Power Shift:

How to build Gender Balance in the Energy Research Portfolio

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Executive Summary

As the UK parliament declares a climate emergency[1] and the Committee on Climate Change[2] recommends a new target for the UK of net-zero greenhouse gas emissions by 2050 it is clear that UK energy research needs to harness 100 per cent of available talent in order to meet the challenge of rapidly decarbonising energy systems.

Female academics are already building the energy research portfolio, but many find it hard to access research funding and to progress within academia. Too often, significant research funding is the preserve of the few – in mainly male-led teams. This is a waste of female talent and expertise. This report draws on new data and sets out how UK Research and Innovation (UKRI)[3] and other funders can progress gender balance within their energy research portfolios, and how universities can better support female energy academics.

This report is based on our research on gender balance within the energy research portfolio. It looks at what the existing data tells us about the allocation of research funding, and at the lived-experience of female academics along the energy research career trajectory. The energy research landscape is hugely diverse and the issues relating to gender balance[4] are complex and intertwined with other diversity and inclusion issues. However, progress on gender balance has been too slow for too long. There is a welcome renewed focus on equality, diversity and inclusion (EDI) issues by UKRI and many instances of good practice, but this research suggests there is a need for more systemic and far-reaching change.

As others have pointed out, it is old news that women are underrepresented in leadership positions in academia. For energy research the data is stark. Far fewer women than men progress from studentships to independent energy research funding. The proportion of female principal investigator (PI) or co-investigator awards (Co-I) is low (figure 1). Few women receive (or apply for) the largest and most prestigious grants. There is some positive progress with the last two years indicating an increase in female PI success rates (particularly for fellowships) and some improvement in the gender balance of peer review panels. But despite these successes progress is slow. There is also very limited visibility of EDI data for cross-cutting areas such as energy research – making it difficult to evaluate progress.

1   www.bbc.co.uk/news/uk-politics-48126677

2   www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

3   UKRI brings together the Arts and Humanities Research Council; Biotechnology and Biological Sciences Research Council; Engineering and Physical Sciences Research Council; Economic and Social Research Council; Medical Research Council; Natural Environment Research Council; and Science and Technology Facilities Council; Innovate UK and Research England.

4   by this we mean 'equal participation of women and men in all areas of work, projects or programmes', https://eige.europa.eu/thesaurus/terms/1148).

Figure 1 Combined Principal Investigator (PI) and Co-Investigator (Co-I) grant and fellowship applications and awards in EPSRC Energy

Source: Authors from EPSRC Energy Data

In order to understand these issues better we talked to 59 female energy academics, from across career stage, disciplines and institutions, regarding their experiences of funding and academic life. Our findings make clear the need for further action to make funding processes and structures more inclusive, but also that any progress in funding needs to be accompanied by systemic change within the institutional structures and cultural environment of the universities. Although we highlight gender balance initiatives and good practice within funders and universities, our research also uncovers a whole range of funding and systemic issues that act as barriers to career progression for female energy academics. We set out four key ways in which UKRI, other funders and universities can better support and progress female energy academics and improve gender balance: **Look at the data; Fund more women; Stimulate career progression for female energy academics**, and; **Build on what is working**.

Key recommendations in each of these areas are:

Look at the data

Key issue: Understand the data and be transparent

- Build a robust database for analysis of gender balance in energy research funding, and more broadly across thematic areas, rather than just at research council level. Quantitative data will lead to more structured action

- Set targets, monitor progress and provide annual updates on results

- Make gender balance data more accessible and transparent. Review UKRI privacy statements to ensure that diversity data can be used (including by external organisations) for monitoring purposes

- Make EDI criteria part of the application process and score results alongside research outputs

Key issue: Speak to female academics

- Acknowledge the links between research culture and EDI issues and take co-ordinated action

- Use quantitative and qualitative data to identify key intervention points. For example both data sets analysed in this study indicated that the trend towards large grants and big consortia bids disproportionately impacts female academics

Key issue: Continue to improve review panel gender balance

- Continue to get more women involved in reviewing and on panels and recognise the important role that experience of peer review and panels can play in learning how to write successful applications

- Provide extra training for more junior women (and men) and provide a process for review requests to be pro-rated in line with part-time employment

- Increase awareness of policies to support fairness in peer review. There was limited awareness of the existing provision for care costs over and above standard care arrangements to be considered as part of EPSRC proposals or to be requested in relation to attendance to funding events and panels

Fund more women

Key issue: Funding structures can be a barrier

- Set and adhere to standards regarding the minimum length of a call and ensure all funding events are remotely accessible. Do not predicate funding on attendance to specific events

- Effectively monitor EDI statements and plans in funding application

- Fund and promote networking events for female energy academics, particularly in relation to specific funding calls

- Fund and facilitate networking and collaboration between female energy researchers and female industry representatives

Key issue: Part-time working and career breaks are perceived to slow progress

- UKRI should ensure the assessment of part-time working and parental leave is standardised across funder eligibility criteria and in review processes, and is communicated to researchers

- Re-evaluate how CVs are assessed at different career stages

- Recognise the EDI impacts of over-reliance on quantitative measures of academic recognition and esteem

Key issue: A lack of diversity of funding types impacts on women

- Acknowledge that the trend towards large centres and consortia is unlikely to support improved gender balance in research funding and seek to address this

- Focus on supporting (female) early career researchers

- Trial innovative approaches to allocating funding including lottery systems and blind peer review

Stimulate career progression for female energy academics

Key Issue: Work-life balance

- Acknowledge and take action on the long hours and precarious culture of academia

- The ability to work long, un-contracted hours should not be synonymous with productivity and commitment. There is a need to challenge organisational cultures that privilege work above everything else. Make work-life balance the norm.

- Recognise the effects of wide spread fixed term contracts on the retention of early career researchers. Take action against the precariousness of research careers and create an attractive and secure working environment to get the best out of researchers.

Key Issue: Institutional structures and cultures

- Review current measures of recognition and esteem. Address the funding hierarchy and review criteria for research productivity: don't assume everyone has an equal start point. Changing university culture means looking beyond initiatives such as Athena Swan. There is a need to value academic citizenship and take performance into account for career progression.

Key Issue: Training, support and mentoring

- Build and tailor training, mentoring and support networks to help more women progress. Training, mentoring and support is vital for all academics but for women to progress and be more ambitious (and successful) in their funding aspirations, there is evidence that current systems need tailoring to suit their needs.

Key Issue: visibility of female energy academics

• Make female energy researchers more visible. Female energy researchers need more visibility both within the research councils and within their academic institutions.

Build on what is working

• Publicise more widely what UKRI and other research councils are already doing to fund female energy academics and raise their profiles

• Identify key points of engagement to build transition

• Use a top-down and bottom-up approach. Adopt systemic solutions, a piecemeal approach will not work

• Ensure equality of voice – women's voices must be heard

• Conduct more research studies on gender balance in the energy research portfolio (nationally and internationally) to build on the findings of this report

Our recommendations aim to move away from only using standard metrics because sustainable gender balance also requires a sea-change in cultural values if more female energy academics are to progress in their careers. There needs to be a focus on not only the overarching legislative frameworks and the organisational structures that support academic research in energy but also on building closer more cohesive relationships between universities and UKRI and, most importantly, on finding out what women have to say. This report is a start, but we call for more research both nationally and internationally.

Acknowledgments

Contents

1.0 Introduction

Female academics are already building the energy research portfolio, but many find it hard to access research funding and to progress within academia. Too often, significant research funding is the preserve of the few – in mainly male-led teams. This is a waste of female talent and expertise. UK Research and Innovation (UKRI)[6] and other funders need to progress gender balance within their energy research portfolios, and universities need to better support female energy academics. This report sets out how.

1.1 Why now?

This is not a new story. A plethora of reports provide evidence of the barriers and biases that many women encounter within STEM subjects (science, technology, engineering and maths)[7] and more widely. While women account for well over half of postgraduates far fewer women hold academic posts and just 1 in 4 professors are women (figure 2). In common with other subject areas, even a cursory look at the data on funding for energy research and on the small number of women in senior academic positions reveals the extent of the gender balance problem for energy within academia. As the ScienceGrrl team say in their report, *'these aren't new shocking facts. This is old news.'* Yet there has been little progress.

Figure 2: Higher education female population in 2017-18

56.5%	**Undergradute student population**
58.2%	**Postgraduate population**
45.9%	**Academic staff population**
25.5%	**Professors**

Source: Authors analysis from HESA data[8]

We are also researching and writing this report as a range of political, ecological and cultural factors have put a spotlight on the energy sector. As the UK parliament declares a climate emergency[9] and the Committee on Climate Change[10] recommends a new target for the UK of net-zero greenhouse gas emissions by 2050, climate action needs women[11]. Closing the energy gender gap can accelerate the transition to more sustainable and renewable energy systems. Research shows that having a more diverse workforce leads to more innovation, and companies with more women on their boards are more likely to proactively invest in renewable energy and reduce carbon emissions throughout their supply chains.[12]

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6   Arts and Humanities Research Council (AHRC); Biotechnology and Biological Sciences Research Council BBSRC; Engineering and Physical Sciences Research Council (EPSRC); Economic and Social Research Council (ESRC); Medical Research Council (MRC); Natural Environment Research Council (NERC); Science and Technology Facilities Council (STFC), Innovate UK and Research England.

7   see for e.g. 1993: https://www.gov.uk/government/publications/realising-our-potential-a-strategy-for-science-engineering-and-technology or 2017: https://sciencegrrl.co.uk/assets/SCIENCE-GRRL-Stem-Report_FINAL_WEBLINKS-1.pdf

8   https://www.hesa.ac.uk/data-and-analysis

9   www.bbc.co.uk/news/uk-politics-48126677

10 www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

11 https://unfccc.int/news/5-reasons-why-climate-action-needs-women

12 https://theconversation.com/dear-hillary-where-are-the-women-in-your-energy-strategy-58847

'We need to do everything we can to encourage diversity in clean energy, for the simple reason that we're not going to tackle a problem as big as climate change with only half of the population along for the ride'
Juliet Davenport in the Regen report: *'The role of women as drivers of change in the energy transition'* [13]

A study by PWC[14] in 2016 found that just 9% of energy sector board seats are held by women, and that progress in increasing the number of women in senior management positions is slow. As the Enterprising Women in Renewable Energy (EWiRE) network puts it *'In a sector historically led by heavy engineering it's not surprising that energy companies were traditionally male-dominated, but history is not a valid justification for gender imbalance in 2019'* [15].

This is also a time of change for UK research funding as UKRI becomes established and brings together all seven research councils, Research England and Innovate UK. On the one hand, this new strategic role for UKRI presents an opportune moment to improve gender balance in the energy research portfolio as part of its evolving Equality, Diversity and Inclusion (EDI) strategy[16,17], alongside separate initiatives from the research councils[18] and UKERC's suite of projects on gender under the Whole System Networking Fund[19] (of which this project is one). But on the other hand, this is also a moment when the possible impacts of Brexit on funding are unknown. As the EU is a significant source of funding for UK energy infrastructure and climate mitigation this could pose further barriers for women if funds are cut or re-distributed.

This report makes clear that any progress in funding for women needs to be accompanied by systemic change within the institutional structures and cultural environment of the universities. Although we highlight gender balance initiatives and good practice within funders and universities, our research also uncovers a whole range of funding and systemic issues that act as barriers to career progression for female energy academics.

13 www.regen.co.uk/wp-content/uploads/EWiRE-Role-of-women-Doubles.pdf
14 https://pwc.blogs.com/files/16.05.09---pwc_pfw_-igniting-change-2-report.pdf
15 www.regen.co.uk/wp-content/uploads/EWiRE-Role-of-women-Doubles.pdf
16 www.ukri.org/about-us/policies-and-standards/equality-diversity-and-inclusion/
17 www.ukri.org/about-us/equality-diversity-and-inclusion/strengthening-our-approach/
18 For example: https://epsrc.ukri.org/funding/edi-at-epsrc/evolving-and-upholding-fairness-in-peer-review
19 http://www.ukerc.ac.uk/programmes/networking-fund.html

This report is based on our research on gender balance within the energy research portfolio[20]. It looks at what the existing data tells us about the allocation of research funding, and at the lived-experience of female academics along the energy research career trajectory. The energy research landscape is hugely diverse and the issues relating to gender balance[21] are complex and intertwined with other diversity and inclusion issues. However, progress on gender balance has been too slow for too long. There is a welcome renewed focus on EDI issues by UKRI and many instances of good practice, but this research suggests that much of the current activity – while helpful – tends to be focussed on individual barriers resulting in only incremental change. We set out four key ways in which UKRI, the research councils, other funders and universities can better support and progress female energy academics and improve gender balance:

1. Look at the data

2. Fund more women

3. Stimulate career progression for female energy academics

4. Build on what is working

20 The 'energy research portfolio' is defined broadly as: UK government funding to research and higher education through UKRI; EU Horizon 2020 funded projects led by UK institutions and projects directly funded by BEIS. However due to limitations in data availability this report focusses on energy research funded by EPSRC, with some limited analysis of ESRC funding.

21 by this we mean 'equal participation of women and men in all areas of work, projects or programmes' (European Institute for Gender Equality, https://eige.europa.eu/thesaurus/terms/1148).

2.0 Look at the data

We have analysed available data on academic populations and the distribution of energy research funding, as well as spoken to 59 female energy academics regarding their lived experience of both funding and wider academic life. Our data reflects that of many other studies – progress is slow in achieving gender balance. However our research also reveals the importance of using the data (ours and others) to continue to identify the barriers to gender balance in energy research funding and implement comprehensive action to deliver change.

This section outlines the quantitative data we collected, our methodology and discusses some key priorities in relation to collecting and analysing equality, diversity and inclusion (EDI) data. More information about the data can be found in the methodology section in the annex.

