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## 2 Executive summary

#### The chemical sciences should reflect our broader society.

We believe that for the chemical sciences to prosper, they must attract, develop and retain a diverse community of talented people – chemistry for everyone.

#### The Royal Society of Chemistry has a long history of promoting diversity and inclusion.

We have a responsibility as an employer, a professional and membership body, and as a key voice for the chemical science community to help encourage and inspire change. We changed our own governance, policies and activities to drive inclusion and diversity.

Our work has influenced the policy and practice of others.

#### While there have been successes, there is much more to do.

We are guided by robust evidence and data to make decisions about how we can best prioritise and focus our efforts and our resources, so that everyone can reach their full potential.

In this report, we identify themes around mental health, disability, ethnicity, sexual orientation, gender identity and socioeconomic background where we need to do better. These themes are systemic and interrelated. Most importantly, data are often limited.

## It is resoundingly clear from our findings that there is still a lack of progress in developing and retaining women in leadership positions in the chemical sciences.

Gender equality remains a significant problem for chemistry. Specific challenges identified include: women's progression and retention, the pipeline of women in higher education, gender pay inequality, and lower impact publishing.

#### We must accelerate the pace of change.

Inclusion and diversity will continue to need strong and visible leadership by the Royal Society of Chemistry. In 2018, we will focus on women in leadership as one of our core themes.

We will do this because:

- the problem is particularly acute in STEM
- our 'leaky pipeline' is far more pronounced than in other scientific disciplines
- there is clear potential for us to have an impact at scale in this area, and
- we have the data and evidence to support our actions.

Tackling this issue head on is not merely the right thing to do – a more diverse workforce should result in better science and economic benefits. A more diverse representation at leadership level should in turn create longer-term social change.

Accordingly, we make a number of recommendations and commitments aimed at driving progress on diversity and inclusion.

We propose five key calls for change across the community to ensure that chemistry is for everyone:

- 1. Strong and visible leadership
- 2. More research and analysis
- 3. Greater focus on measuring impact
- 4. Effective collaboration
- 5. Cultural change

#### Our commitments

To accelerate the pace of change, we propose new commitments aimed at changing our policies and practices. We will:

- launch a new flagship programme of research to tackle gender equality and understand the barriers and enablers to women's retention and progression into leadership roles
- develop our new inclusion and diversity strategy, and
- review how we work with our community.

#### Our community

We cannot do this alone.

We also recommend that others should help to create momentum and promote further change.

We must raise the bar for diversity and inclusion in higher education.

Employers should better understand the contributions of diversity to their business and make stronger commitments to creating the right environments and policies for change.

The scientific research community needs to tackle systemic disadvantages and enable as many people as possible to contribute to scientific discovery and innovation.

This report is not an account of our inclusion and diversity strategy. It captures the current state of diversity and inclusion in the chemical sciences based on avaeeC rctegand st3 (ommitments aimbouter infur)12.1

#### There is more work to do and we are impatient for change.

Our research and further feedback from the chemical science community presented in this report identified themes around mental health, disability, sexual orientation, ethnicity and socioeconomic background where we know improvement is needed.

We require a deeper understanding of mental health and wellbeing needs in the scientific community, what interventions have been considered in this setting, and whether those interventions have been effective in addressing the issues, especially among researchers.

More work is needed to understand the specific barriers to access for students with disabilities in STEM subjects.

Socioeconomic background has a strong effect on an individual's likelihood of entering higher education. Socioeconomic inequality in higher education participation and degree acquisition appears to be widening – these are broad and systemic problems. We need more research and more data to better understand the particular barriers and causes of inequality that exist for the chemical sciences and to use these insights to design appropriate interventions.

Chemistry undergraduate courses have a slight over-representation of minority ethnic students compared to the general population. However, these members of our community face unique barriers to retention, and progression into leadership roles is poor.

