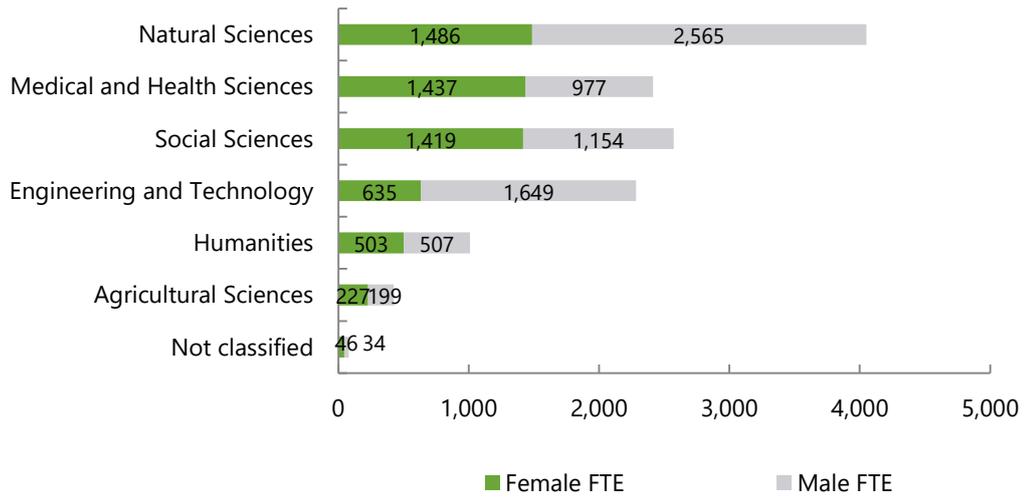
Figure 14: Female researchers as a % of total researchers (headcount), 2014 or latest available data



Source: OECD, Main Science and Technology Indicators, February 2017

Figure 15 below shows the number of FTE male and female researchers by field of science in 2012. In the field of medical and health sciences, female researchers account for 60 per cent of total researchers, contrasting with the field of engineering and technology where male researchers account for 72 per cent of total researchers.

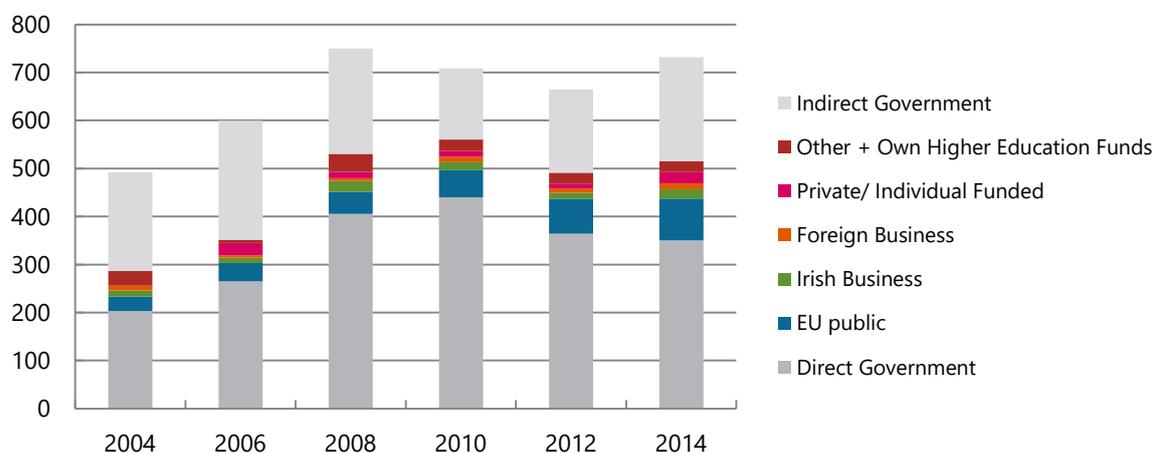
Figure 15: Female and male FTE researchers, 2014



Source: DJEI HERD Data

## Chapter 3: Source of funding of HERD expenditure

Figure 16: Sources of research funding<sup>3</sup>, 2004-2014, in current prices (€ millions)



	2004	2006	2008	2010	2012	2014
Direct Government	203	265	405	440	364	350
Indirect Government	205	248	219	148	174	217
EU public	30	38	46	57	73	87
Irish Business	13	11	23	16	13	19
Foreign Business	10	5	6	11	9	13
Private/ Individual Funded		26	13	12	10	23
Other + Own Funds	31	6	37	24	22	23
Total	492	600	750	709	665	732

Source: DJEI HERD Data

Direct government funding amounted to €350m in 2014, accounting for 48% of total HERD in 2014. Since 2010, there has been a significant reduction in direct government R&D funding of €90m (-20%); there was a reduction of €14m (-4%) since 2012.