No lack of data

A wealth of data exists on undergraduate, postgraduate and academic staff populations in the UK higher education sector, as well as in relation to research funding. The Higher Education Statistics Agency (HESA) publish annual statistics on numerous aspects of the UK higher education sector[22] and all seven Research Councils hold diversity data on funding applications and awards, studentships[23] and membership of review panels. UKRI publishes high-level research council diversity data annually and the UCU (University and College Union) publishes annual data on the gender pay gap in higher education[24].

The message from this data is clear. Progress is slow in achieving gender parity in academia. The latest HESA data indicates that while women make up 56.5% and 58.2% of undergraduates and postgraduates respectively, just 1 in 4 Professors are women (25.5%), and only 8.4% of female professors identify as Black and Minority Ethnic (BME)[25],[26]. A higher proportion of women are also on precarious fixed-term contracts. Based on the rates of progress indicated in the HESA data it will take over 20 years to reach gender parity in academic staff populations and over 30 years to reach gender parity in Professorial positions.

It is also clear that the challenge is much starker in some disciplines with women accounting for a much smaller proportion of the academic population in STEM subjects. Similar themes are evident in the EU with data on gender balance in research and higher education for the EU28 indicating that gender imbalance increases with seniority, and is more evident in STEM fields[27].

22 https://www.hesa.ac.uk/data-and-analysis
23 https://www.ukri.org/files/rcuk-diversity-headline-narratives-april2017-pdf/
24 https://www.ucu.org.uk/genderpay
25 https://www.advance-he.ac.uk/news-and-views/Equality-in-higher-education-statistical-report-2018
26 Although the proportion of female BME professors is higher than across academia where just 1.7% of Professors identify as BME.
27 https://publications.europa.eu/en/publication-detail/-/publication/9540ffa1-4478-11e9-a8ed-01aa75ed71a1/language-en

However, despite extensive data existing on academic populations and funding there is a surprising lack of analysis, particularly across thematic area. Data tends to be available by discipline (such as Engineering and Technology, or Medicine, Dentistry and Health) but there is extremely limited data available for cross cutting areas such as energy. Much diversity data also have limited granularity or transparency. For example the annual UKRI reports present headline statistics on the allocation of funding by research council, but the narratives on this data are limited and links to action unclear. There is also often extensive rounding of data to protect the identity of individuals, limiting its utility to researchers seeking to explore the issues.

No lack of evidence

There is a very significant body of quantitative and qualitative studies that suggest gender biases persist across academia and have a material impact on the success of female researchers. A comprehensive Nature comment piece by Kathleen E. Grogan[28] in January 2019 summarises many of the key studies of these biases and barriers for women in science, technology, engineering and mathematics fields. These span funding, under-representation in publishing, biases in recommendations and hiring, and less recognition and visibility. Additionally Danica Savonick and Cathy N. Davidson at LSE present an annotated bibliography[29] of recent studies of academic gender bias and gender discrimination which lists 34 studies that find gender bias (against women in academe) and only 6 studies that find lack of bias or bias in favour of women in STEM fields.

No lack of pronouncements

Over the last 30 years reports and strategies have repeatedly highlighted the benefits of addressing the lack of gender balance in UK academe and sought to act as a fulcrum for change. The below reports represent a small selection of the many publications highlighting and calling for action on the gender imbalance in academia.

1993: the Government published Realising our Potential: a strategy for science, engineering and technology[30] which highlighted that there *'is a widespread waste of talent and training throughout industry and academia due to the absence of women. Women are the country's single, most under-valued and therefore under-used human resource.'*

2009: EPSRC published an international review of perceptions of the UK materials research base[31] which emphasises that the panel who conducted the review were concerned by the *'lack of diversity of the faculty groups they met. Given that these groups were generally presented as the leadership of the institutions they visited, the lack of gender diversity in particular was very troubling. While EPSRC statistics show that 11% of grants in the materials remit are awarded to women (a statistic that in itself gives rise to concern), the faculty leadership groups we met with were even more overwhelmingly male'.*

28 https://www.nature.com/articles/s41559-018-0747-4.pdf
29 https://blogs.lse.ac.uk/impactofsocialsciences/2016/03/08/gender-bias-in-academe-an-annotated-bibliography/
30 https://www.gov.uk/government/publications/realising-our-potential-a-strategy-for-science-engineering-and-technology
31 https://epsrc.ukri.org/newsevents/pubs/international-perceptions-of-the-uk-materials-research-base/

2017: The ScienceGrrl report *'Through both eyes: the case for a gender lens in STEM'*[32] highlights the poor statistics on the proportion of women within the STEM sector in academia and industry. They stress that *'these aren't new shocking facts… There is broad recognition that women represent an untapped resource for the STEM sector and that allowing girls to realise their potential is as much about good business sense as it is about social justice. Why then, despite widespread concern, is nothing much changing?'*

2018: The Royal Society of Chemistry report *'Breaking the Barriers. Women's retention and progression in the chemical sciences'*[33] reports that there is a *'worrying lack of progress in developing and retaining women in leadership positions in the chemical sciences'* citing evidence that just 9% of chemistry professors in the UK are women and the 35 percentage point drop in the proportion of women reaching senior positions compared to undergraduate study.

2019: Chris Skidmore, Minister of State for Universities, Science, Research and Innovation writes that *'To have real equality in the sector, we need to ensure talented women are able to progress into the academic and leadership roles they desire, and get the remuneration they deserve. Data shows us the ladder to success gets harder for women to climb the further up they go… Having women properly represented in all aspects of university life is not only a sign of a fair and inclusive society; it can also lead to a more cohesive, collaborative academic community'.*[34]

Recently UKRI have stated their aim to strengthen their approach to equality, diversity and inclusion, including setting up a new EDI External Advisory Group in late 2018 and undertaking a (currently ongoing) review of EDI challenges and interventions in research and innovation[35]. The energy industry has also been a refocussing on the need to improve gender balance with industry networks such as POWERful Women[36], EWiRE[37] and WISE[38] acting as powerful advocates for change.

All these developments are positive and evidence a renewed focus on EDI across academic research and in the energy industry. However the long history of such reports and statements of intent emphasises the need to mobilise current momentum into substantive action across Higher Education Institutions (HEIs), funders, the academic community and industry. Only by taking an approach that recognises and acts on the significant structural and institutional challenges to gender balance will the issues be effectively addressed.

32 https://sciencegrrl.co.uk/assets/SCIENCE-GRRL-Stem-Report_FINAL_WEBLINKS-1.pdf

33 https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/womens-progression/media-pack/v18_vo_inclusion-and-diversity-_womans-progresGion_report-web-.pdf

34 https://www.theguardian.com/education/2019/mar/08/universities-need-to-promote-more-women-to-professor

35 https://www.ukri.org/about-us/equality-diversity-and-inclusion/where-we-stand/

36 http://powerfulwomen.org.uk/

37 https://www.regen.co.uk/area/women-in-renewables/

38 https://www.wisecampaign.org.uk/

Exploring energy research

In the UK the Engineering and Physical Sciences Research Council (EPSRC) is the lead research council for the energy programme and a key funder, although energy research is funded across a range of research councils. Currently EPSRC indicate that the energy theme consists of 290 grants at a value of £299,711,585[39]. Energy is situated with the EPSRC research portfolio as one of seven 'challenge' areas[40] and subsequently tracked across a number of sub-categories as illustrated in figure 3.

Figure 3: EPSRC Energy research portfolio as of May 2019

Source: EPSRC website[41]

The first point to make is that 'energy research' is not straightforward to define because of the multi-faceted and interdisciplinary nature of energy as an academic area. Although EPSRC, BBSRC, ESRC, NERC and STFC[42] work together to develop and deliver energy research and training (under EPSRC's leadership of the Energy Programme) the information presented in figure 3 represents energy funding led by EPSRC. Further research is funded across many of the other research councils, Innovate UK and European funding but it was not possible to access data for all research councils in the course of this research.

39 https://gow.epsrc.ukri.org/NGBOListThemes.aspx
40 Other challenge areas include digital economy and global uncertainties.
41 https://epsrc.ukri.org/research/ourportfolio/vop/pack/RESEARCHAREA/NONE/THEME/Energy/9999
42 Engineering and Physical Sciences Research Council (EPSRC), Biotechnology and Biological Sciences Research Council (BBSRC), Economic and Social Research Council (ESRC), Natural Environment Research Council (NERC) and Science and Technology Facilities Council (STFC)

Due to a range of challenges in accessing comprehensive data on the full range of energy research (as discussed in detail in the methodology annex) we have focussed our quantitative data analysis on funding allocated by EPSRC and ESRC, but note that these funders, particularly EPSRC, are key funders of energy research in the UK.

2.1 Summary of methodology

In order to explore gender balance specifically in relation to energy research we gathered data on funding in the energy portfolio and spoke to female energy academics about their experiences. Key points to note in our methodology are:

- EPSRC provided us with a summary of diversity data in relation to their energy research portfolio. This included Principal Investigator (PI) and Co-Investigator (Co-I) application and award rates across grant types and fellowships, as well as information about the EPSRC Energy PhD student population and membership of peer review panels. This data was anonymised using HESA rounding and suppression methodology[43] and did not include information on award values.

- UKERC Energy Data Centre provided a database of energy research awards based on their publicly available Projects Catalogue[44]. This data source was more comprehensive than the EPSRC data in that it detailed multiple research council data (although only EPSRC and ESRC data was complete enough for analysis for the purpose of this project), individual award value and allocated a percentage of energy relevance across a number of sub-themes. Gender was manually assigned to this data source for principal investigators based on publicly available information.

- Interviews were carried out with 29 female academics across career stage, and two focus groups were completed with a total of 30 female early career energy academics. Participants were asked about their experiences of career progression and the funding landscape, whether gender has played a role in their career and their views on how gender balance can be progressed within funders and higher education institutions (HEIs). The 59 female academics we engaged with came from a wide range of institutions, disciplines and career stage as discussed further in the annex A.

- The detailed methodology we employed, together with a range of caveats and further information on sources are presented in annex A.

2.2 Analysis of funding data and academic populations

2.2.1 Headline findings

- Application rates from women are low for energy funding, although largely in line with academic populations

- When they apply female academics are equally, and sometimes more, likely to be funded than male academics[45]

- There is a significant drop off in numbers of women between studentships and funded academic level

- Grants awarded (and applications made) tend to be for smaller value grants

43 https://www.hesa.ac.uk/about/regulation/data-protection/rounding-and-suppression-anonymise-statistics
44 https://ukerc.rl.ac.uk/cgi-bin/era002.pl
45 This is in line with the findings of studies on other sectors, as outlined in https://www.nature.com/articles/s41559-018-0747-4.pdf.

The data provided by the EPSRC on grant application and award rates indicate that the proportion of female researchers either applying for or being awarded energy research funding is low, but largely comparable to the proportion of women within the wider EPSRC academic community. The percentage of awards allocated to women ranged between 13.5-17.3% between 2011-12 and 2017/18 (see Figure 4 and 5). The Research Council's Diversity Data estimated the female academic population of EPSRC in 2015-16 to be 17%[46].

Figure 4 Combined Principal Investigator (PI) and Co-Investigator (Co-I) grant and fellowship applications and awards in EPSRC Energy

Source: Authors analysis from EPSRC Energy Data

From 2011-12 to 2015-16 the percentage of successful applications from women was generally similar to the percentage of female applications. However data in 2016/17 and 2017/18 indicates that there has been a small increase in the proportion of female applicants being awarded grants and fellowships (see figure 5).

Figure 5 Combined Female PI and Co-I grant and fellowship applications and awards in EPSRC Energy
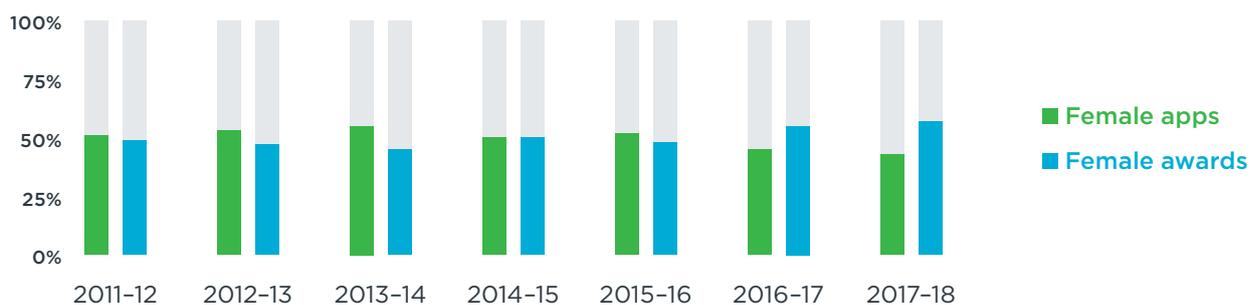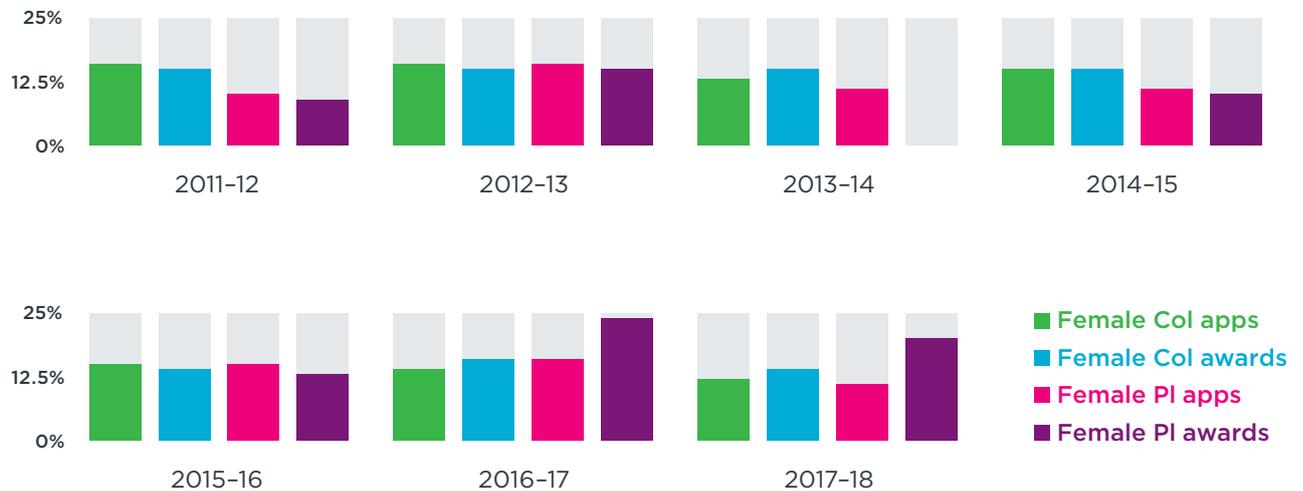

Source: Authors analysis from EPSRC Energy Data

When we look at the proportion of female Co-I and PI awards separately (figure 6) we can see that this increase can be mainly attributed to a larger number of PI grant and fellowship awards in the last two years.