66 Diverse talent will thrive in an inclusive culture where everybody is valued and treated equally with respect and dignity without any form of discrimination. That's real inclusion. And what we do know is that if we get the 'l' [inclusion] bit right, then the 'D' [diversity] bit will follow.

Interplay between these issues can create further forms of disadvantage and discrimination. This intersectionality means that the inequality experienced by individuals who identify themselves with multiple underrepresented groups may be further compounded or exacerbated.

#### Data are a limiting factor.

A general increase in profile of diversity and inclusion issues has led to improvements in data collection and monitoring. However, our ability to properly describe the diversity of the chemical science community is still limited by the availability of data.

Sample sizes are limited and for many data gathering exercises it is difficult to cut by multiple dimensions (for example by ethnicity, socioeconomic background, disability or sexual orientation). This can raise more questions than answers. Therefore, there is a clear need for further and more detailed research and data gathering to be undertaken by us and by others.

Unfortunately, relevant information about scientists working in industry is also very limited, so inevitably there is greater focus on academia in this report. We have drawn on publicly available data from bodies including the Universities and Colleges Admission Services (UCAS), the Department for Education and the Higher Education Statistics Agency, as well as analysing our own membership data.

We commit to working with learned societies, academic and funding bodies, government agencies and industry to build a robust evidence base and actionable solutions. We have already established a partnership with the Institute of Physics in recognition of the shared diversity issues within the physical sciences community.

Gender equality has received most attention. Although the chemical science community has made progress, it remains a persistent problem.

Our key research reports as far back as 1999 have identified specific issues that could inhibit retaining and developing women into leadership positions. 5,10,14

While there have been some positive signs in the UK higher education sector overall ..

- Inclusion and diversity is now an even greater priority in the scientific community, with diversity becoming a focus for academic institutions and research funders.<sup>23</sup>
- The number of female chemistry professors has tripled in the last 10 years, from 15 to 45.24
- Chemistry is outperforming other fields as judged by the proportion of UK patents registered by female inventors.<sup>25</sup>
- Chemistry undergraduate courses continue to have a high proportion of female students (44%).<sup>24</sup>

...it is clear we have not yet solved the issues associated with gender parity:

- At the current rate of change, based on a linear model\*, we will never reach gender parity in higher education institutions.
- Retention and development of women into senior positions remains poor. In 2016, only 9% of chemistry professors were women. Our membership data show that the proportion of women in our membership falls with age.
- Female physical science graduates are paid less than their male counterparts and the gender pay gap widens in the first five years.<sup>26</sup> Our own survey shows that the pay gap is present at all career stages.<sup>27</sup>
- Analysis of academic publishing output shows that women are underrepresented.<sup>28</sup>

It is resoundingly clear from our analysis of the evidence that a continued challenge for gender equality exists, particularly in retaining and developing women into positions of leadership within the chemical sciences.

Strong and visible joint leadership in the scientific community is called for to ensure that these issues are tackled head on and addressed as a matter of urgency.

## 4 Recommendations and commitments

In the light of our findings, we propose five calls for change to ensure chemistry is for everyone.

#### 1. Strong and visible leadership

Jointly with the scientific community and our partners, we need to take responsibility for issues specific to the chemical sciences and push for action towards a more inclusive and diverse community.

#### Our commitments

We make three major commitments for the immediate future. We will:

#### Launch a new flagship programme of research

We will tackle the lack of progress in developing and retaining women into leadership roles and make this one of our principal initiatives for 2018. We will design and launch a new research and evidence gathering programme on barriers and enablers to their progression and retention.

#### Develop a new inclusion and diversity strategy

We will set out a clear view of our ambition for inclusion and diversity, developing and setting new goals and targets. We will influence the policy and practices of others and ensure accountability through monitoring and reporting on progress.