The most significant reductions in direct government funding since 2012 were:

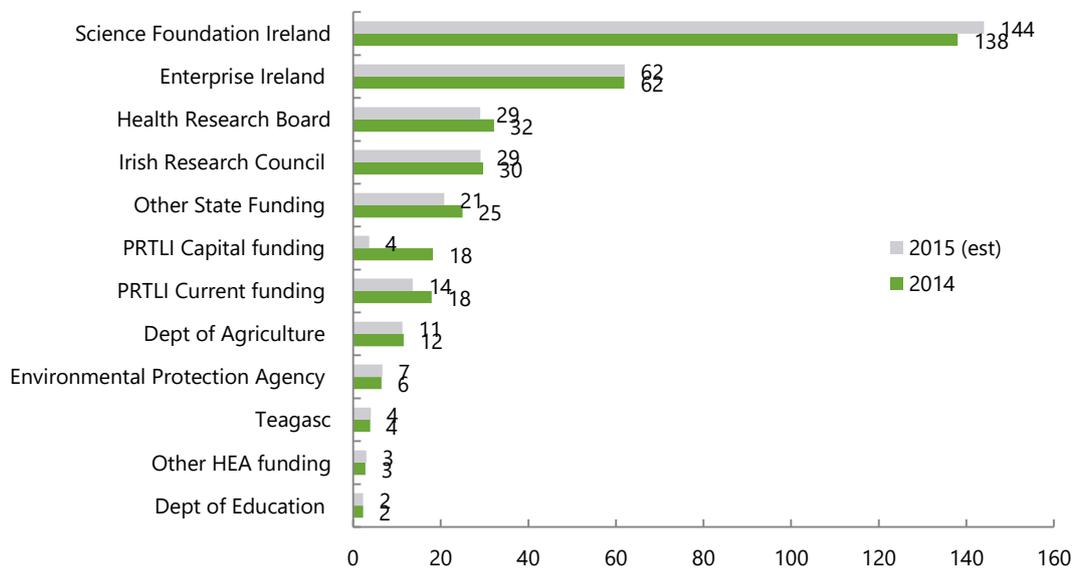
- €40m – other HEA funding
- €6m – PRTL current funding

<sup>3</sup> Total funding of R&D amounted to €732.2 m and expenditure on R&D amounted to €730.1 m. Slight differences can be noted by field of science between funding and expenditure totals. This could be explained by interdepartmental loans in the institutes to cover shortfalls in funding which is later repaid when funding comes through.

These reductions were offset somewhat by increased funding of:

- €11m from Science Foundation Ireland (SFI)
  - €10m of PRTL I capital funding
  - €5m from Enterprise Ireland
  - €4m from the Health Research Board (HRB)
- Since 2004, however, direct government funding increased by 72%, from €203m to €350m.
  - The portion of the block grant allocated to research (indirect Government funding) increased by 25% since 2012 from €174m to €217m due to higher levels of research activity reported and more IoTs reporting block grant details since 2012. Indirect funding accounts for 30% of total funding for HERD in 2014, up from a 26% share in 2012.
  - EU funding increased from €73m to €87m between 2012 and 2014 (a 20% increase), and has increased threefold since 2004.
  - Funding by Irish and foreign business amounted to €19m and €13m respectively in 2014, cumulatively accounting for 4.4% of total HERD.
  - Private funding increased by €13m since 2012 to €23m in 2014, and other and own funds accounted for €23m in 2014.

Figure 17: Sources of direct government research funding (€ millions) 2014 and 2015 (estimate)