Figure 6 Grant and Fellowship awards in EPSRC Energy by type of Investigator

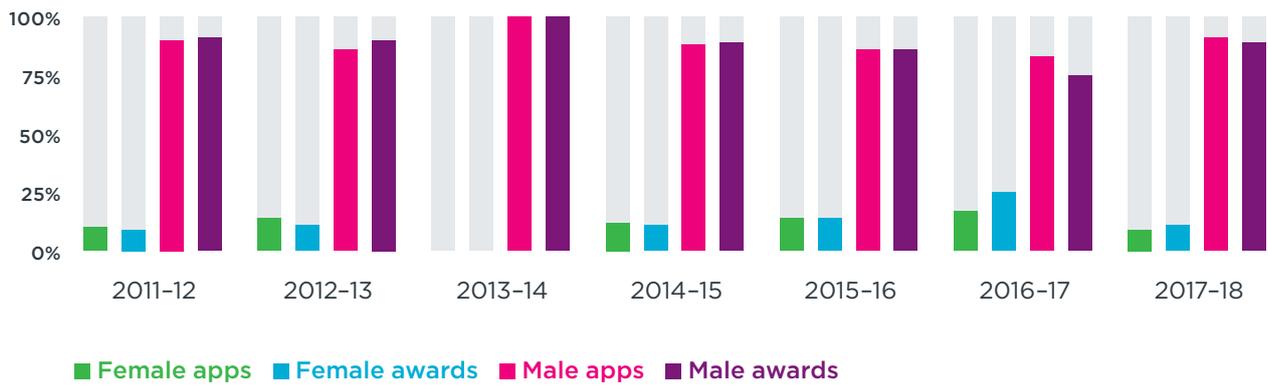**Source: Authors analysis from EPSRC Energy Data**

* note that in 2013/14 women received zero PI awards in EPSRC Energy

While it is too early to draw conclusions regarding whether this trend will continue in future, or whether this will influence the number of female applications going forward, it is interesting to note that this small increase in female awards has taken place over the same time period as the EPSRC has increased the proportion of women on funding panels (see section 2.2.5 on Peer Review and Funding Panels).

2.2.2 Women as Principal Investigators

The data relating to female principal investigators demonstrates the small number of applications received from women, with no applications submitted for responsive and targeted mode calls in 2013-14. Comparing female PI grant award rates (Figure 7) with the PI grant and fellowship awards in Figure 6 indicates that, despite their small numbers, fellowship applications played a significant role in increasing women's overall success rate in 2017/18 with female PIs leading 11.1% of targeted and responsive awards but 20% of awards when fellowships are included in the analysis.

Figure 7 Women's and Men's PI responsive and targeted grant applications and awards

Source: Authors analysis from EPSRC Energy Data

Figure 8 Combined average grant & fellowship application and award rates of Female PIs in EPSRC and EPSRC Energy (%)
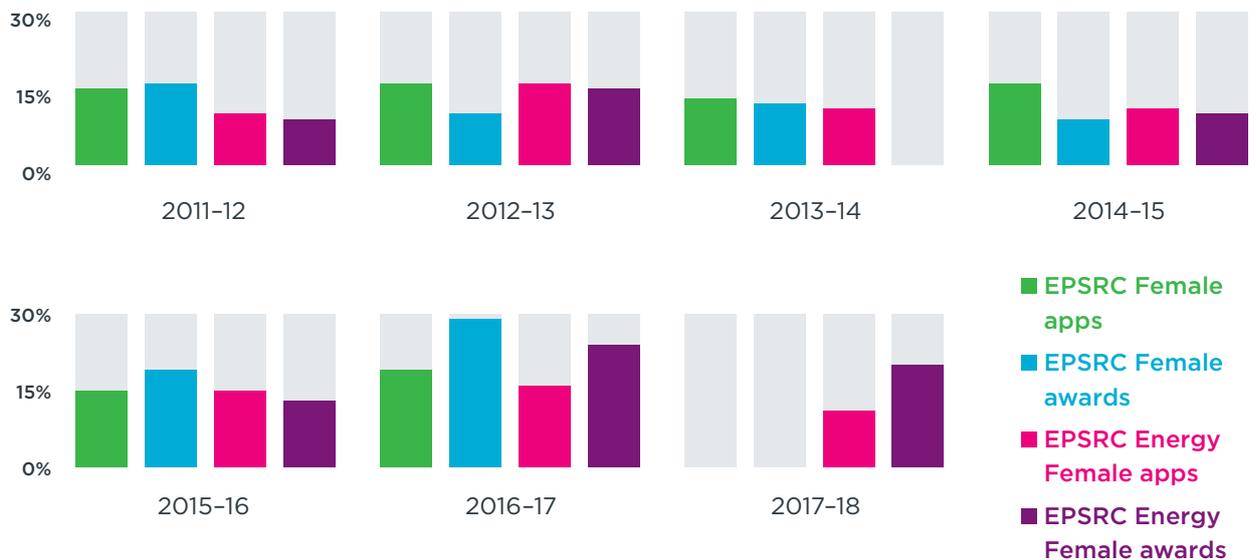
Source: Authors analysis from EPSRC Energy Data and Research Council's Diversity Data

* no data available for EPSRC for 2017/18
* note that in 2013/14 women received zero PI awards in EPSRC Energy

As mentioned previously, there has been an increase in female PI awards across both EPSRC and EPSRC Energy in the last two years (Figure 8). In EPSRC the proportion of awards allocated to female PIs surpassed the application rate, by 4%, in 2015-16 and this tendency continued in 2016-17, this time by 9.8%. In EPSRC Energy the percent of awards that were allocated to female PIs surpassed the application rate for the first time in 2016-17, by 7.2% and this progression continued in 2017-18 with an 8.9% difference this time.

2.2.3 Women as Co-Investigators

The application rates for Co-I awards in the EPSRC energy portfolio (Figure 9) are largely in-line with the wider EPSRC portfolio (Figure 10), with few women applying and being funded. There has been little progress in terms of increasing application numbers over the past 7 years in the energy portfolio.

The proportion of Co-I applications from women in the wider EPSRC portfolio (Figure 10) has ranged from 12.2%-18.4%, slightly higher than for Energy where it ranges from 12.2% to 15.8%. However women are slightly more successful in being awarded energy funding than across the whole portfolio.

Overall in EPSRC Energy women submitted more applications for Co-I than PI funding (Figure 6), with 2016-17 being the only year in the analysed period when the proportion of PI applications was higher than that of Co-I applications. The proportions of female Co-I awards have also increased in the last two years, however this increase was much more pronounced for female PI awards in the same period.

Figure 9 Women's and Men's Co-I grant applications and awards in EPSRC Energy

Source: Authors analysis from EPSRC Energy Data

Figure 10 Women's and Men's Co-I grant applications and awards in EPSRC

Legend: ■ Female apps ■ Female awards ■ Male apps ■ Male awards
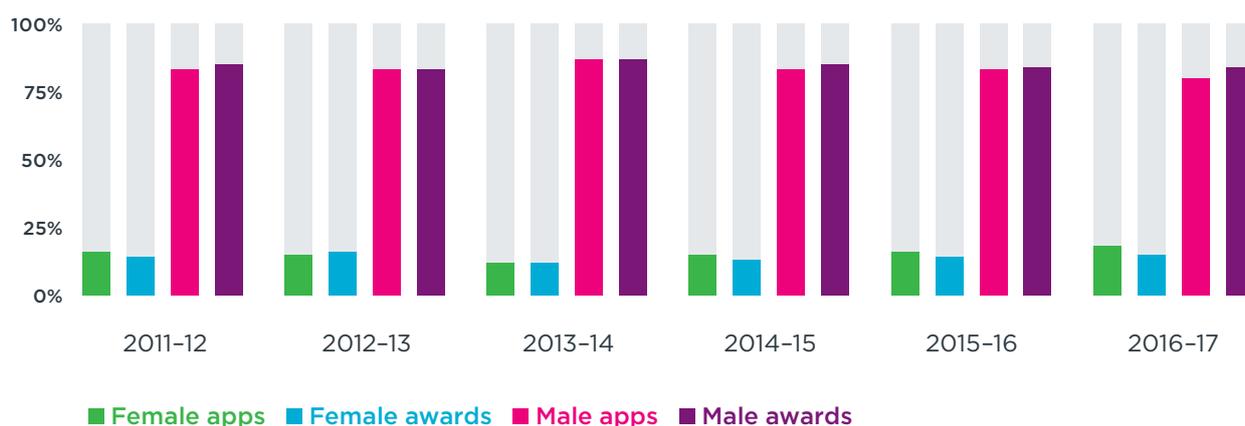
Source: Authors analysis from Research Council's Diversity data

2.2.4 Student population

The proportion of energy studentships held by women is significantly higher than the proportion of funding awards held by women (see figure 11). While the proportion of awards held by women is not a direct proxy for the energy academic population the data gives an indication of the proportion of research being carried out by women. Additionally while there are difficulties in comparing the data on studentships as the data each year is a total of all studentships across years (i.e. not only new studentships in that year) the persistence of a wide discrepancy between female studentships and funding awards may highlight the transition from PhD to securing independent research funding as one of the possible 'drop-off' points where the energy research portfolio is losing female talent at an early stage. Data relating to the gender balance of post-doctoral positions was not available. However it is likely that a post-doctoral position on a research grant would be the next career step for the majority in terms of the transition towards independent research and further visibility of gender balance at this stage would provide a clearer picture of where female researchers leave academia.

Figure 11 Female students and funded female researchers[47]

Legend: ■ Female students ■ Funded female researchers
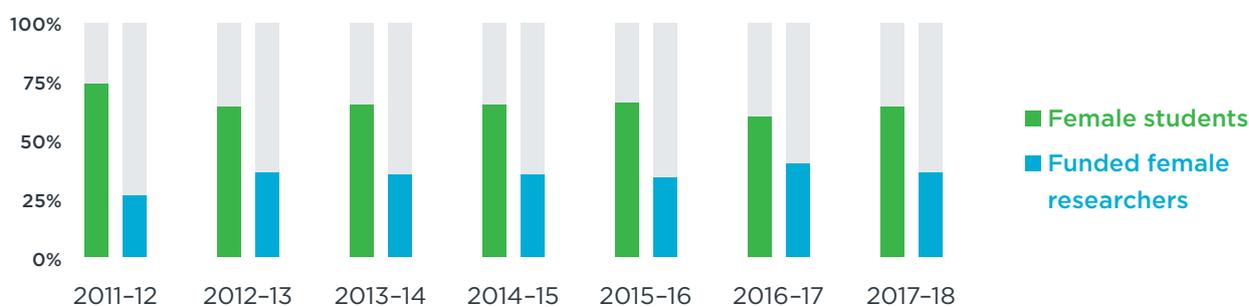
Source: Authors analysis from EPSRC Energy data

47 Studentships in 2011-12 were particularly low so the high proportion of female awards should be viewed in this context.
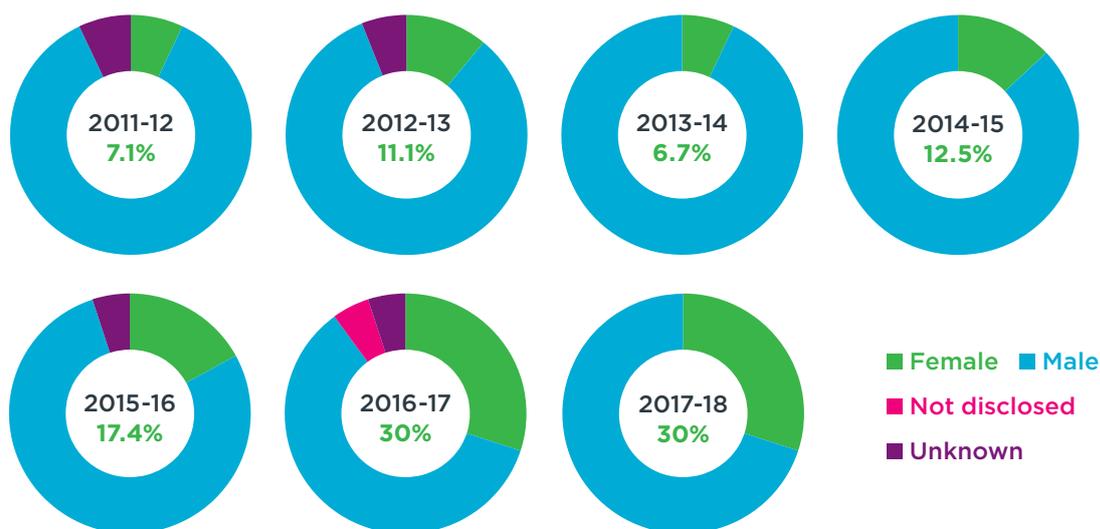
2.2.5 Peer review and funding panels

Peer review is central to EPSRC funding decisions and relies on expert advice which comes primarily from members of the College of Peer Reviewers. The college is made up of 5,500 individuals and is the source of most reviewers and panel members.