#### Review how we work with our community

With over 55,000 members, we have the responsibility to ensure that the chemical sciences attract, develop and retain a diverse and inclusive community of talented people. We commit to reviewing our own policy and practices to find new ways of accelerating the pace of change. This will include:

- collaborating and partnering with other organisations to identify and develop joint solutions
- continuing to explore appropriate approaches to monitoring diversity characteristics across our membership and the wider chemical science community
- developing approaches to encourage the progression and retention of women throughout their careers
- analysing our publishing data for gender trends in commissioning, submission, editorial and refereeing decisions, and citations, and
- reviewing appointment policies and practice for our boards and all relevant committees.

#### Our community

#### We cannot do this alone.

We need our community to come together to create momentum and promote further change. We see opportunities in higher education, amongst employers and in the scientific community at large.

In **higher education**, we want to continue to raise the bar for inclusion and diversity. We want to support the sector to better understand and address the barriers to progression and the inequalities that still persist.

The sector should consider:

- building on the successful action taken in higher education institutions, ensuring that the leadership necessary to maximise impact is in place
- improving transparency by sharing staff diversity data, including recruitment and retention rates and exploring the potential for participating in benchmarking
- investing in training and support to ensure inclusive management, and
- exploring the reasons behind gender disparity in those holding permanent contracts in higher education institutions.

**Employers** should better understand the contributions of diversity and inclusion to their business. They need to make stronger commitments to creating supportive work environments and implement better monitoring and reporting to help drive and sustain change.

We recommend that employers consider:

- reviewing early-career salary award policies and practice to ensure they support equality and inclusion, including promotion practices
- promoting a culture conducive to flexible working and career breaks by reviewing policies and actively supporting these options, including during recruitment
- raising awareness of individuals working flexibly, in particular in senior roles, and of parental leave options, encouraging take-up by men, and
- how better to attract and support returners, building on learning from various schemes that already target this group.

The **chemical science community** must confront systemic disadvantages and enable as many different kinds of people as possible to contribute to scientific discovery and innovation. We will work with colleagues and partners to drive positive change and promote inclusion and diversity across different sectors.

5 Inclusion and diversity: the current

Table 1. Degree classification for chemistry, by gender. Source	HESA 24.49.65.0000 24.49.65.0000 24.40.00000 24.40.0000 24.40.0000 24.40.0000 24.40.0000 24.40.0000 24.40.0000 24.40.0000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.000000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.00000 24.40.000000 24.40.000000 24.40.000000 24.40.000000 24.40.000000 24.40.0000000 24.40.0000000 24.40.000000000 24.40.00000000000 24.40.000000000000000000000000000000000
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postgraduate study. The proportion of women continuing to postgraduate study drops from 44% at undergraduate level to 39% at postgraduate level across the whole physical sciences cohort, and to 35% for UK domiciled postgraduate students. The gender balance at postgraduate level has remained virtually unchanged over the last 10 years.

The proportion of female full-time postgraduate chemistry students is the same as for the physical sciences as a whole. However, for UK nationals the proportion of women is four percentage points lower, at 35%.

#### Figure 5

The data show that white students are slightly more likely to progress to postgraduate study than their Asian or black peers, with the proportion of minority ethnic students falling from 26% at undergraduate level to 14% at postgraduate level.

**Figure 10**. Number of first year undergraduates in 2014/15, by gender and ethnicity, comparison to physics. Source: HESA<sup>24</sup>

Students with disabilities studying STEM subjects face challenges that do not occur in other disciplines.

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Figure 11. Proportion of undergraduate entrants declaring a disability, comparison to physics.

Source: UCAS<sup>31</sup>

These include accessing laboratories and the challenge of translating scientific and mathematical notation with tools such as text readers.percracta

With 24% minority ethic students, chemistry undergraduates are more ethnically diverse than physics undergraduates (13%).

For both subjects, the proportion of minority ethnic women is higher than for men: 4% for physics and 9% for chemistry.

Ethnicity data for higher education staff are not presented due to the incomplete nature of the dataset, which makes it difficult to draw significant conclusions. However, the percentage of minority ethnic chemical scientists in academia appears to drop significantly with increasing career stage.

