



### Introduction

ACED's members' faculties and schools – and their research institutes, centres and groups – train the next generation of researchers and conduct a significant proportion of Australia's engineering research.

This Factsheet uses recent national data to provide a summary the scale and performance of engineering research and research training in Australian universities.

The data show that engineering is a relatively strongly research-oriented field. Engineering research is healthy, with room for improvement.

### The research system

Three specific categories of people are involved<sup>1</sup>:

- **'Teaching and Research'** academics, typically with a PhD, are usually funded from revenue from coursework teaching and the fees associated with students enrolled in higher degrees by research (HDR). T&R staff teach, conduct and supervise research, and contribute to school and faculty leadership and administration. Some T&R staff have a predominantly research workload.
- **'Research-only'** academics, commonly on time-limited contracts, are funded from specific funds and external research project and program sources. Most have PhDs.
- **Research (HDR) students** are enrolled in higher degrees, principally PhDs. Their supervision and basic facilities are funded through tuition scholarships and fees. They are effectively professionals in training and contribute to research outcomes, such as publications.

Basic laboratory and research equipment and related technical support services are funded from coursework and fee revenue and research infrastructure funds (based on research performance). Specialised research project and program-oriented resources are funded from additional 'external' sources. Only external funds are reported here.

The ANZSRC research classification<sup>2</sup> is used for reporting external funding and research outcomes. The *Engineering* classification primarily covers research fields in 'engineering science', rather than in engineering practice.

### Academic staff

The numbers here are for 'full-time-equivalent' staff, including part-time positions, but not casual contracts.

academic position type	2011	2014	2017
<b>Research-only</b>	1,581	1,650	1,670
<b>% of women</b>	24.5%	22.5%	21.9%
<b>Teaching &amp; Research</b>	1,999	2,112	2,146
<b>% of women</b>	12.6%	13.6%	14.3%

The higher proportions of women in engineering research positions, and in research degrees (see below) should ensure continuing increases in the proportion of women in T&R academic positions in engineering.

### HDR students and graduates

#### Commencing HDR enrolments

award	citizenship	2011	2014	2017
<b>PhD</b>	<b>domestic</b>	621	673	712
	<b>international</b>	907	1,161	1,428
<b>MRes</b>	<b>domestic</b>	219	258	176
	<b>international</b>	232	211	204

International commencing enrolments of PhD candidates overtook domestic enrolments around 2007-8.

In 2017, Engineering enrolled 10% of all commencing domestic PhDs, and 28% of the internationals<sup>3</sup>.

Over 2011-17, women comprised 25±2% of domestic PhD commencing enrolments, with a slightly higher proportion in the international cohort. Amongst the Master by Research (MRes) candidates, women were (19-25%) of the domestic cohort, but 26-31% of the internationals.

#### HDR Graduates

award	citizenship	2011	2014	2017
<b>PhD</b>	<b>domestic</b>	399	572	637
	<b>international</b>	383	696	780
<b>MRes</b>	<b>domestic</b>	115	103	105
	<b>international</b>	120	115	121

Women were about 25±2% of the PhD graduates over 2011-17, for both domestic and international students. This range was larger for the MRes graduates.

**HDR graduate outcomes** are reported in national sample surveys. The 2018 survey reported that 90.8% of recent HDR graduates in Engineering were in work, with 85% in full-time work. Some 25% of the latter reported that their skills were not fully used. The median salary for those in full-time work was reported as \$90,000 for men, but \$83,000 for women, compared with the 'all field' medians of \$90,000 for both genders.

the divisions for *Information & Computer Sciences, Design and Built Environment, and Education*. The ANZSRC classification is currently under review.

<sup>3</sup> Figures for coursework degrees are in *Australian Engineering Facts: Coursework Degrees May 2019*, [www.aced.edu.au](http://www.aced.edu.au)

<sup>1</sup> These data are for the field of education *Engineering and Related Technologies* (ACSED FoE03).

<sup>2</sup> The Australia and New Zealand Research Standard Research Classification (ANZSRC) has *Engineering* as Division 09 and *Technologies* as Division 10. Each Division is subdivided into 4-digit Groups and 6-digit Fields. Other engineering-related research is in

The majority (87%) of HDR graduates in engineering gave positive ratings for 'overall satisfaction' with their HDR learning experience, and for 'skills development', 'supervision', 'infrastructure' and 'goals and expectations being met'. Only two-thirds gave a positive rating for 'intellectual climate', higher than the figure for all HDR graduates.

### External research income

External research income earned by each institution is vitally important to sustain research programs, and is used by the Australian government in the formula for 'research block grant' funding and the allocation of Australian government research scholarships.