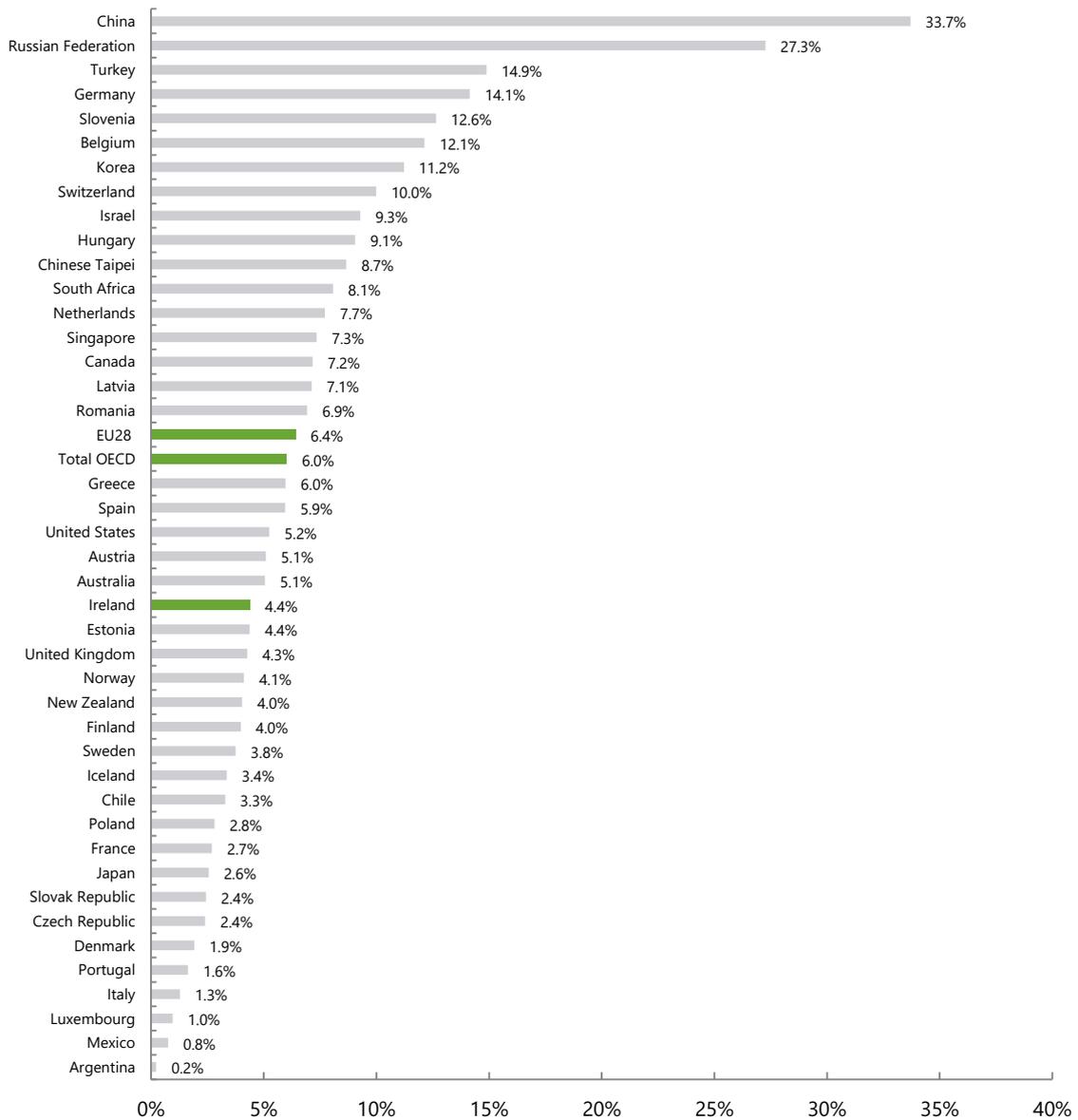


Source: DJEI HERD Data

- SFI accounted for 39% of total direct government funding (€138m) in 2014 and the HEIs expected funding from SFI of €144m in 2015.
- Funding from Enterprise Ireland to the higher education sector amounted to €62m in 2014, accounting for 18% of total direct Government funding, and the HEIs estimated the same level of funding in 2015.

- The Health Research Board funded R&D to the value of €32m in 2014 and the 2015 estimate is €29m.
- Research funded by the Irish Research Council amounted to €30m in 2014 and is estimated to remain at almost the same level (€29m) in 2015.
- Other State funding amounted to €25m in 2014 and is expected to fall to €21m in 2015.
- PRTL capital funding amounted to €18m in 2014 and is estimated to fall to €4m in 2015, due to two significant capital projects in UCC and UL nearing completion in 2015.
- PRTL current funding amounted to €18m in 2014 and is expected to fall to €14m in 2015.

Figure 18: Percentage of HERD financed by industry in selected OECD Countries, (2014 or latest available data)



Source: OECD, Main Science and Technology Indicators, February 2017

- 4.4% of total HERD in 2014 was financed by industry in Ireland, significantly higher than 3.3% reported in the 2012 but considerably below the EU28 average of 6.4% and the OECD average of 6%. China reported the highest proportion of R&D in the higher education sector financed by industry at 33.7%. Notably, some of the countries with the highest R&D intensities e.g. Denmark, Sweden, and Finland all had lower levels of R&D financed by industry than Ireland.