#### Disability

The proportion of chemistry degree entrants declaring a disability has risen from 6% to 9% between 2010 and 2016.

What is implied by the term 'disability' is important. We acknowledge there are differences in the way that people choose to identify themselves with different terms.

We need to encourage a more open culture for disclosure, to identify and address the different barriers faced by people with disabilities. Current data are very limited and do not differentiate between types of disability. More research is required to understand the barriers that confront different groups, and the stages of education at which they occur.

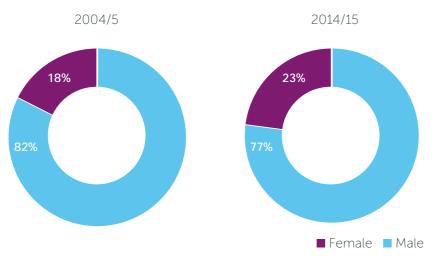
## 7 Higher education sta

#### Gender

#### Gender analysis of academic sta

Since 2004, the proportion of women employed as academic sta in UK chemistry departments has increased from 18% to 23%.

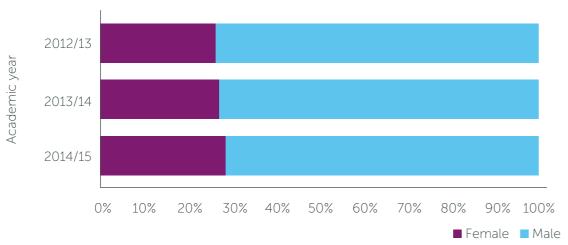
**Figure 12**. Academic staff in UK university chemistry departments, by gender. Source HESA<sup>24</sup>



#### Gender analysis of technical sta

Over 70% of professional and technical support sta in university departments are male.

**Figure 13**. UK university chemistry department senior administrative staff (professional/technical), by gender. Source HESA<sup>24</sup>

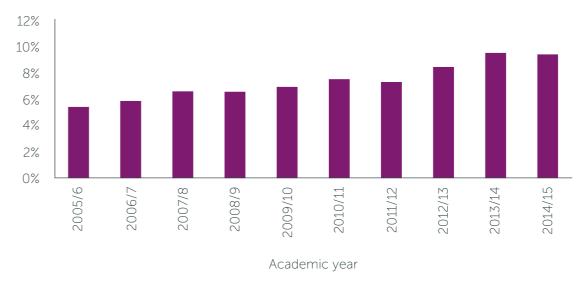


#### Gender analysis of chemistry professors

The limited progression of women into professorships remains a significant and serious issue for chemistry.

The progression of women to professorial positions remains poor. In 2015, only 9% of chemistry professors were women. This is very significantly below the national average, at 24% across all subject areas.<sup>37</sup>

**Figure 14**. Proportion of female professors in UK university chemistry departments. Source: HESA<sup>24</sup>

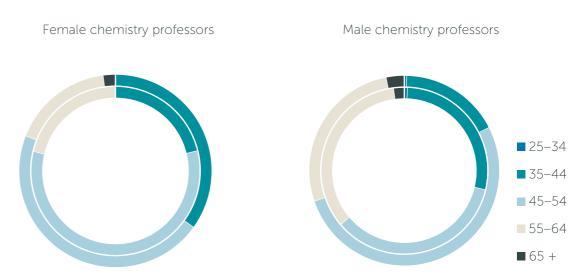


#### Age distribution of chemistry professors

While the numbers remain very low, HESA data suggest that in recent years a younger cohort of female academics have been appointed to professorial positions.

It is interesting to compare the age profile for male chemistry professors with that of their female counterparts. The number of professors in the 45–54 age bracket has more than doubled over the last 10 years. Although the proportion of female professors under the age of 44 has increased, a positive sign that a younger cohort is coming through, the absolute numbers are still low, with just 45 female professors, compared to 440 male professors.