EPSRC is committed to upholding fairness in peer review[48] and have recently reviewed their policies in this areas. Measures to support fairness in peer review include:

- A policy to complete a Equality Impact Assessment[49] for major policy changes, calls for proposals and events;

- Support for people with caring responsibilities[50] including provision for care costs over and above standard care arrangements to be considered as part of EPSRC proposals and support can be requested to attend EPSRC funding events and panels.

- EPSRC staff complete unconscious bias training that is tailored to their role as a panel convenor. All panel members are provided with an unconscious bias briefing to help raise awareness of the impact it has on decision making and how to manage this in panel meetings.

- There has been significant progress made on the gender balance of EPSRC energy review panels in the last two years (see figure 12). EPSRC guidance states that all prioritisation and interview panels must be mixed gender. They aim for 30% of the underrepresented gender to be represented across all panels in a financial year financial year, and publish data on the diversity of the peer review college[51].

Figure 12 EPSRC Energy Membership of Peer Review Panels

| 2011-12 7.1% | 2012-13 11.1% | 2013-14 6.7% | 2014-15 12.5% |
| 2015-16 17.4% | 2016-17 30% | 2017-18 30% | Female Male Not disclosed Unknown |

Source: Authors analysis from EPSRC Energy data

48 https://epsrc.ukri.org/funding/edi-at-epsrc/evolving-and-upholding-fairness-in-peer-review/?utm_source=Twitter&utm_medium=social&utm_campaign=SocialSignIn

49 https://epsrc.ukri.org/funding/edi-at-epsrc/equality-impact-assessment/

50 https://epsrc.ukri.org/funding/applicationprocess/basics/caringresponsibilities/

51 https://epsrc.ukri.org/files/funding/diversitydataonpeerreview/

2.3   Insights from UKERC Energy Data Centre's Projects Catalogue

The UKERC Energy Data Centre provided a database of energy research awards based on their publicly available Projects Catalogue[52]. This data source was more comprehensive than the EPSRC data in that it detailed multiple research council data (although only EPSRC and ESRC data was complete enough for analysis for the purpose of this project), individual award value and allocated a percentage of energy relevance across a number of sub-themes. To be able to draw conclusions on gender balance in this dataset we needed to manually assign gender to the Principal Investigators. Our method involved looking at individual researcher's academic profiles to assign their gender identity according to the gender pronouns they use. We were able to assign gender to the PIs on 91.1% of the projects from gender pronouns made manifestly public by the academic or their institution[53]. We weren't able to assign PI gender on 8.9% of the projects. The methodology and reasons for assigning gender manually are explained in more detail in section 1.1 of the annex.

The value of research funds distributed by EPSRC and ESRC from 2011-12 to 2018-19 in our final data set of 1839 projects was £2,062,327,214 from EPSRC and £52,339,019 from ESRC.

The data illustrates similar themes to the EPSRC Energy data with female PI numbers historically hovering around the 15% mark and a slight increase in women being awarded funding since 2016-17 (figure 13). Additionally the UKERC data enabled analysis of funding value and distribution (figure 14). The data suggests that women tend to be awarded smaller grants than men with the proportion of annual funding allocated to women PIs ranging from 5-13% over the last 8 years although women have led between 10-18% of all projects. The same data for male PIs show the opposite tendency – while men led between 73-81% of all projects they received 78-93% of the total funding.

It should be noted that, for multi-partner projects, the UKERC Project Catalogue does not indicate the split of funding between PIs and Co-Is. Our analysis therefore assumed all funding was allocated to PIs. In reality a significant amount of funding would then be distributed to Co-Is and further analysis of Co-I gender and the allocation of funding between PIs and Co-Is would give a fuller picture of gender balance in research funding. However, our analysis gives an indication of the total value of projects led by male and female researchers.

52 https://ukerc.rl.ac.uk/cgi-bin/era002.pl
53 via their academic profile, personal website, institution's website, research project websites and LinkedIn.

Figure 13 Proportion of female PIs in all funded projects   Source: Authors
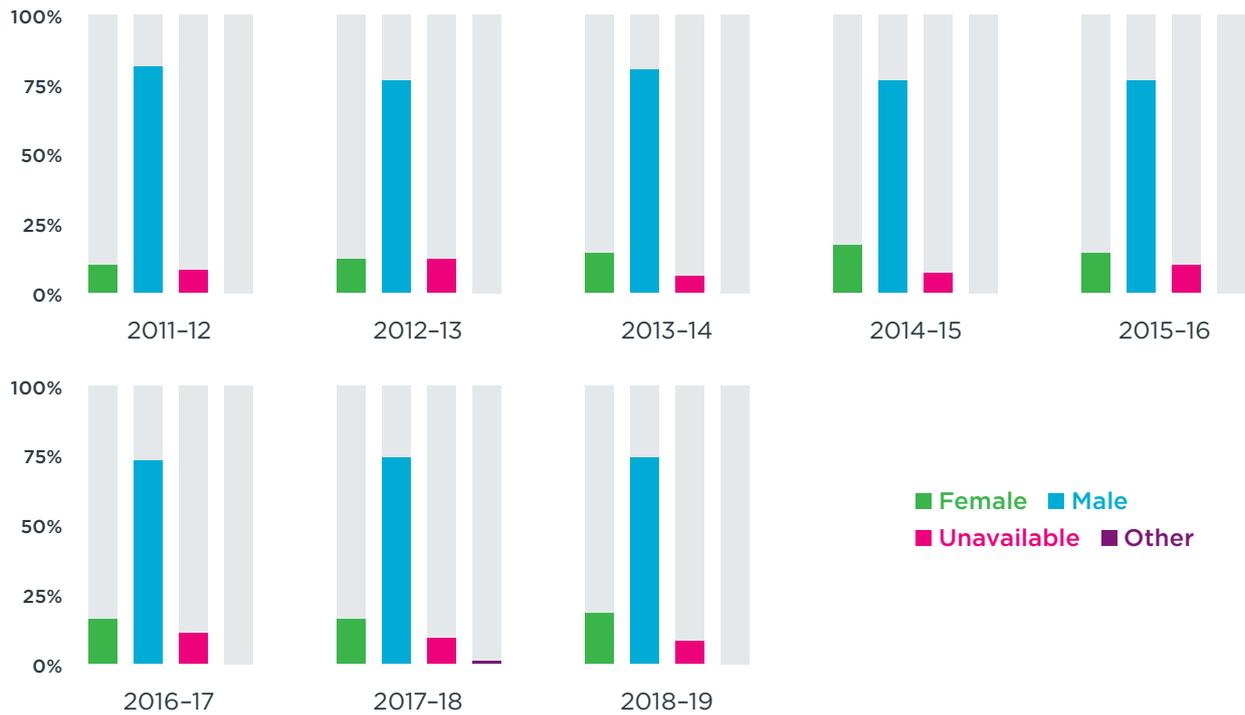
Figure 14 Proportion of the total funding in a given year by gender   Source: Authors
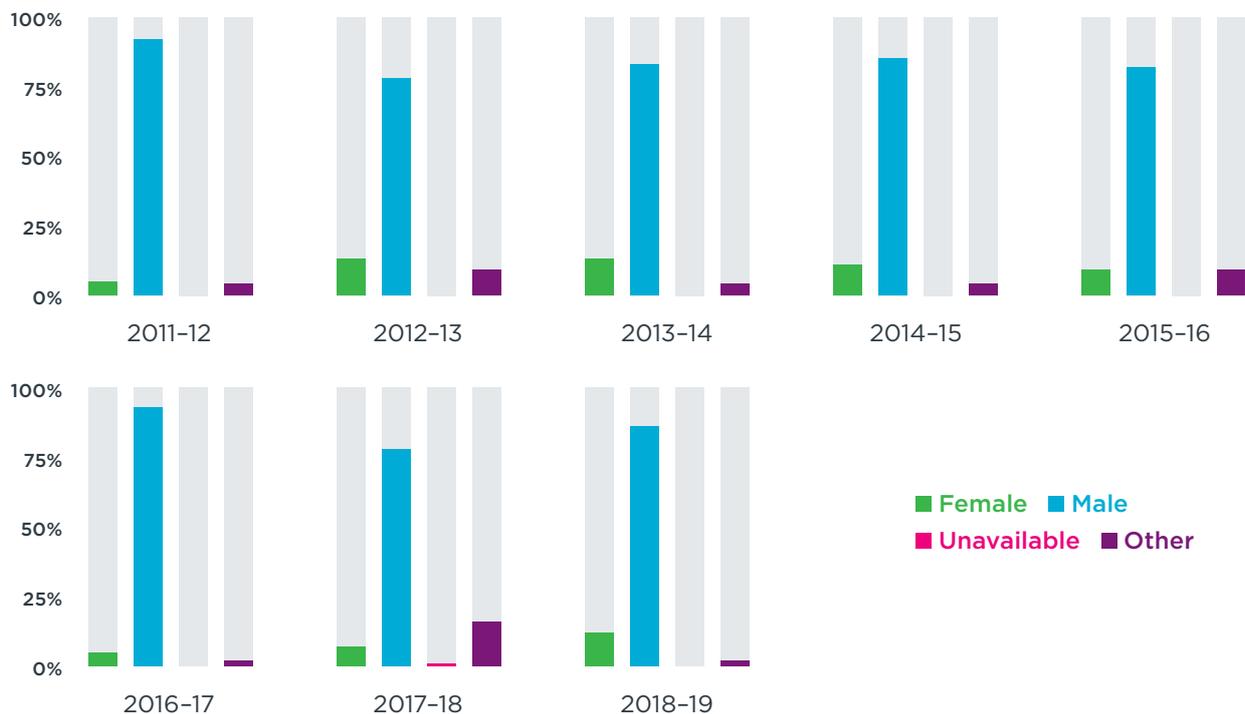
Who gets the highest value grants?

Analysis of the distribution of grant values indicated that 83% of women get awards of less than a million pounds compared to 76% of men. Women are also more likely to get the lowest value grants with 63% of female PIs leading projects awarded less than £500,000 compared to 57% of male PIs, and 46% of women leading projects worth less than £250,000 compared to 34% of men.

The distribution of funding across genders is more even in the £1 million-£10 million range but according to the data no women have obtained awards of more than £10 million in the period assessed.

Further analysis of the distribution of grant funding across genders, as shown in table 1, indicates that male PIs receive higher value awards than female PIs with the mean grant value for men £597,443 higher than that for women. This is further demonstrated by the median that is £116,064 higher for men. The standard deviation also illustrates how the spread in award values is significantly higher for male PIs.

Table 1: Mean, median and standard deviation of awards by gender

	Mean	Median	Max	Standard deviation
Male	£1,275,395	£414,783	£131,758,145	£5,203,334
Female	£677,952	£298,719	£8,000,000	£1,117,221
Unavailable	£863,707	£303,376	£55,688,424	£4,396,413

Source: Authors

*the 'Other' category is not included due to the small sample size

Award value by year

Analysis of the median award value over the past eight years shows that women consistently secure lower value grants with 2012-13 being the only exception in the analysed period (figure 15).

Figure 15 Median award value by gender 2011-12 to 2018-19
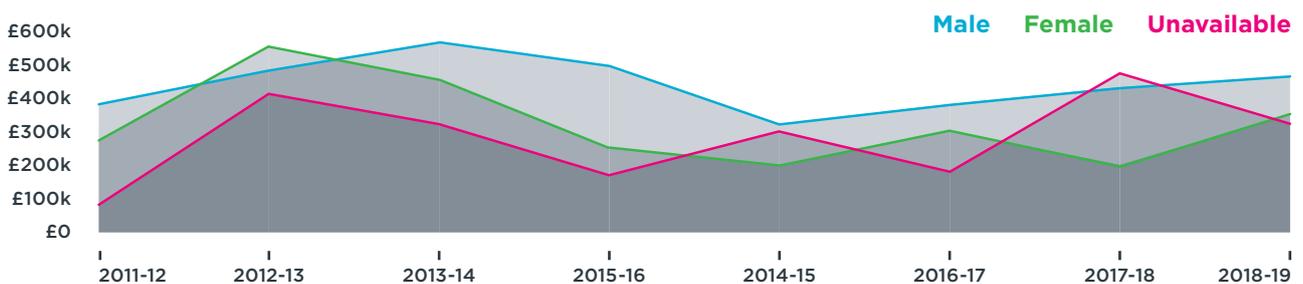
Source: Authors

*the 'Other' category is not included due to the small sample size

When it comes to the highest value grants awarded since 2011-12 the picture is stark with the exceptionally high value projects typically led by male Principal Investigators (figure 16). Awards of that magnitude are however a rare occurrence with only 1.49% of male PIs securing grants worth more than £10 million (this translates to 21 projects over the last eight years). Nevertheless the number for female researchers receiving awards over £10 million was zero.