This table provides two annual snapshots of the total research income won by ANZSRC Division 'Engineering' plus the 'Communications Technologies' Group.

Research income category	2014		2016	
	\$ M	% nat total*	\$ M	% nat total*
<b>Cat 1 Australian competitive grants</b>	168.2	14.4%	152.6	15.6%
<b>Cat 2 Other public sector</b>	74.4	14.1%	83.5	14.2%
<b>Cat 3 Industry &amp; other</b>	104.7	22.0%	143.0	25.0%
<b>Cat 4 CRC research</b>	29.1	30.1%	21.2	26.1%

\*the totals from which these proportions are calculated do not include the allocations to the Health & Medical Division. This earns between one third and one half of total funding in each of Categories 1, 2 and 3, and has access to funding schemes not available to non-medical areas.

It is evident that Engineering is earning a good proportion of national research income, most significantly from the Cooperative Research Centre (CRC) program. The distribution of total income for 2016 between the main branches of engineering is shown in following table.

ANZSRC codes	ANZSRC Groups	Research income, \$ M
0901, 0902, 0910, 0913,	Aero, Auto, Manufacturing Mechanical	58.4
0903	Biomedical	26.86
0904, 0908	Chemical, Food Science	57.87
0905, 0909	Civil, Geomatics	76.83
0906, 1006	Electrical & Electronic, Communications Technoolgy.	70.95
0907	Environmental	11.32
0911	Maritime	5.61
0912	Materials	50.44
0914	Resources & Extr'ive Metal'y	35.82
0915, 0916	Interdisciplinary, Other Eng'g	6.17
<b>09</b>	<b>TOTAL</b>	<b>400.32</b>

### Research performance and impact

Measurements of research performance and impact have major importance within higher education. They contribute to assessments of return on research investment and institutional reputation. Australia's triennial *Excellence in Research* (ERA) program<sup>4</sup> provides authoritative data for describing research performance. The following table

shows commercialisation income, unique patents, and ERA2018 ratings for the principal branches of engineering.

ANZSRC Groups	comm'n inc, \$M	unique patents	ERA mean/ # inst's	# inst's rated 5
Aero, Auto, Manufacturing, Mechanical	0.04	11	4.3 / 20	12
Biomedical	2.72	31	4.0 / 11	3
Chemical, Food Science	0.26	23	4.2 / 13	6
Civil, Geomatics	0.26	5	4.0 / 25	9
Electrical & Electronic, Communications Tech.	3.86	110	4.4 / 26	18
Environmental	0	2	3.9 / 10	3
Maritime	0	1	5.0 / 2	2
Materials	0.16	30	4.6 / 25	16
Resources & Extractive Metallurgy	0.54	15	3.8 / 12	4
Interdisciplinary, Other	0	0	0.7 / 3	-
<b>ENGINEERING (total or ERA aggregate)</b>	<b>7.86</b>	<b>228</b>	<b>3.9 / 34</b>	<b>8</b>
<b>NAT TOTAL (ex Med)</b>	<b>27.0</b>	<b>484</b>	<b>n/a</b>	<b>n/a</b>

The ERA ratings show the number of ACED members contributing in each branch and the mean ERA score over those contributors (5: well above world standard; 4: above world standard). The final column shows the number of contributors receiving a rating of 5.

From these ratings, the universities' engineering research is of generally high quality. In *Materials* and the *Electrical and Electronic Engineering* group, two-thirds of contributors are performing above world standard.

Engineering is also contributing nearly half of the patents registered and nearly one-third of the commercialisation revenue, outside the medical area.

In 2016 research *Engagement and Impact* metrics were introduced and reported in 2018 for each ANZSRC Division. Most ACED members participated, with the following results:

# of ACED members	Engagement	Impact	Approach to Impact
Counted	33	29	29
Rated High	16	20	12
Rated Medium	14	7	15
Rated Low	3	2	2

Whilst these ratings for engineering were higher than for most other research areas, they indicate that there is scope for considerable improvement.

#### Australian Council of Engineering Deans Inc.

The membership of ACED is a senior academic representative of each of the 35 Australian universities that provide professional engineering degrees accredited by Engineers Australia. ACED's mission is to promote and advance engineering education, research and scholarship on behalf of the Australian higher education system.

More data and trends on engineering enrolments and staffing are on the ACED website: [www.aced.edu.au](http://www.aced.edu.au) Contact: Prof Doug Hargreaves AM, ACED Executive Officer [d.hargreaves@qut.edu.au](mailto:d.hargreaves@qut.edu.au)

<sup>4</sup> <https://dataportal.arc.gov.au/ERA/NationalReport/2018/>