**Figure 15**. Age distribution UK chemistry professors, 2004/5 (inner) and 2014/15 (outer). Source HESA<sup>24</sup>



#### Higher education pipeline

Retention and development of women into senior roles remains poor in the chemical sciences. The numbers drop o at each stage of the academic career ladder.

At undergraduate level the gender balance approaches parity (44% female) but at each successive stage there is attrition of women. Chemistry within higher education becomes increasingly male dominated at senior levels. At professorial level, the representation of women falls to only 9% – even lower than physics, where even though 20% of undergraduates are female, 10% of professors are female.

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## Not only is current retention of women within chemistry poor, but this has been the case for many years.

The 'Factors affecting the careers choices of graduate chemists' report published in 1999 highlighted these issues.<sup>4</sup>

It is important to note that this analysis does not account for further interaction between different forms of discrimination and disadvantage. Additional inequalities will be present in the pipeline. For example, students from disadvantaged backgrounds are underrepresented at highly selective universities.<sup>38</sup> More research and data are needed to better understand the

Other useful insights from the ECU report include:

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Within technical staff, men are more likely to be employed on permanent contracts.

**Figure 18**. UK university chemistry department senior administrative staff (professional/technical), 2014/15, by contract type and gender. Source HESA<sup>24</sup>

#### **Athena SWAN Charter**

The Royal Society of Chemistry has long taken a leading role in supporting university chemistry departments to work towards gender equality. The 2004 'Good Practice' report<sup>6</sup> set out a checklist and provided a benchmark for progress, which contributed towards the establishment of the Athena SWAN Charter the following year. The charter encourages and recognises employment practices that support gender equality in higher education and research. It has recently been expanded to include subjects beyond STEMM and to embrace professional and support staff.

 Table 2: Chemical science departments holding Athena SWAN Charter awards:42

Award level	Number of departments
Gold	2
Silver	16
Bronze	24
None	30
Total holding awards	42/72 (58%)

<sup>1</sup> Imperial College London

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<sup>2</sup> University of York

## 8 Research

#### Research Excellence Framework

The Research Excellence Framework (REF) assesses the quality of research in UK higher education institutions and is important as a determinant of future funding. The REF results have a significant impact on the reputation of a university. As such, they have the ability to influence practice within university departments.

Adjustments to support equality were introduced in the 2014 REF assessment process.
The revised rules permitted a reduced number of submissions where there were 'individual circumstances', such as parental leave. A3chigherStio[(e135.tedR2R UK hiED[(ed3chia)3 (F) o) (e fu Councividual)]TJfThe ohiEnglions(HEFCE)dual in27/TT/T1\_0 5.83Tf105.83T234.3649 637.5330.204( (27/TTJ/T1\_2 1 Tf10 0 2 109846 639)

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### Research funding

The EPSRC is the main distributor of public funding for research in the chemical sciences. The chart below shows the proportion of women applying for EPSRC grants, and the success rate.

**Figure 21**.Proportion of EPSRC grant applications in the physical sciences from, and awards to, female applicants, 2015/16. Source: RCUK<sup>46</sup>

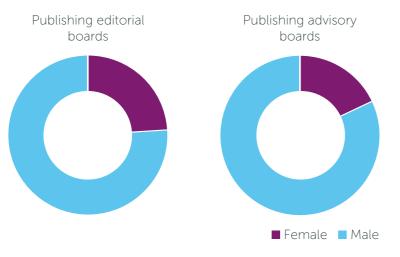
The First Grants stream supports early-career researchers and receives the highest proportion of applications from women. The percentage of women applying fa2een applying 3 338.2817 strGoC grants cheves to tear hesaublshend researchern. The Critsical Maess granten ap 2 lying 3 338.2817 st physical sciencem, im

#### Royal Society of Chemistry publishing activities

The Royal Society of Chemistry publishing portfolio includes 44 peer-reviewed journals. Analysis of our publishing activity shows that female representation on our editorial and advisory boards has increased from the 2014 levels, by 5% and 4%, respectively. Our editorial boards have a higher representation of women than our advisory boards.