Table 5: Sources of research funding by field of science (€ millions), 2014

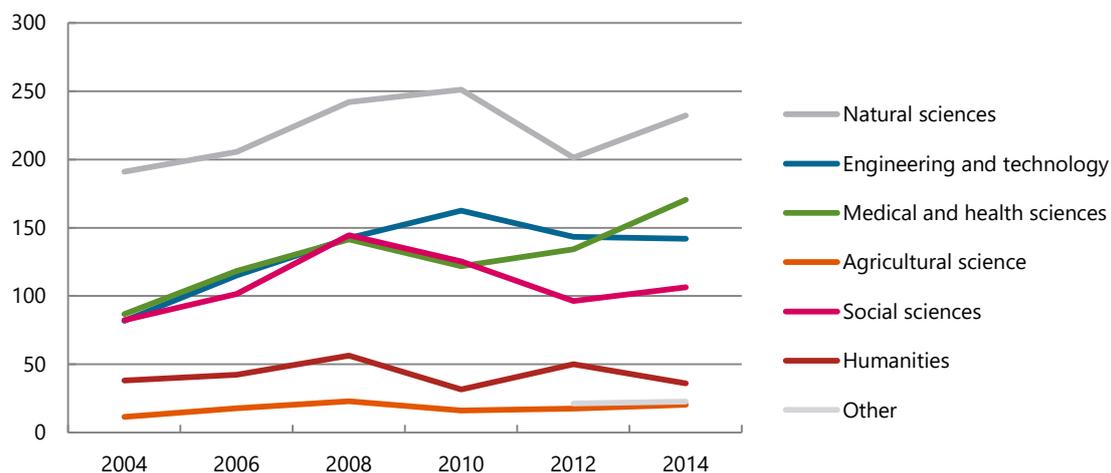
Field of Science	Direct Sources of Funds				Indirect Government (HEA Block Grant)	Total
	Irish Public Research	EU	Industry	Other and Own		
Natural Sciences	127.2	33.1	9.8	19.1	43.1	232.3
Engineering and Technology	82.9	24.3	8.3	2.4	25.7	143.5
Medical and Health Sciences	83.3	15.0	6.6	19.8	45.6	170.4
Agricultural Sciences	9.6	2.4	1.2	0.2	7.1	20.4
Social Sciences	23.5	8.9	4.2	3.1	67.6	107.3
Humanities	9.5	2.7	0.4	0.6	22.8	36.0
Not classified	14.0	0.9	1.6	0.8	5.0	22.3
Total	350.0	87.2	32.1	45.9	216.9	732.2
% of Total	48%	12%	4%	6%	30%	100%

Source: DJEI HERD Data

- Overall, 48% of total HERD is funded from direct Government sources, 12% from EU funds, 10% from Industry and Other Sources and 30% from the HEA Block Grant.
- For most fields of science the majority of funding for R&D was from Irish public research sources in 2014, with the exception of social sciences and humanities where the majority of funding came from the HEA block grant.
- EU funding accounted for 17% of total funding for Engineering and Technology and 14% of funding for Natural Sciences.
- €26.5m of funding for R&D in Medical and Health Science (16%) were from Industry and Other Sources in 2014.

## Chapter 4: HERD Expenditure by Field of Science

Figure 19: Higher education expenditure on R&D by field of science in current prices, (€millions), 2004-2014