Figure 16 Maximum award value by gender 2011-12 to 2018-19
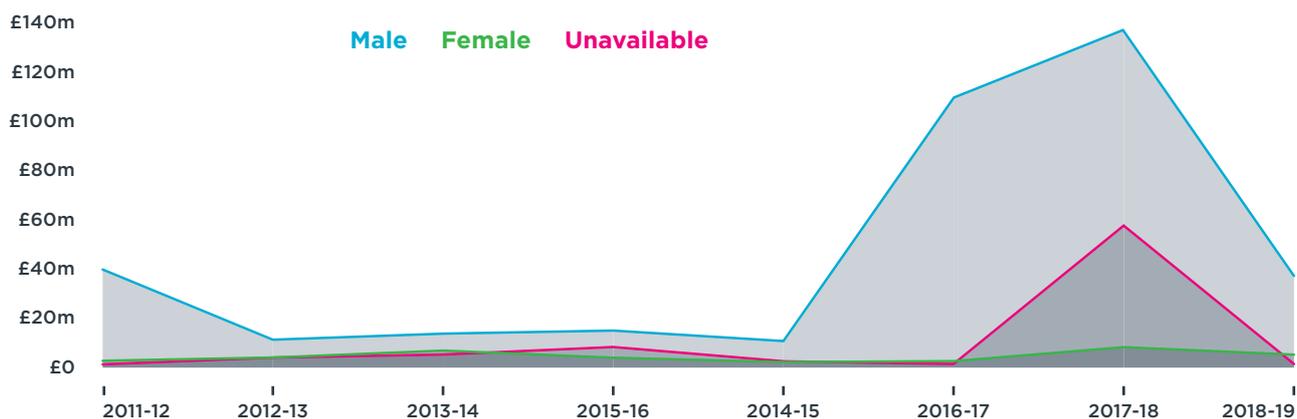
Source: Authors

*the 'Other' category is not included due to the small sample size

2.4   Key Issue: Understand the data and be transparent

We outline the difficulties in accessing meaningful data on gender balance in energy research in more detail in annex A. These difficulties included a lack of data on all energy relevant research across research council's as EPSRC only hold data on EPSRC led awards. However there were also issues with accessing existing data on EPSRC applicant and awardee gender due to varying interpretations of the General Data Protection Regulation (GDPR). The research team believed there is a lawful basis for third parties to access data about the gender of grant recipients on 'public task' grounds where the processing of personal data is necessary to perform a task in the public interest.

There was a significant appetite from interviewees for more reporting and analysis of the energy research portfolio, particularly in relation to EDI issues. Although headline research council data[55] is published there is limited analysis or discussion of the data. The annual EDI data could be presented in a much more open and engaging way, through the use of visualisations, comparisons across research councils, thematic area, and career stage, as well as a full discussion of trends evident in the data[56].

Currently there is little visibility of research applications and awards by thematic area. Section 2.2 of this report presents some specific data for energy research, but as discussed there are numerous caveats in this data and significant difficulties in both establishing a definition of 'energy research' and accessing comprehensive data. Increasingly grant funding is allocated to cross cutting thematic areas and as UKRI continues to form there is significant potential for a methodology for tracking and analysing activity across both research councils, disciplines and thematic areas to be adopted.

55 https://www.ukri.org/files/rcuk-diversity-headline-narratives-april2017-pdf/
56 for an example see the visualisations created by the Financial Times to explore the gender pay gap
    - https://ig.ft.com/gender-pay-gap-UK/

We have made some initial conclusions about the most significant drop out points for female academics or bottle-necks in progress, based both on the funding data and on our qualitative data. However much more work should be done to analyse the key barriers and turning points for female (and other underrepresented groups of) academics in energy research.

Recommendations

- Build a robust database for analysis of gender balance in energy research funding, and more broadly across thematic areas, rather than just at research council level. Quantitative data will lead to more structured action.

- Set targets, monitor progress and provide annual updates on results;

- Make gender balance data more accessible and transparent; including reviewing UKRI privacy statements to ensure that diversity data can be used (including by external organisations) for monitoring purposes.

- Make EDI criteria part of the application process and score results alongside research outputs

2.5 Key issue: Speak to female academics

Speaking to (female) academics is data. There is a lack of published evidence which draws directly on the lived experience of active researchers in relation to biases, barriers and wider experiences of academic life. Such research should be carried out more often with results shared openly. There is some encouraging recent activity in this area including the Royal Society's work on research culture[57], the Vitae Research Concordant[58] and Vitae coordinated surveys on careers in research[59]. There is a need to publish granular findings from these studies and coordinate responses across UKRI, HEIs and Government. Additionally work to address research culture should make the links to EDI more explicit; for example the Royal Society's Changing Expectations report makes no reference to gender or equality.

Recommendations

- Acknowledge the links between research culture and EDI issues (as explored in sections 3 and 4 of this report) and take co-ordinated action.

- Use quantitative and qualitative data to identify key intervention points. For example both data sets analysed in this study indicated that the trend towards large grants and big consortia bids disproportionately impacts female academics.

57 https://royalsociety.org/topics-policy/projects/research-culture/
58 https://www.vitae.ac.uk/policy/concordat-to-support-the-career-development-of-researchers
59 Careers in Research Online Survey (CROS) and Principal Investigator and Research Leaders Survey (PIRLS)

Key issue: Continue to improve review panel gender balance

EPSRC have achieved significant progress on the gender balance of review panels. Given the small number of senior female energy researchers, in order to continue this trend into the future it is likely to be necessary to involve a wider pool of more junior women. This has multiple benefits in terms of exposing earlier career women to the full funding process and supporting career development. This would also take some pressure off the small pool of senior women who tend to be approached multiple times for such panels.

Recommendations

• Continue to get more women involved in reviewing and on panels and recognise the important role that experience of peer review and panels can play in learning how to write successful applications.

• Provide extra training for more junior women (and men) and provide a process for review requests to be pro-rated in line with part-time employment.

• Increase awareness of policies to support fairness in peer review. There was limited awareness of the existing provision for care costs over and above standard care arrangements to be considered as part of EPSRC proposals or to be requested in relation to attendance to funding events and panels.

3.0 Fund more women

As discussed in section 2, data on studentships, funding applications and awards tells us that few women are funded, there is a significant differential between men and women progressing from studentships to independent energy research funding[60], and few women receive (or apply for) the largest and most prestigious grants. Although multiple actions are required to address these complex issues many of the actions can be summarised simply as *'fund more women'*. This section reviews the findings of the interviews and focus groups in relation to this topic and outlines key recommendations to increase female applications and grant awards.

Female academics described a range of barriers and issues relating to accessing academic funding ranging from simple issues of the timescales and size of many funding calls to complex structural and cultural issues relating to measures of academic esteem and research culture. However three central themes emerged from our interviews and focus groups: **get the basics right, clarity on part-time working and career breaks, and innovate in funding structures**.

In discussing experiences of research funding and opportunities for women in energy research the clear area of most focus by participants was the need for more innovative funding structures and approaches. Proposals ranged from the use of quotas and ring fenced funds to better support for early career researchers, the structure of funding calls and the targeted use of lottery or blind review systems. At its most simple suggestions referred to the need for the structure and process of calls to be more accessible. This relates to more virtual research funding

60 Clearly there will be a lag between cohorts of women progressing from studentships to independent funding but our analysis indicates that there has been little change in the proportion of either female students or independent grant awards in last 6-7 years.

events and briefings, reduced usage of methods such as sandpits and 'townhall' meetings. Timescales also need to be realistic for part-time workers and those with caring responsibilities.

There was awareness that some of the participants' recommendations involved allocating a larger number of lower value awards and that this has considerable resource implications for research councils and reviewers. In response various alternative processes were proposed to streamline assessment for some funds. For example, applications deemed to have passed a certain quality threshold could be entered into a lottery system of allocation.

Peer review is not only hugely resource intensive but also likely to be poor at funding the most innovative research and potentially subject to a myriad of *'biases, inconsistencies, and oversights'*.[61] Such critiques of using peer review to allocate research funding are well established. Professor Dorothy Bishop draws attention to a number of studies on the topic and suggests that targeted use of lottery approaches could help avoid bias in the review process, reduce the negative feeling academics experience about grant rejection and help to promote novelty and creativity in research.[62] Many other researchers, including Mark Humphries[63] have written on the flaws of peer review processes and the potential role for 'random' allocation of some small funds in supporting innovation and risk-taking. Additionally work by Shahar Avin has evaluated how such lottery systems could be implemented as well as identifying three major funders who already allocate a portion of their funds through a process that involves random selection.[64] An alternative to lottery approaches could include the trialling of blind review for some calls which are less reliant on research track record. Alternatively blind review could assess research quality and innovation only with the review panel making an assessment of track record and suitability to carry out the research. EPSRC (and other Research Councils) have utilised anonymous peer review for a number of investments to date and the impact of this on diversity measures should be explored.

An additional key issue identified by participants relates to processes for assessing periods of part-time working or career breaks. Whilst caring responsibilities are increasingly fulfilled by both genders, there was a clear theme from participants that periods of caring absence (parental leave or other caring responsibilities) still tend to disproportionately fall on women and were perceived as negatively impacting on career progression. We discuss institutional remedies for these challenges in the next section, however in relation to funding there was a considerable lack of clarity from interviewees on the process for assessing periods of part-time working or career breaks in funding applications.

61 http://m.embor.embopress.org/content/15/2/131.full.pdf
62 http://deevybee.blogspot.com/search?q=Wellcome
63 https://medium.com/the-spike/how-not-to-choose-which-science-is-worth-funding-c6b4605ce8f1
64 Namely the Health Research Council of New Zealand's "Explorer Grants" (Health Research Council of New Zealand, 2017), New Zealand's Science for Technology Innovation "Seed Projects" (Science for Technological Innovation, 2017) and the Volkswagen Foundation's "Experiment!" grants (VolkswagenStiftung, 2017).

Finally, network building was identified as an area where funders could support the development of female energy academics. We discuss the role of training and development in the next section[65] but funders can play a role here by supporting targeted networking and development events for women, particularly focussed around upcoming funding calls. For example, our research participants emphasised the importance of women focused networking events and programmes such as the recent IVUGER female energy researcher funding retreat[66]. Such events, tailored to a particular career stage, can be pivotal in supporting women to develop cross disciplinary networks and collaborative funding bids.

In relation to energy the difficulty in developing industrial partnerships within a male dominated industry was stressed with one participant suggesting that networking events between women in industry and female academics, particularly focused around upcoming calls, could be a valuable way to develop new, innovative partnerships.

3.1 Key issue: Funding structures can be a barrier

Despite progress in some areas, funding structures are perceived as a barrier for many women.

What the evidence says:

• Don't make attendance to events a key decider in funding

Participants repeatedly referred to the need for more accessible, and particularly virtual events. Although some efforts have been made in this area, many events still require in-person attendance. Facilities for videoconferencing remain poor in many institutions and concerted effort is needed to develop meeting and funding formats that allow effective remote participation.

• Funding calls and events aren't always inclusive

Some types of research funding event favour certain types of behaviour or ways of working. For example, 'sandpit' style events tend to suit those who are already well networked, dominant and aggressively competitive. These are traditionally – but not exclusively – 'male' approaches and risk excluding researchers not displaying these behaviours.

'I think that there is that culture in academia of big beasts, and they tend to be big male beasts who set the tone for what happens and I have been actually quite surprised by how prevalent that is in academia compared to other sectors.' (mid-career researcher)

'It should be unacceptable to run any kind of externally funded workshop, panel etc. without a certain percentage of women. This would result in more female engagement' (early career researcher)

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65 and note the importance of avoiding a 'develop yourself out of discrimination' mindset.
66 http://www.ukerc.ac.uk/news/ivuger-funding-retreat.html. IVUGER (Increasing Representation of Underrepresented Groups in Energy Research) was funded by the UKERC Whole Systems Networks Fund.

• Support female networks

Facilitating female academics to develop academic and industrial partnerships could boost application numbers.

'There should be more thought about industry partnerships – which often mean partnering with men who are not always welcoming' (mid-career researcher)

'Men tend to recommend other men in their networks. This makes identifying female collaborators harder' (senior researcher);

Funding calls rely on *'you having an established network, it relies on you anticipating a year or two in advance of what calls are going to come in'* (mid-career researcher).

Recommendation: Get the basics right

• Set and adhere to standards regarding the minimum length of a call and ensure all funding events are remotely accessible. Do not predicate funding on attendance to specific events.

'Small things that make things clearer and more transparent are important to build confidence and trust' (senior academic);

• Effectively monitor EDI statements and plans in funding applications

• Fund and promote networking events for female energy academics, particularly in relation to specific funding calls

• Fund and facilitate networking and collaboration between female energy researchers and female industry representatives

3.2 Key issue: Part-time working and career breaks are perceived to slow progress

'Many fellowship schemes do say, if you have had a period away, to contact them about your eligibility to be extended [...] but they are still judging you against the next person in terms of publication record and things.' (early career researcher)

In determining eligibility for various funding schemes the EPSRC does not have rules based on years of post-doctoral experience but asks applicants to judge themselves against listed attributes to decide which fellowship level to apply for.[67] However, this helpful approach is not consistent across funders with many specifying a number of years post PhD that applicants can apply for early or mid-career funding. Some apply a standard extra time allocation for each period of maternity leave and some disregard periods of maternity leave but do not grant any extra time[68]. There has been some positive progress in this area, for example the removal of the time bound eligibility for EPSRC New Investigator Awards (NIA)[69], but interviewees indicated an ongoing lack of clarity of the terms of assessment across different funding calls or funders. Given the interdisciplinarity of much energy research it is likely that inconsistencies between funding criteria or funders will particularly impact on researchers in this area.