A target of 30% representation is often cited for boards and committees; 30% female membership is considered to be the point when critical mass is reached such that in a group setting, the minority individuals can be heard in their own right rather than as representatives of their minority.<sup>54</sup>

**Figure 22**. Gender balance for Royal Society of Chemistry editorial and advisory boards, January 2017.



#### Male authors of research papers receive more citations than female authors.

A preliminary analysis of papers published in the Royal Society of Chemistry's journals distinguished gender from author name.

Gender was assigned to names by following the approach suggested in the Gender Profiles in UK Patenting report authored by the UK Intellectual Property Office.<sup>25</sup> Matias data sets<sup>55</sup> were used to identify names based on data from the US Social Security Administration and the UK Office for National Statistics. Gender was assigned where a 95% confidence score was achieved, where the confidence level was below 95%, the two data sets were combined and binomial based scoring reapplied. If the confidence exceeded 95%, the name was categorised as the relevant specific gender; otherwise the gender was assigned as undefined.

Results are based upon analysis of 68,559 papers (corresponding to approximately 330,000 citations) across all Royal Society of Chemistry journals, where the corresponding author is identified, the paper is classified as a "research paper" and the gender of the corresponding author can be assigned.

An analysis of the mean number of citations a paper received in the first two years after publication versus corresponding author gender shows that male corresponding authors receive more citations than female authors. The discrepancy in the number of citations between men and women also appears to be widening over time. Papers with a large number of citations (>25) were not included in the analysis, showing that this effect is not driven by a small number of high performing papers.

**Figure 23**. Mean number of citations for male and female corresponding authors in the first two years after publication (error bars show 95% confidence). Source: Royal Society of Chemistry Publishing



#### Male authors are more likely to submit to higher impact journals.

Analysis of author gender and journal showed a medium correlation between the impact factor of journals and the gender of authors submitting papers. Journals with a lower impact factor have a higher proportion of submissions from female authors.

**Figure 24**. Proportion of submitted papers with a female corresponding author, and journal impact factor (2015) for submissions to Royal Society of Chemistry journals in 2016. Source: Royal Society of Chemistry Publishing (shaded area indicates the 95% confidence).

#### Gender profiles in UK patenting

Measuring the outputs from science and engineering can be challenging, but patent registrations provide one avenue for doing so. There is no requirement to disclose diversity data relating to the inventor. However, the Intellectual Property Office has been able to apply gender inference techniques to name data. In March 2016, it released a report summarising its findings.<sup>25</sup>

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# 9 The Royal Society of Chemistry membership, prizes and awards, events

As the UK's professional body for chemical scientists, the Royal Society of Chemistry has a key role to play in supporting and connecting individuals within the chemical science community throughout their careers, from the earliest stages of study through to retirement.

We currently hold age and gender information against member records. However, more appropriate monitoring and data gathering are needed to help deepen our understanding of the diversity of members.

#### Membership

#### Membership by gender

The proportion of women in membership has increased steadily o da0N scanst 10y ears, frof Figure 25royal Society of Chemistry(membership,splitp by gender)]TJ-550238 28010 Td[(Tga)3 (g aalysisy f)5.1 ( unn tga)3 (g

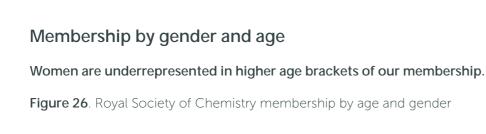


Figure 28. Age profile of committee members compared to membership age profile, 2015.

The age distribution of committee members broadly follows that of the membership as a whole with younger members being under represented.

Fellows by gender

Figure 27. Membership categories by gender and age

Analysis of our membership categories shows that at Affiliate and Associate levels, there is a healthy proportion of women in membership and the balance is reflective of the undergraduate population. However, the proportion of women in the two more senior categories of membership falls dramatically, mirroring the 'leaky pipeline' in academia. The average age of female Members and Fellows is lower than that for men, as might be expected from the fact that the proportion of women in membership tails off with age.