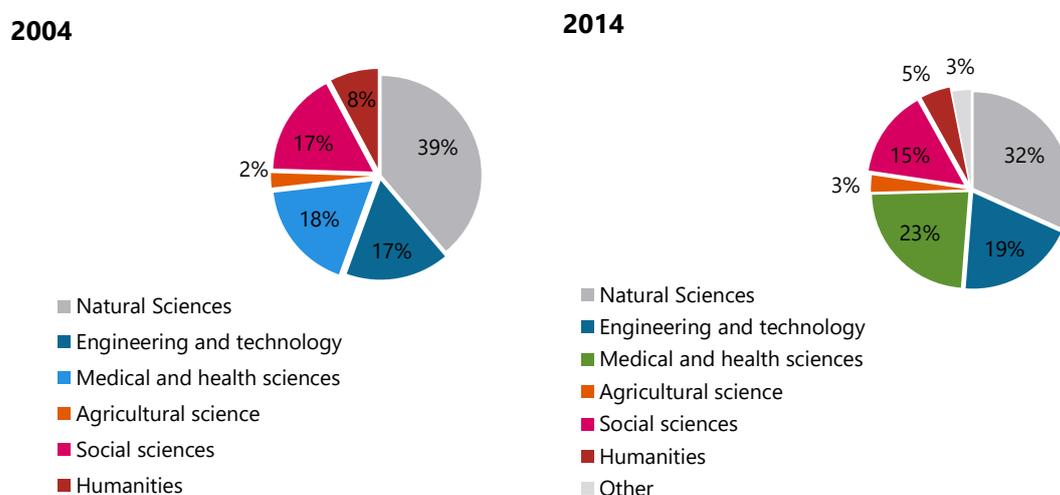
	2004	2006	2008	2010	2012	2014
Natural sciences	191	206	242	251	201	232
Engineering and technology	82	115	142	163	143	142
Medical and health sciences	87	118	142	122	134	170
Agricultural science	12	18	23	16	18	20
Social sciences	82	102	145	125	96	106
Humanities	38	43	56	32	50	36
Other					21	23
Total	492	601	750	708	664	730

Source: DJEI HERD Data

- The largest proportion of R&D expenditure was in the field of natural sciences in 2014, a constant trend since 2004. R&D expenditure increased from €201m in 2012 to €232m in 2014.
- Medical and Health Sciences accounted for the next highest proportion of total R&D expenditure in 2014, with an increased spend of €36m since 2012. The level of R&D expenditure in the Medical Sciences has been increasing since 2010.
- Engineering and technology was the field of science with the next largest R&D expenditure in 2014, although expenditure declined in 2012 and has remained at the same level in 2014 (€142m). Spend on R&D had been steadily increasing in the engineering and technology field up to 2010.

- R&D expenditure in the field of social science steadily increased up until 2008 (€145m) but had been declining until 2012. Expenditure increased by 11% in 2014. This should be regarded with caution (see caveats on Page 3), as previously the 'other' or 'not classified' category was coded under 'Social Sciences'.
- Expenditure on R&D in the Humanities field amounted to €36m in 2014, down from €50m in 2012.
- Agricultural Sciences recorded an increase of €2m on R&D expenditure since 2012, and €8m since 2004. In 2008, R&D expenditure in the agricultural sciences peaked at €23m.

Figure 20: Share of total R&amp;D expenditure by field of science, 2004 and 2014

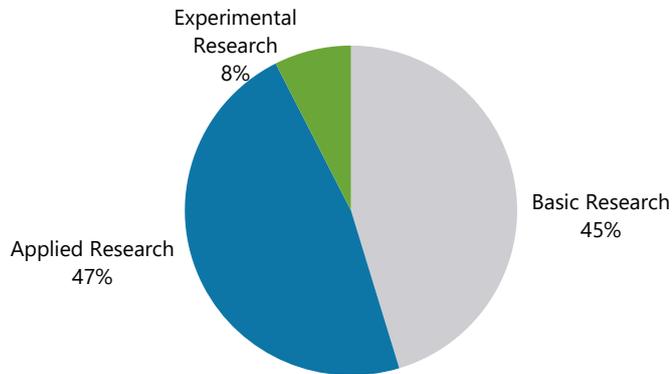


Source: DJEI HERD Data

- In absolute terms HERD has increased from €492m in 2004 to €730m in 2014, and expenditure is higher for almost every field of science (with the exception of Humanities) in 2014 than in 2004.
- When comparing the share of HERD by field of science in 2004 and 2014:
  - Natural Sciences dropped from 39% to 32%;
  - Engineering and Technology increased from 17% to 19%;
  - Medical and Health Sciences increased from 18% to 23%;
  - Agricultural Science increased from 2% to 3%; and
  - Social Sciences decreased from 17% to 15% (this should be regarded with caution, as previously the 'other' or 'not classified' category was coded under 'Social Sciences');
  - Humanities maintained the same share of HERD in 2004 and 2014 at 8%;
  - The 'other' category refers to Department/Schools that were not readily classified into a field of science (refer to Caveats on page 5).