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67 https://epsrc.ukri.org/skills/fellows/peerreviewprocess/whocanapply/

68 https://mamaisanacademic.wordpress.com/2019/04/01/maternity-leave-is-extending-the-eligibility-period-really-necessary/

69 The New Investigator Award scheme is to support individuals who hold an academic lectureship position, have not previously led an academic research group or been the recipient of a significant grant (usually defined as those which included PDRA time, capital equipment or were in excess of £100,000 FEC).

Additionally there was concern from many interviewees that review processes for applications (and HEI progression processes) do not take into account periods of leave or part-time working with the quantitative outputs of those with career gaps being directly compared to those without. Participants consistently described concerns regarding the pressures and performance expectations on part-time workers. In relation to this, a study of publications in a social science institute indicated that men appeared more productive when simple measures of publications were used but when the researchers adjusted for leave of absence the women's productivity increased by 12 percent and the men's rose by 4 percent[70].

Issues related to the assessment of part-time working are also inexorably linked to wider issues of measures of academic progress and research culture. The Royal Society's Changing Expectations[71] project on research culture explored these issues between 2016 and 2018 and concluded that current measures of recognition and esteem in the academic environment are *'disproportionately based on quantitative metrics such as grant income, citation counts and the impact factor of the journals in which they published. There is widespread recognition that these metrics do not adequately capture research excellence'.*

The Royal Society report also outlined some participants' beliefs that quantitative metrics of research impact were the only measures of their potential that mattered, suggesting that this was influenced by their understanding of the Research Excellence Framework (REF). For example, the fact that the REF 2014 guidelines explicitly excluded consideration of journal impact factors did not appear to be well known. The report highlights that senior staff from UK universities tend to be clear that individuals' broader contributions to teaching, research and other strategic endeavours inform decisions on promotion and advancement. However, Early Career Researchers typically had a different perception of what is required of them and spoke of the pressure to *'publish early and often'* in order to secure promotion. The Royal Society has reinforced others' calls for transparent promotion and progression criteria for all research staff.

> *"Diversity is being crushed by narrower and narrower criteria for assessing success."* **Dame Ottoline Leyser FRS**. (in[72])

Recommendation: Provide clarity on assessment of part-time working and career breaks

- UKRI should ensure the assessment of part-time working and parental leave is standardised across funder eligibility criteria and in review processes, and communicated to researchers.

- Re-evaluate how CVs are assessed at different career stages: *'de-bias them'* (early career researcher)

  'Emphasise the multiple different ways it's possible to build an international reputation' (senior academic).

70 https://reader.elsevier.com/reader/sd/pii/S1475158518301103?token=920B0946F0FD29BB359572F9CAF351E31BA7F893F32E49A656A3014 8E855B25FB4D89FCD1A7C4E955AF708A0F6AC86D2

71 https://royalsociety.org/topics-policy/projects/research-culture/ define research culture as encompassing 'the behaviours, values, expectations, attitudes and norms of our research communities. It influences researchers' career paths and determines the way that research is conducted and communicated'.

72 https://royalsociety.org/-/media/policy/Publications/2018/research-culture-workshop-report.pdf

- Recognise the EDI impacts of over-reliance on quantitative measures of academic recognition and esteem.

  'Women like me do not need advice on how to compete with men, or how to "be more Mars", but on how to find a place in a system that wasn't made for us. The culture of early career academia works if you do not have a family, if you are able to move every couple of years and if an academic career is your only priority' (early career researcher).

3.3 Key issue: A lack of diversity of funding types impacts on women

Support academics returning from a career break

Some participants suggested that the most direct action to increase gender balance in energy research would be to set quotas or ring-fence certain funds for high performing women. There was particular emphasis on the role of such approaches for women returning to work after a career break. It is positive to note that the EPSRC work with the Daphne Jackson Trust[73] to support academics returning to work from a career break of 2 years or more due to family, caring or health reasons, although none of our research participants referred specifically to this scheme.

A focus on large centres impacts on gender balance

There was a strong theme of the potential for funding to be more effectively targeted. For some this meant setting quotas, in line with several European countries which have set quotas for the membership of women on company boards. For others this meant targeting funding more effectively at different career stages, particularly early career. In particular the shift towards a higher proportion of funding going to large centres was identified as unhelpful to promoting gender balance. The role of large centres in supporting equality and diversity has been recognized by UKRI and there have been some positive examples of large centres developing flexible funds for Early Career Researchers. It is also significant that the 2018 call for Centres for Doctoral Training indicated that the *'Centres are expected to take a leadership role in driving improved ED&I within relevant areas'*[74]. However the focus on allocating a smaller number of large awards perpetuates a system where mainly male senior academics lead large centres and then play a very significant role in shaping the distribution of research funding in their area. It is also clearly important to ensure that the EDI plans of large grants and centres are meaningful, monitored and evaluated.

- The more that funding becomes concentrated in larger centres or in larger grants, *'then the more that relies on your ability to have established networks'* (senior researcher)

- *'All these things around network building are key to go for larger grants. The more the money gets concentrated, the more you need these things. And I think that there are significant gender issues here.'* (senior academic)

73 https://epsrc.ukri.org/funding/edi-at-epsrc/evolving-and-upholding-fairness-in-peer-review/?utm_source=Twitter&utm_medium=social&utm_campaign=SocialSignIn

74 https://epsrc.ukri.org/files/funding/calls/2018/2018cdtsoutlinescall/re-workshop-report.pdf

Recommendation: Innovate in funding structures

• Acknowledge that the trend towards large centres and consortia is unlikely to support improved gender balance in research funding and seek to address this.

  'I do preclude myself from certain funding because I think that it's already written that it's going to senior professors who are mostly male' (mid-career researcher)

• Focus on supporting (female) early career researchers.

• Trial innovative approaches to allocating funding including lottery systems and blind peer review.

4.0 Stimulate career progression for female energy academics

'We should not forget the huge waste of potential, knowledge and innovation implied by the aggregated loss of female time, energy and talent. Women get tired battling against the odds; I know I do.' **Athene Donald**[75]

'Perhaps the challenge lies in outdated expectations of what an academic should be. There's an expectation that everyone should be equally productive from day one, without a break. Maybe we should think instead that an academic life is built up over a long period of time and can be strengthened with slightly different life experiences.' **Lynn P. Nygaard**[76]

This section explores the data gathered from talking to 59 female energy researchers to examine 'the huge waste of knowledge, potential and innovation' referred to by Athene Donald in the above quote, and also explores work-life balance and the expectations and perceptions of 'what an academic should be' as touched on in the second quote from Lynn P. Nygaard. Woven through this narrative are the biases and barriers that many women face at all stages of their careers within energy academia and how these impact on their funding opportunities and career progression within the academic system, together with some of the potential solutions they suggest to improve things.

The first point to make relates to the 'leaky pipeline' which is often used as a useful analogy for exploring how women 'drop out' along career trajectories in research and academia. Chris Skidmore, Minister for Education, noted in March 2019[77] that there has been a 28% increase in England in the number of women accepted on to full-time undergraduate degrees in science, technology, engineering and maths in the last decade. In the last academic year, women accounted for more than half of all STEM postgraduates at UK universities. However, at the moment there is no data that allows us to meaningfully track the leaky pipeline for the energy sector in academia although data indicates that across academia only 1 in 4 professors are female[78]. Another example from the science, engineering and technology fields (SET) for 2018,[79] concluded, *'Despite comprising the majority of staff working in UK higher education, women remained underrepresented among academic staff,*

75 http://occamstypewriter.org/athenedonald/2019/01/24/feeling-exhausted/

76 http://kifinfo.no/en/2019/01/when-numbers-tell-different-stories

77 https://www.theguardian.com/education/2019/mar/08/universities-need-to-promote-more-women-to-professor

78 https://www.hesa.ac.uk/data-and-analysis/sb253/figure-3

79 https://www.ecu.ac.uk/publications/equality-higher-education-statistical-report-2018/

in SET subject areas and in senior management roles. [...]Overall, 58.1% of SET academic staff were men. Subject areas with notably high proportions included electrical, electronic and computer engineering (85.3% male staff) and mechanical, aero and production engineering (82.9% male staff).' These figures give some indication of how few women reach senior academic positions but also suggest there is a need to collect data to track the leaky pipeline and address the pressure points.

What also comes through loud and clear in this report is that women's expertise and their approach to project design are frequently not being prioritised by funders. As we point out in the Introduction to the report, the leadership and participation of women as part of gender balanced teams is not only essential for gender equality and work-life balance for both men and women, it also has crucial impacts on the outcomes of each project. Although it is clear that many men have good leadership style and provide equal opportunities for women and men, and many are also assuming and acknowledging their caring roles and commitments, the underlying narrative of 'tokenism' was also a focus of our conversation with interviewees. Many expressed frustration with pressure to do things just because funding applications, panels and committees 'need' a woman, rather than appointing women because they know what they are talking about. We want to address the common perception that funders and universities only consider Equality, Diversity and Inclusion (EDI) as 'an also ran'.

When it comes to the importance of work-life balance, we found that women were frequently conflicted and rather despairing about maintaining some kind of order in their lives. Many recognised that this was not just a problem for women. In fact, one felt that women were not doing themselves any favours in making work-life balance a gender issue because it should be about everyone getting away from the pressure to work anti-social and long un-contracted hours. Another felt that gender issues and caring issues should not be conflated, the working environment needs to recognize that both men and women have the same responsibilities. However, as one mid-career researcher commented, most senior roles in energy are held by men and they have grown up in a culture where you work really long hours and they expect their staff to be in the office; she said, *'I think it's hard to break those perceptions.'*

There was also an overwhelming feeling that university structures and cultures need an overhaul if women are to progress in energy academia. Although some interviewees expressed good experiences of departments and teams that ran clear and transparent work-load models which accommodated, for example, women working part-time and men taking paternity leave, many women expressed frustration with a range of structural and cultural biases and barriers that included publishing, funding, employment and promotion opportunities. One interviewee said that women need advice on how to compete in a system that *'wasn't made for us'*. Another felt the current system necessitated being *'pushy'*, and others expressed frustration when no account is being taken over level of output when a woman is working part-time or has caring responsibilities.

The section starts with a brief explanation of what we mean by explicit and implicit (or unconscious) gender bias. It then lays out four key issues that hinder career progression for female energy academics: work-life balance; institutional structures and cultures; training, support and mentoring; and visibility of female energy academics. Each issue has a unique recommendation to help support progress.

Explicit and implicit gender bias

Explicit gender bias takes place when people (women or men), express the idea that women are inferior to men or that they are unable to perform at the same level as men. Examples might include, the belief that women are less ambitious, or less committed to their career than men, and that they prioritize their family over their career. For example, in a recent article[80], Joan C. Williams, a Professor at the University of California, provides an example of what she calls, *'maternal wall bias'* which occurs when colleagues view mothers, or pregnant women, as less competent and less committed to their jobs. As she says, *'it's a major problem for women's career advancement.'* Our findings mirror this and several women reported experiencing explicit biases. Examples include expertise being questioned, questions about plans for having children, and being told they only got a job 'because they're a women'. This highlights that despite significant progress in some areas it is still common for female energy academics to experience direct discrimination in their professional careers.

Implicit or unconscious gender bias is more difficult to identify because it concerns how ones background, personal experiences, societal stereotypes and cultural context can have an unconscious impact on decisions and actions. Implicit gender biases are built through many different mechanisms such as media images of scientists as men, by universities having mostly male professors, by the working culture of many academic departments arranged to suit male rather than female working patterns, and when CV and shortlisting processes are affected by unconscious bias that affects both recruitment and salary decisions.[81] One example from those we interviewed includes a mid-career researcher who was worried she may *'seem risky'* when being interviewed for a promotion because she hadn't had children yet. Another commented that gender issues were more aggressive in academia than in other areas because *'more goes on behind closed doors'.*

In a recent speech[82], Chris Skidmore Education Minister, said: *'To have real equality in the sector, we need to ensure talented women are able to progress into the academic and leadership roles they desire, and get the remuneration they deserve.'* We lay out below what women say needs to happen.

80 https://www.sciencemag.org/careers/2019/04/working-mothers-face-wall-bias-there-are-ways-push-back?fbclid=IwAR0A1QLH5QFqP
8ESz9h74NGBLdh5tWZILxbduGaW4suZGrKGcGxnD0KfFFQ

81 see also: https://www.ecu.ac.uk/guidance-resources/employment-and-careers/staff-recruitment/unconscious-bias/

82 https://www.theguardian.com/education/2019/mar/08/universities-need-to-promote-more-women-to-professor

We found that women were frequently conflicted and rather despairing about maintaining work-life balance in their lives.

What the evidence says

Long un-contracted hours are considered synonymous with productivity and commitment

• Those who only work full-time are regarded as 'underachievers';

• *'Academic careers are assessed on how hard you are prepared to work'* (senior academic);

• *'Universities say all the right things, and that's really important […] there are provisions in place, colleagues are generally very understanding […] But that is outweighed by the nature of the system which is one where the harder you work, the more you publish, the better it is'* (early career researcher);

• *'What I need is advice on how to choose jobs and prioritise workloads to enable me to publish and write fellowship and funding applications without working 80 hours every week'* (early career researcher);

• *'I start to worry if all the emphasis is put on what women need to do to improve their own careers. So, essentially you make it an individualistic problem and not a systemic problem.'* (early career researcher)

We need more structures that automatically take account of those working part-time vis-à-vis targets

• *'I frequently have to remind people that I don't work every day […] I have to constantly remind people that I can't take a full teaching load because I'm only part-time'* (mid-career researcher).

Fixed term/temporary contracts are increasingly the norm[83]. They are discouraging and make taking maternity leave a problem

• Researchers have *'no ability to plan into the future'* (early career researcher);

• No time is added on for maternity leave, *'people just get made redundant'* (early career researcher).