Our Inclusion and Diversity Strategy for 2014–2017 set a target of 10% female FRSC and 30% female MRSC by 2017, compared to the 2013 levels of 6% and 22% respectively. The 2016 figures show that we are on track to reach these targets.

#### **Chartered Status**

There are established routes for chemistry professionals to work towards three different forms of Chartered Status: Chartered Chemist (CChem), Chartered Scientist (CSci) and Chartered Environmentalist (CEnv). Attaining chartered status recognises the achievement of professional standards and is a commitment to continuous professional development.

The majority of Chartered Chemists are male and their average age is eight years greater than that of female Chartered Chemists, for whom the mean average age is 52 years old. Our 2017 pay and reward survey found that the median salary for members and fellows with Chartered Chemist status was £13,800 more than those without.<sup>57</sup>

Figure 30. Chartered Chemists by gender, 2016

#### Pay and Reward Survey 2017

Every two years the Royal Society of Chemistry carries out a members' survey to collect data on salary, employment benefits and career satisfaction.<sup>57</sup> In 2017, over 6,000 members responded and the sample was representative of the membership as a whole with 28% female and 72% male. A higher proportion of respondents in the older age range were male. Therefore, the gender results are largely informed by age.

47% of surveyed members worked in an industrial or commercial firm, just under 30% are employed in an educational environment such as university. Women were more likely to be working in a school/sixth form or employed by not-for-profit organisations.

15% of members had taken a career break of more than three months since the beginning of their career – 33% of women, compared to 8% of men. 79% of the career breaks taken were up to one year in duration and family leave accounted for 56% of these career breaks. Nationally, the take up for Shared Parental Leave by men is still very low with 0.5%–2% of eligible fathers taking up the opportunity, which was introduced in October 2015. Other reasons for career breaks cited by members included unemployment (16%), study, travelling, or other caring responsibilities.

For 42% of employees who have taken a career break, their perceived prospects since returning to work have remained unchanged. However, 34% of women feel their prospects have worsened compared to only 14% for men.

62% of members' employers offer flexible working – the opportunity to choose the hours worked within the boundaries of core hours. 41% offer part-time working and 14% do not offer either flexible working or part-time working. It should be noted that all qualifying employees in the UK have the legal right to request flexible working – not just parents and carers.

Achieving a suitable work–life balance was the key priority for members when considering future employers. Flexible working or flexi-time was the highest priority benefit. The desire for a healthy work–life balance is reinforced by 70% of members selecting holiday allowance and flexible hours as their most important benefits. The Chartered Institute of Management defines good work–life balance as a situation where work/home conflict is minimised so that the demands of work do not prevent a person gaining satisfaction from their life outside work, while aspects of their personal life do not spill over to exert a negative impact on their work.<sup>58</sup> Positive work–life balance helps to minimise stress and improves productivity.

The survey results showed that the gender pay gap is still present and has increased since the 2015 survey to £13,000. Overall earning potential generally increases with age and experience, but when split by gender, it is apparent that the gender gap increases markedly with age.

**Figure 31**. Gender pay gap by age – median remuneration by gender. Source: Royal Society of Chemistry Pay and Reward Survey 2017<sup>57</sup>

#### Prizes and awards

Figure 32. Royal Society of Chemistry award winners by gender

The Royal Society of Chemistry has collected data on the gender of nominees since 2014 and during that period the percentage of all nominees that were female was less than or equal to the percentage of female winners. There is therefore no evidence that there is bias at the point at which winners are selected. Measures such as unconscious bias training, continuous review of the nomination and judging processes, and broadening the pool of nominators and nominees remain a priority.

Since 2014 we have been proactive in communicating the statistics related to gender diversity and in encouraging the community, individually and collectively, to be proactive in considering inclusion and diversity when making nominations.

Figure 33. Proportion of female nominees tions.

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