## Chapter 5: Types of research

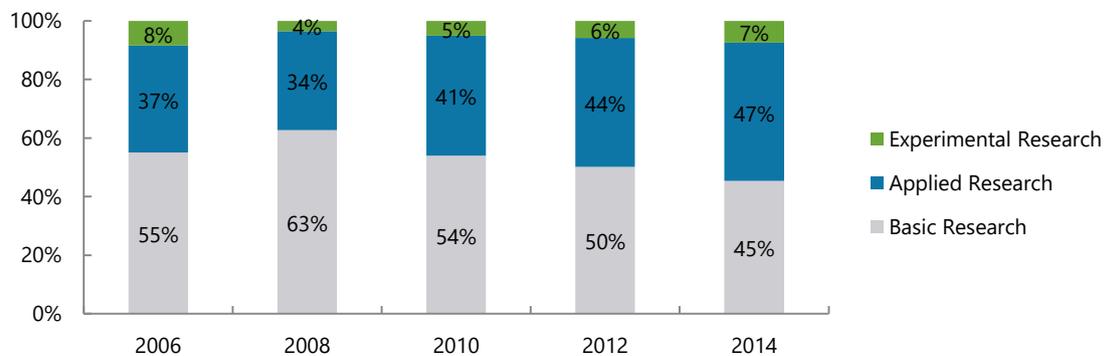
Figure 21: Percentage of total HERD budget by research type<sup>4</sup>, 2014 (Total = €730m)



Source: DJEI HERD Data

- In 2014, applied research accounted for 47.2% of all research spend in the higher education sector, 45.3% was spent on basic research activities, while experimental research accounted for 7.5% of the total HERD budget.

Figure 22: Percentage of total HERD budget by research type<sup>5</sup>, 2006 - 2014



Source: DJEI HERD Data

<sup>4</sup> 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.

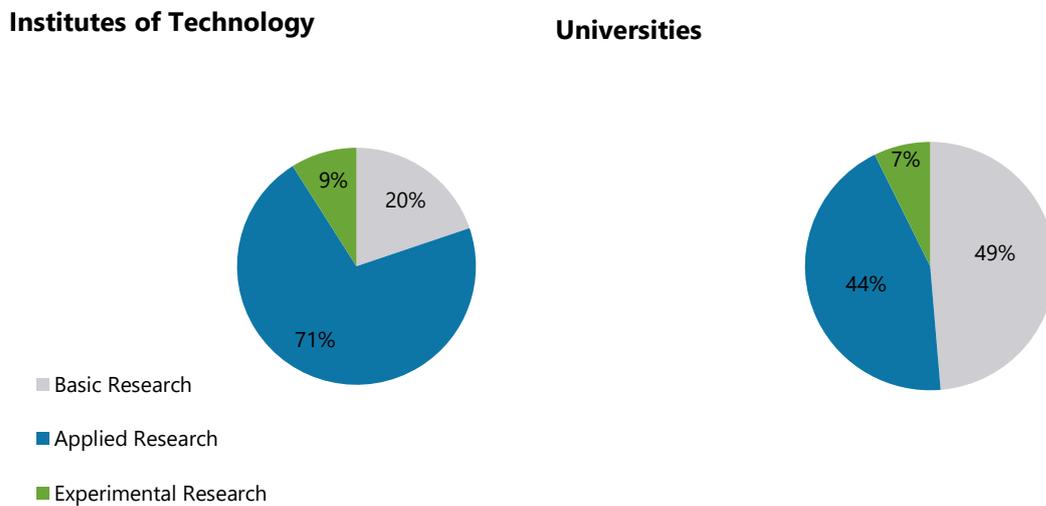
Applied research – also original investigation undertaken in order to acquire new knowledge, it is however, directed primarily towards a specific practical aim or objective.

Experimental development – 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.

<sup>5</sup> Types of research were not included in the 2004 HERD survey.

- Figure 22 shows the trend in HERD by type of research since 2006. It can be clearly seen that there has been a shift in focus from basic to applied research since 2008.
- In 2008, just over a third of all research undertaken in the Higher Education Institutes (HEIs) was applied research; this share has increased to almost half in 2014.
- 2014 is the first year to show that the majority of research undertaken in the HEIs is applied, at 44% in universities and 71% in Institutes of Technology.
- Experimental research has increased marginally since 2008.

Figure 23: Type of research carried out by Universities and IoTs in 2014



Source: DJEI HERD Data

- Figure 23 shows that the main focus of research for the universities is basic research (49%) and 44% of research undertaken in the universities was applied in 2014.
- In contrast, the focus for the Institutes of Technology is applied research accounting for almost three quarters of research undertaken in 2014.