• *'You have no prospects of permanent job status, it's really hard for you to do your job, it's hard for you to get funding to do your job, you have to pay yourself by getting research income[…] and so you just think, "Well, why on earth would I do this?" I'll go somewhere and get a permanent job because it's much easier to pay my mortgage and potentially have children and operate in the world.'* (early career researcher)

We need to dispel the idea that women who work part-time don't want to progress

• *'Working part time had a real stalling effect on my career. My progression was entirely related to family issues like childcare, schooling etc.'* (senior academic);

Balancing parenting and work has implications

- *'Becoming a mother has implications for my career'* (mid-career researcher);

- Childcare responsibilities are still quite heavily weighted towards women. One said she avoids travelling and having too many nights away because of the impact on the family and, in turn, this impacts on her international profile and promotion prospects (senior academic);

- *'Male colleagues with children have achieved professor much quicker'* (senior academic).

Recommendation: Acknowledge and take action on the long hours and precarious culture of academia

- The ability to work long, un-contracted hours should not be synonymous with productivity and commitment. There is a need to challenge organisational cultures that privilege work above everything else. Make work-life balance the norm.

- Recognise the effects of wide spread fixed term contracts on the retention of early career researchers. Take action against the precariousness of research careers and create an attractive and secure working environment to get the best out of researchers.

4.2 Key Issue: Institutional structures and cultures

Women face biases and barriers at all stages of their careers within energy academia and these impact on career progression. A fundamental shift is required that is not just about appointing more women on panels and committees but one that changes or reconfigures institutional structures and practices to better support gender balance.

What the evidence says

Address the funding hierarchy

- *'I was encouraged to join a male-led bid so that there were women on the team'* [this was part of the bid's eligibility criteria] *'and it came across as if it was because they 'needed' a woman'* (early career researcher)

- *'it's delusional to think that a senior academic who lends their name as PI writes everything, there's a big team behind them'* (mid-career researcher);

- *'People who have been funded get more funding. Thus women are immediately at a disadvantage. This is turn has a knock-on effect for securing permanent positions as these are often predicated on bringing money with you'* (mid-career researcher);

- *'Women are sometimes put forward for lower levels of funding than they should command'* (mid-career researcher).

- *'Support comes from university services once you have secured funding'* (senior researcher)

- Transformative practice: *'we now look at what funding opportunities go across the group rather than individual opportunities'* (senior researcher).

Review criteria for research productivity: stop holding women academics to higher standards than men. Numbers don't tell the whole story

- Criteria need to be adjusted for leave of absence and pro-rata working;

- Address the CV 'gap': colleagues taking maternity leave worry about how to *'disguise'* the gaps in their CVs (mid-career researcher);

- *'I need advice on how to write CVs and job applications which can compete despite the fact they have 6 and not 16 recent publications'*
  (early career researcher)

- Institutions should use internal sift processes to spot potential in funding applications rather than focusing on the most polished at an early stage;

We need to look beyond Athena SWAN[84]

- Positives: meetings are held in core hours and there is more support for mothers and people with caring responsibilities.

- Negatives: It *'puts pressure on a few women to sit on panels and committees'*; *'it is a box ticking exercise'*; *'it's limited in scope because it has to go towards the lowest common denominator;'* *'senior leaders don't take it seriously and getting men on working groups is a real challenge'*; and *'the processes are for permanent staff, and getting commitment to measure things is difficult.'*

- *'without the culture change, it's not going to be transformational'*
  (early career researcher)

Address the gender pay gap

- Latest figures reveals little progress, and a number of universities have increased the gap.[85]

Appoint and promote more women: gender balance gets worse higher up the career trajectory

- Precarity is more likely to hit women with data from the EU28 indicating that female researchers are more likely than men to be employed under *'precarious'* contracts[86].

- A recent US study[87] reveals a higher share of women faculty in STEM fields may particularly benefit women STEM students, and the presence of women faculty on campus in general positively influences female student's chances of earning STEM degrees;

- We note the University of Leicester's target to increase the number of female professors by 1.5% each year, with the overall goal of having 30% professorships held by women by 2020[88]

84 https://www.ecu.ac.uk/equality-charters/athena-swan/. The Athena SWAN charter was initially established to improve the representation of women in scientific disciplines in higher education and has expanded to promote gender equality in multiple disciplines, including the arts, social sciences, humanities, business and law.

85 https://www.ucu.org.uk/genderpay

86 Defined as those without contract, with fixed term contracts of up to one year, or with other non-fixed term, non-permanent contracts, see https://publications.europa.eu/en/publication-detail/-/publication/9540ffa1-4478-11e9-a8ed-01aa75ed71a1/language-en.

87 Warming the Chill: Insights for Institutions and Researchers to Keep Women in STEM. Emily Daina Đaras, Lara Perez-Felkner, Samantha Nix. New Directions for Institutional Research No.179 115-138

88 https://staffblogs.le.ac.uk/ult/2017/03/08/international-womens-day-the-gender-pay-gap-at-the-university-of-leicester/

Value academic citizenship

- Many interviewees commented on how under-appreciated and under-valued academic citizenship or pastoral roles were. Many women willingly, and sometimes under pressure, take up these roles. There is a need to value, and measure, academic citizenship and to take performance into account in career progression.

- *'At the end of the day, the rewards still go to the people that bring in the results, put in the crazy hours, and do the travelling. Made it their 100% priority. It's hard to see that ever changing until the university starts to value other contributions in addition to bringing in huge pots of research money'* (mid-career researcher).

- *'Researchers deserve to be judged on the basis of what they have done, not simply where they have published – and to be given credit for the many contributions they make above and beyond the publication of research papers'*[89]

Recommendation: Review current measures of recognition and esteem

Address the funding hierarchy and review criteria for research productivity: don't assume everyone has an equal start point. Changing university culture means looking beyond initiatives such as Athena Swan. There is a need to value academic citizenship and take performance into account for career progression.

4.3 Key Issue: Training, support and mentoring

Good training, mentoring and support networks make a difference to career progression and women voiced concerns about how this is delivered across the career trajectory.

What the evidence says

More support for career development

- *'Early career researchers need strategic career development and support programmes'* (early career researcher)

- *'It's absolutely great to provide, support and mentoring for individual women but not as a way of papering over the cracks in the system'* (early career researcher);

- Early career researchers often lack support to make the transition to more permanent positions. Funders should engage with host institutions to monitor and support their career progression;

- We note and await the review of the Concordat[90] to Support the Career Development of Researchers as an agreement between funders and employers of research staff to improve the employment and support for researchers and research careers in UK higher education.

89 Stephen Curry in https://www.nature.com/articles/d41586-019-01151-4
90 https://www.ukri.org/skills/policy-and-frameworks/review-of-the-concordat-to-support-the-career-development-of-researchers/

Management and leadership skills make a difference to women's progression

- *'So little weight is placed on leadership skills by our academic institutions […] being an excellent scientist who has just landed their fellowship, lectureship or whatever because of their academic brilliance, is not enough to ensure good team leader skills'.* Athene Donald.[91]

- *'I have been pushed forward and held back in equal measure according to who was line manager or head of school'* (senior academic)

- *'Line managers who understand issues for working mothers make a huge difference'* (mid-career researcher).

Enable female energy academics to be more ambitious in their funding aspirations: recognise that women may need different support mechanisms

- *'Women don't always recognise their achievements in the same way men do'* (early career researcher);

- *'We tend to be more cautious, more precise when we apply for funding'* (mid-career researcher);

- A major barrier is *'seeing yourself in the role […] I think that women often struggle with that'* (senior academic)

- But women also stressed the need to avoid reinforcing gender stereotypes and cultural perceptions of *'fixing women'*;

- Practice-oriented seminars at post-doctoral level could help build confidence and academic skills.

The value of mentors

- *'I had a female supervisor and felt this was an important formative time for both gender balance and confidence'* (senior academic);

- For some, moral support is more important than mentoring. *'Confidence comes when others encourage you to go for funding'* (senior academic)

Recommendation: Build and tailor training, mentoring and support networks to help more women progress

Training, mentoring and support is vital for all academics but for women to progress and be more ambitious (and successful) in their funding aspirations, there is evidence that current systems need tailoring to suit their needs. These initiatives need to go alongside, and can't be a substitute for, systemic change.

91 http://occamstypewriter.org/athenedonald/2019/01/13/facing-up-to-the-existence-of-the-jerk/

4.4   Key Issue: Visibility of female energy academics

Female energy researchers lack visibility. This has implications for attracting women to the energy field, for inspiring those who enter it, and for ensuring that their voices are heard.

What the evidence says

Universities need to make female energy researchers more visible

- *'I think we have to absolutely champion women's success but I think we also need to recognize how much harder they have worked to get it. And really truly, to what extent has institutional support enabled that? Or is it just because (the women) are pretty awesome?'* (mid-career researcher)
- Raise their profile and ensure their research and expertise is easy for funders and others to access on-line;
- *'As a woman I have to work harder for my visibility'* (early career researcher);
- *'You need to be quite proactive to shout almost how good your research is'* (mid-career researcher);
- *'Champion women, but not just the extraordinary ones'* (mid-career researcher);
- Ensure materials, posters, publications support better gender balance messages: *'Apparently men don't get put off by seeing images of women, but women get put off by seeing only images of men'* (senior researcher)

Recognize good teaching and female role models and ensure women's voices are heard in class

- *'We need gender balance in teaching staff'* (mid-career researcher);
- We need to encourage female students to feel confident and speak up in class.

Make conferences more accessible and family-friendly so that more women participate

- *'It is incumbent on those running conferences and panels to have diverse gender balance'* (early career researcher);
- Not having affordable, accessible conference childcare shuts down career advancement and collaborative opportunities for those with young children, inevitably affecting women more than men[92]
- *'We need to encourage equal on-line interaction and on-line energy conferences'* (early career researcher)
- Virtual conferencing: virtual technologies hold the promise to substitute many forms of physical interactions and increasingly make their way into academic conferences to reduce the number of travelling delegates[93]
- International travel contributes to emissions and recent research found no relationship between air travel emissions and metrics of academic productivity[94]

92 https://www.nature.com/articles/d41586-018-07783-2?utm_source=twitter&utm_medium=social&utm_campaign=crs-&utm_content=260119v3
93 https://newcastle.onlinesurveys.ac.uk/virtual-conferencing-survey
94 https://www.sciencedirect.com/science/article/pii/S0959652619311862

Recommendation: Make female energy researchers more visible

As others draw attention to *'invisible women'*[95], we show clear evidence that female energy academics often remain hidden in the data and overlooked for career progression. Female energy researchers need more visibility both within the research councils and within their academic institutions. We must ensure equality of voice – women's voices must be heard

5.0 Build on what is working

'Significant change does not happen when one group acts in isolation. It is essential that every part of our community – academic funders, academic employers, societies, and you as individuals – works together to drive momentum and promote further change'. 'Breaking the Barriers'[96]

'Just having women in the room is not enough. It needs to be a participative process' (senior researcher)

This section identifies points of engagement for building gender balance in the energy research portfolio.

Using the headline – **Look at the data** – in Section 2 of this report we suggest using quantitative and qualitative data to identify points of engagement for building gender balance in the energy research portfolio. We show there is a lot of data available, but there are difficulties in accessing meaningful data on gender balance because of a lack of reporting and analysis. As UKRI gets established there is significant potential to develop a methodology for tracking and analysing this data. This transparency would establish a baseline in order to monitor progress on gender balance and provide a clearer picture of where funding goes across thematic/topic areas in energy research. We also make the point that speaking to (female) academics is data and there should be more of it! There is a lack of published evidence of how active energy researchers experience biases, barriers and the wider experiences of academic life. Publishing granular findings from our research and other studies, such as the Royal Society's work on research culture, with coordinated responses across UKRI, HEIs and Government, would help build awareness of the links between institutional structures, research culture and EDI issues, resulting in more coordinated action.

In Section 3 we say **Fund more Women**. There is a significant differential between men and women progressing from studentships to independent energy research funding, and few women receive (or apply for) the largest and most prestigious grants. Female academics describe various barriers and issues relating to accessing academic funding, ranging from simple issues of the timescales and size of many funding calls, to complex structural and cultural issues relating to measures of academic esteem and research culture. There is a need to adopt new systemic solutions and build on existing ones. The lack of female energy academics applying for (the highest value) awards does not necessarily stem from a lack of training or confidence but is likely to also relate to the combined effect of

95 https://www.theguardian.com/books/2019/feb/28/invisible-women-by-caroline-criado-perez-review
96 https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/womens-progression/media-pack/v18_vo_inclusion-and-diversity-_womans-progression_report-web-.pdf

multiple deeply embedded cultural and structural factors. High achieving female energy academics already exist and the work of these women – and other women from across career stage and circumstances – should be rewarded, celebrated, and their profiles raised. The need to innovate in funding structures and approaches is also key to building gender balance. Women say funding needs to be more effectively targeted, and as UKRI continues to develop more thoughtful and informed EDI strategies, these need translating into action!

Section 4 looks at what female energy academics say will **stimulate career progression**. It acknowledges 'the huge waste of knowledge, potential and innovation' amongst female energy academics, explores work-life balance and the expectations and perceptions of 'what an academic should be'. We report how precarity is more likely to hit female academics and on the overwhelming feeling that university structures and cultures need an overhaul if women are to progress in energy academia. A fundamental shift is required that is not just about appointing more women on panels and committees or reforming the funding hierarchy, but one that changes or reconfigures institutional structures and practices to better support gender balance. We suggest that making female energy researchers more visible in the data, within the research councils and in their institutions is vital, as is the need to build and tailor training, mentoring and support networks to help more women progress. It's not all bad news, however, because our evidence also identifies good practice that can be built on, and potential solutions to improve things.