## Chapter 6: Type of Costs

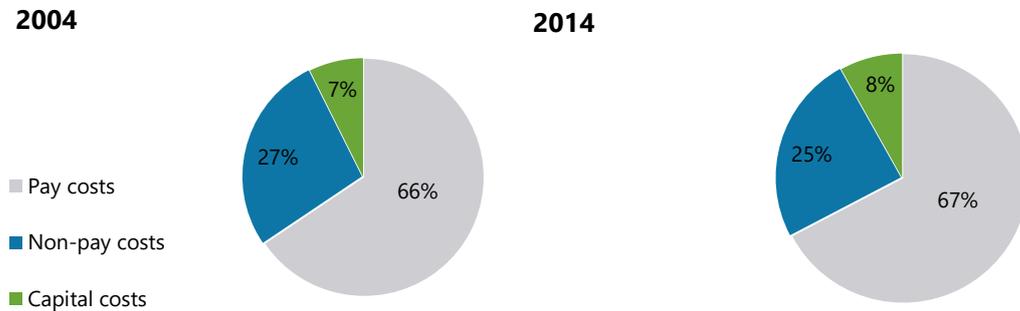
Figure 24: Distribution of research expenditure by type of costs, 2004-2014 (€ million)



Source: DJEI HERD Data

- Figures 24 and 25 shows that the majority of research expenditure goes towards labour costs, accounting for €491m in 2014 (67% of total costs in 2014).
- Pay expenditure increased between 2004 and 2008, then declined by 12% in 2010, but has increased by 19.5% to reach €491m in 2014.
- Non-pay costs increased by 7% in 2014, amounting to €180m in 2014. Non-pay costs refer to non-capital purchases of materials, supplies and equipment to support R&D, and accounted for a quarter of total costs in 2014.
- Capital expenditure on R&D peaked in 2008 and declined by 45% to 2014.

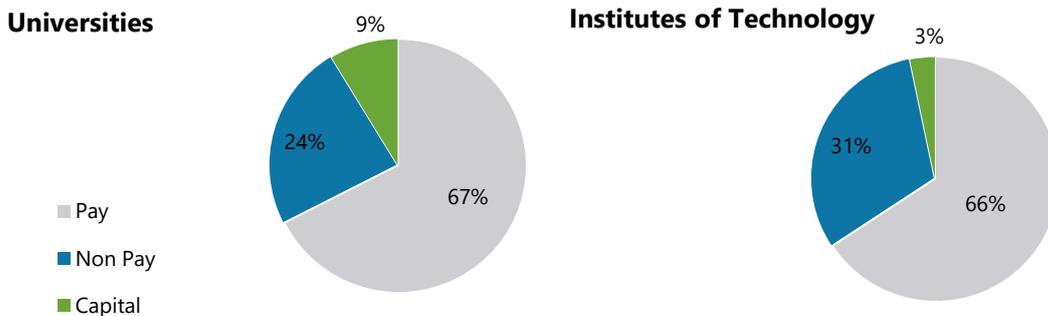
Figure 25: Percentage share of type of costs, 2004 and 2014



Source: DJEI HERD Data

- Figure 25 shows the breakdown of costs for R&D in the higher education sector in 2004 and 2014.
- The split is broadly the same in both years with pay costs accounting for two thirds of costs and non-pay costs having a slightly smaller share of the total R&D budget in 2014

Figure 26: Percentage share of type of costs by Universities and IoTs, 2014



Source: DJEI HERD Data

- Figure 26 allows a more detailed examination of the three different types of costs, broken down for universities and Institutes of Technology, with universities spending a greater portion of their budget on capital costs (9%) compared with 3% for the Institutes of Technology in 2014.
- Pay costs account for two thirds of the R&D budget for both universities and Institutes of Technology in 2014.

- Non-pay costs accounted for almost a quarter of the R&D budget in the university sector compared with almost a third in the IoT sector in 2014.

Table 6: Types of costs by new fields of science, 2014 (€ million)

	Pay costs	% of total	Non-pay costs	% of total	Capital costs	% of total	Total
Natural Sciences	142	61%	60	26%	30	13%	232
Engineering and Technology	91	64%	39	27%	12	8%	142
Medical and Health Sciences	111	65%	45	26%	15	9%	170
Agricultural Sciences	16	77%	4	20%	1	3%	20
Social Sciences	87	82%	18	17%	1	1%	106
Humanities	32	88%	4	12%	0	0%	36
Not classified	13	58%	9	41%	0	1%	23
Total	491	67%	180	25%	59	8%	730

Source: DJEI HERD Data

- Within each field of science pay costs account for the largest proportion of R&D costs in 2014; ranging from 88% for Humanities to 61% for Natural Sciences.
- Excluding the 'Not Classified' category, the fields of Engineering & Technology (27%), Medical and Health Sciences and Natural Sciences accounted for the highest proportion of non-pay costs (26%).
- The field of Natural Sciences had the highest proportion of capital costs, accounting for 13% of the R&D spend in 2014.

## Appendix 1: Methodology

The 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. Data captured in the survey relates to the 2014 academic year (September 2014 to September 2015).

There were two elements to this survey of research and development in higher education colleges:

- 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.

The coverage included all academic departments in seven universities\*, fourteen institutes of technology\*\*, and the Royal College of Surgeons, Mary Immaculate College and St Patrick's College, Drumcondra.

*\*Universities: Dublin City University, NUI Galway, Maynooth University, University College Cork, University College Dublin, Trinity College Dublin and University of Limerick.*

*\*\* Institutes of Technology (IT): Athlone IT, Cork IT, Dublin IT, Dundalk IT, Dun Laoghaire Institute of Art, Design and Technology, Galway-Mayo IT, Letterkenny IT, Limerick IT, Waterford IT, IT Blanchardstown, IT Carlow, IT Sligo IT Tallaght and IT Tralee.*

Questionnaires were sent out in April 2016 to the various colleges and institutes. There was intensive follow-up of non-respondents by telephone until September 2016 when final outstanding information was received.

Detailed departmental income and expenditure was obtained from the finance office in each university. Industrial liaison offices provided similar information for the institutes of technology.

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

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

## Personnel 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 totals the percentage of time spent on research was also obtained. In addition, the headcounts were split between male and female to allow gender comparisons.

Each academic department was also asked to estimate the time spent on research activities by each member of staff in his/her department. Strict guidelines and instructions were sent to each head of department outlining a single agreed methodology which identified comparable time spent on research activities. 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 activities by people employed in the higher education sector.

<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>

## Appendix 2: Acronyms

BERD	Business Expenditure on Research & Development
EI	Enterprise Ireland
EU	European Union
FOS	Field of Science
FTE	Full-time equivalent (1 FTE = R&D 40 hours per week)
GDP	Gross Domestic Product
GERD	Gross expenditure on Research & Development
GNP	Gross National Product
HE	Higher Education
HEA	Higher Education Authority
HERD	Higher Education Expenditure on R&D
HRB	Health Research Board
HSE	Health and Safety Executive
ICT	Information and Communications Technology
IoTs	Institutes of Technology
IRC	Irish Research Council
OECD	Organisation for Economic Co-operation and Development
OPW	Office of Public Works
PRTL	Programme for Research in Third Level Institutes
R&D	Research and Development
SFI	Science Foundation Ireland
STI	Science, Technology & Innovation

## Appendix 3: Detailed Fields of Science Tables

	New - Fields of Science	2014
Natural Sciences	Mathematics	13.2
	Computer and information sciences	57.6
	Physical sciences	22.0
	Chemical sciences	54.0
	Earth and related environmental sciences	28.1
	Biological sciences	53.3
	Other natural sciences	3.9
		232.2
Engineering and Technology	Civil engineering	11.3
	Electrical, electronic and information engineering	25.2
	Mechanical engineering	25.9
	Chemical engineering	2.3
	Materials engineering	15.2
	Medical engineering	0.6
	Environmental engineering	9.6
	Environmental biotechnology	0.0
	Industrial biotechnology	2.5
	Nano-technology	41.2
	Other engineering and technologies	8.2
		141.9
Medical and Health Sciences	Basic medicine	82.3
	Clinical medicine	38.9
	Health sciences	34.5
	Health biotechnology	9.9
	Other medical sciences	4.9
		170.4

Agricultural Sciences	Agriculture, forestry and fisheries	9.9
	Animal and dairy science	3.1
	Veterinary science	7.5
		20.4
Social Sciences	Psychology	8.3
	Economics and business	31.8
	Educational sciences	23.1
	Sociology	6.3
	Law	7.5
	Political science	3.7
	Social and economic geography	17.7
	Media and communications	7.1
	Other social sciences	1.0
		106.5
Humanities	History and archaeology	8.2
	Languages and literature	15.0
	Philosophy, ethics and religion	2.6
	Art (arts, history of arts, performing arts, music)	4.3
	Other humanities	5.9
		36.0
Not classified		22.7
HERD		730.1

Source: DJEI HERD Data

The images on the cover of this document are of drawings by Gabriel Hayes who was commissioned in 1941 to design and complete a range of carved stonework for the facade of the Department of Industry and Commerce building at Kildare Street.

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