How to build gender balance

'I don't think in my case and in most women's cases it's just a clear gender issue. Usually we are talking about intersectionality of specific characteristics that amplify each other' (early career researcher)

Underpinning everything we say in this report is the need to tackle complex organisational and cultural issues that have shaped current research funding frameworks and university career progression routes for female energy academics (and for many other career academics). Whilst we have focussed specifically on gender bias in this study clearly issues relating to gender intersect with other personnel characteristics, such as race, ethnicity, disability, class and sexual orientation, in complex ways. Recognising this, many of the recommendations relating to funding structures and institutional cultures in this report aim to make academic life more accessible and inclusive in the broadest sense.

Different entry points already exist for building the transition to better gender balance. These include: legislation, such as the Equality Act[97], and pay gap reporting[98]; university frameworks, such as Athena SWAN[99] and Gender Equality Plans[100]; initiatives from the research councils, such as building more transparent and better data, new EDI strategies[101], new criteria for peer review[102]; and as detailed in Section 3 of this report, targeted funding initiatives for women and early career researchers, more explicit guidelines on career breaks, and funded research, such as this project. There are also a wide-range of people-driven initiatives that provide support networks and raise the profile of female energy academics.

We need to combine these specific targeted actions at different entry points with long-term action on structural issues that promote cultural change in a participative and iterative process. We list some of these, as identified by our research, below and Figure 17 summarises these processes.

Use quantitative and qualitative data to identify points of engagement for building gender balance in the energy research portfolio

• build on data that already exists, including data from this report;

• *'quantitative data will lead to more structured action'* (senior academic)

As UKRI gets established there is significant potential to develop a methodology for tracking and analysing this data

• This will help dispel the perception that *'funding only goes to those who have money'* (mid-career researcher);

• Funders need to better acknowledge their role in career progression[103]. For example, funders should lead change, to protect their investment in junior researchers. Fellows are hired by universities on contracts which are dependent on the funding source, they can be made redundant at the end of the fellowship with little consequence.

• Work closely with DORA: San Francisco Declaration on Research Assessment[104]: to improve the ways in which the output of scientific research is evaluated by funding agencies, academic institutions, and other parties.

University structures and cultures need an overhaul if women are to progress: adopt new systemic solutions and build on existing ones

• *'gender balance in teaching staff encourages women to progress'* (senior academic);

• *'the best way to learn is to have someone bring you in on a grant and then you see the process through'* (early career researcher);

97   https://www.legislation.gov.uk/ukpga/2010/15/contents
98   https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766794/
       CabinetOffice2018GenderPayGapReport.pdf
99   https://www.ecu.ac.uk/equality-charters/athena-swan/
100 https://eige.europa.eu/gender-mainstreaming/toolkits/gear/what-gender-equality-plan-gep
101 https://www.ukri.org/about-us/policies-and-standards/equality-diversity-and-inclusion/
102 https://epsrc.ukri.org/funding/edi-at-epsrc/evolving-and-upholding-fairness-in-peer-review/?utm_source=Twitter&utm_
       medium=social&utm_campaign=SocialSignIn
103 https://www.biorxiv.org/content/biorxiv/early/2019/03/10/571935.full.pdf
104 https://sfdora.org/read/

- Ensure there are good leadership and management skills for both women and men;

- Continue to build and promote new EDI strategies – these frameworks are essential to support change;

- Adopt more modern ways of working such as on-line interaction and on-line energy conferences (early career researcher); networking without the need to travel, including to research council events (senior academic);

- More use of Gender Equality Plans – a set of actions that aim to:

  — Conduct impact assessment of procedures and practices to identify gender bias;

  — Identify and implement innovative strategies to correct any bias;

  — Set targets and monitor progress via indicators.

Address energy's image problem and attract more women

- Energy has an image problem – *'sell it from the perspective that it an essential part of living, for comfort, for enjoyment, for transport, for everything'* (senior researcher);

- *'those from social science backgrounds have realised that they can do something about how the energy systems of the future can work'* (Independent);

- *'there is a good engaging vision in energy research. This can excite people and is a good message to work on'* (mid-career researcher);

- *'Focus on the impact: women are much more likely to be inspired by what engineering can do for society and how they can make a difference to society through their engineering skills'* (senior researcher).

High achieving female energy academics already exist – raise their profiles

- Women leading major research projects bring in more women. Critical female mass means that application rates go up.

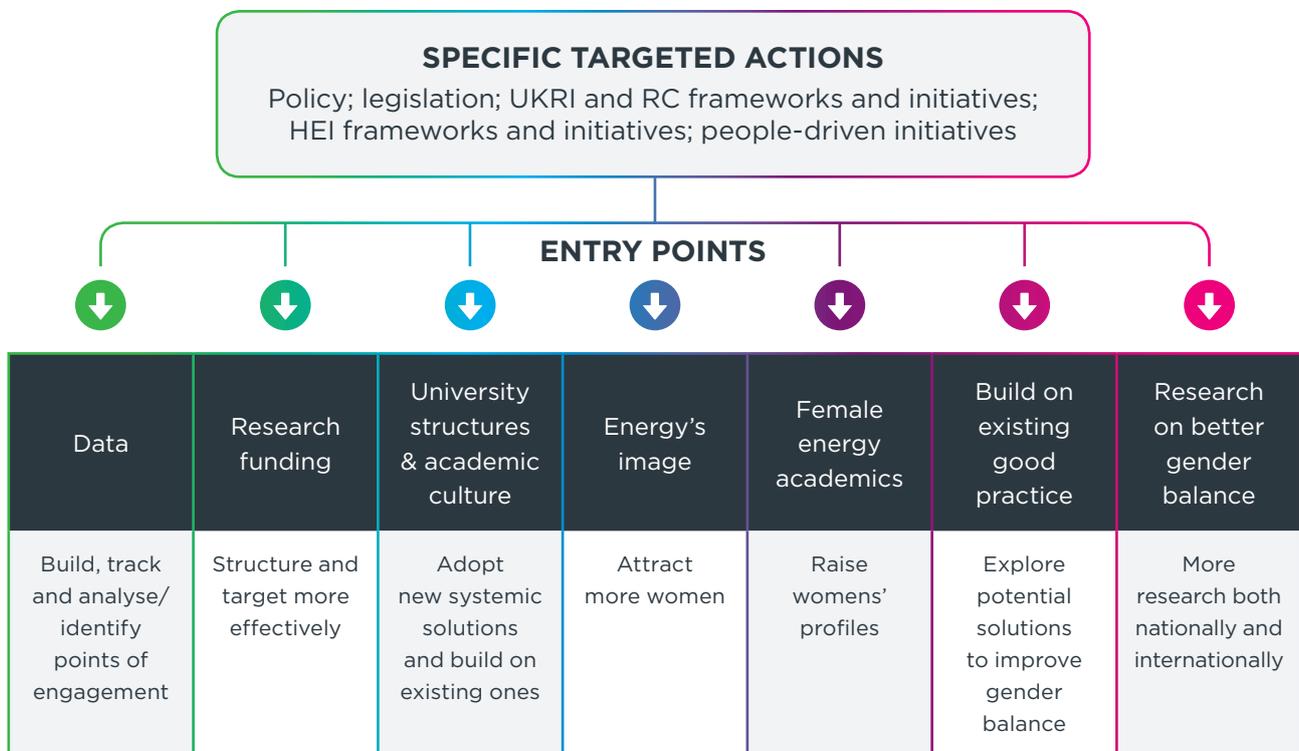### Funding needs to be more effectively targeted

- *'The EPSRC grant ring-fences some funding for ECRs as it was realised that's where female and under-represented groups are likely to be'* (early career researcher);

- *'more support for ECRs to keep them in the system'* (mid-career researcher)

Build on existing good practice and explore potential solutions to improve gender balance

• *'more research like this to hold the research councils to account and highlight normative biases'* (mid-career researcher)

• UKERC have funded several networking projects on gender[105], including: WERIN[106] to set up predominantly female networks and IVUGER[107] to increase participation and visibility of underrepresented groups within the energy sector. Renewable UK host *'Switch List'*[108] where female energy experts can sign up as a speaker;

• Strong female role models inspire and support women to progress their careers;

• Share the findings of innovative funding schemes (such as Inclusion Matters[109]) and look at practice from other funders. For example, Wellcome[110] recently established Diversity and Inclusion as one of their priority areas, supported by £12.5m funding over five years;

• Put social media to good use: For example *'An academic mother's wish list'*[111] was created from responses from a blog community as a resource to help academia create *'family friendly spaces'*: *'Incorporating these suggestions as part of normal working life could reduce the barriers that academic mothers face and, as an added bonus, could improve working conditions and precarity across academia, which can surely only be a good thing'*.

Figure 17 Build on what is working   **Source: Authors**

SPECIFIC TARGETED ACTIONS
Policy; legislation; UKRI and RC frameworks and initiatives; HEI frameworks and initiatives; people-driven initiatives

ENTRY POINTS

Data	Research funding	University structures & academic culture	Energy's image	Female energy academics	Build on existing good practice	Research on better gender balance
Build, track and analyse/ identify points of engagement	Structure and target more effectively	Adopt new systemic solutions and build on existing ones	Attract more women	Raise womens' profiles	Explore potential solutions to improve gender balance	More research both nationally and internationally

105 http://www.ukerc.ac.uk/programmes/networking-fund.html
106 http://www.ukerc.ac.uk/programmes/networking-fund/werin.html
107 http://www.ukerc.ac.uk/programmes/networking-fund/increasing-visibility-of-underrepresented-groups-in-energy-research-ivuger.html
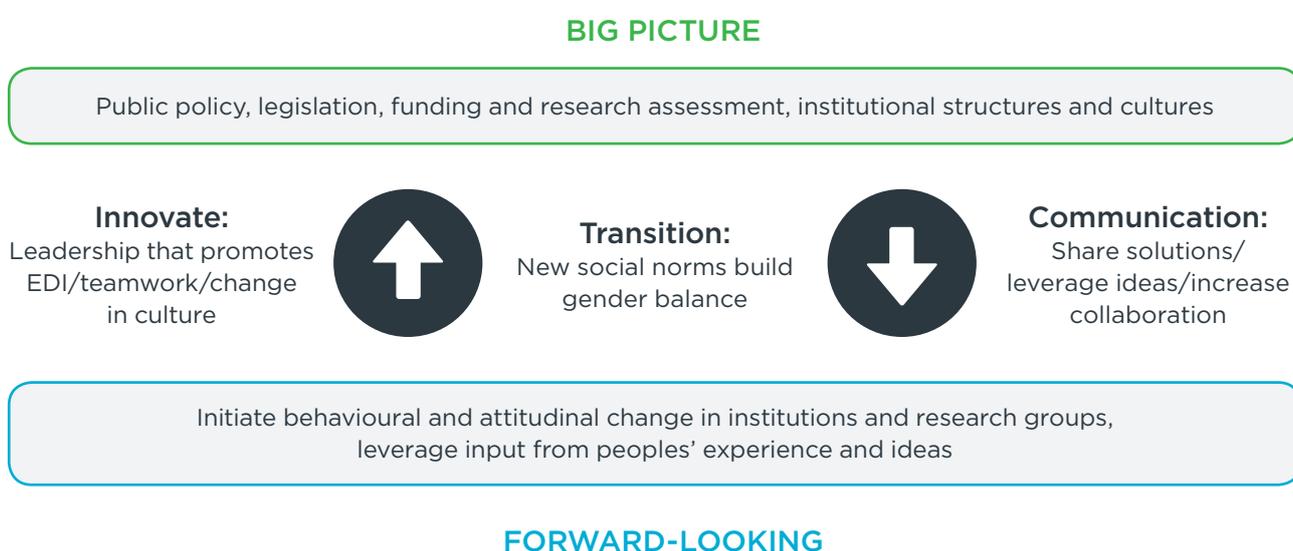108 https://www.renewableuk.com/page/SwitchList
109 https://epsrc.ukri.org/newsevents/news/inclusionmatters/
110 hhttps://wellcome.ac.uk/funding/people-and-projects/grant-funding-data/grant-data-2017-18
111 https://mamaisanacademic.wordpress.com/

5.1   Top-down and bottom-up approach

What is also clear from our findings is that a piecemeal approach will not work. Funders, higher education institutions and individuals must all play their part. Success in building better gender balance in the energy research portfolio is therefore closely tied up with building better relationships and we suggest a top-down and bottom-up approach. This combines the big picture that creates institutional structures and cultures, EDI policies and funding strategies with a holistic, forward-looking approach that leverages input from peoples' experience and ideas. As our findings show, listening to what people say and do brings huge potential for innovation and change. Sharing solutions, increasing collaboration and leveraging small ideas can help build gender balance and stem the flow of the *'leaky pipeline'* for female energy academics. Figure 18 summarises the top-down and bottom-up approach.

Figure 18: Build better relationships

BIG PICTURE

Public policy, legislation, funding and research assessment, institutional structures and cultures

Innovate:
Leadership that promotes EDI/teamwork/change in culture

Transition:
New social norms build gender balance

Communication:
Share solutions/ leverage ideas/increase collaboration

Initiate behavioural and attitudinal change in institutions and research groups, leverage input from peoples' experience and ideas

FORWARD-LOOKING

Source: Authors (concept adapted from Research Culture: embedding inclusive excellence. Royal Society 2018[112])

Recommendations

- Publicise more widely what UKRI and other research councils are already doing to fund female energy academics and raise their profiles;

- Identify key points of engagement to build transition;

- Use a top-down and bottom-up approach. Adopt systemic solutions, a piecemeal approach will not work;

- Ensure equality of voice – women's voices must be heard;

- Conduct more research studies on gender balance in the energy research portfolio (nationally and internationally) to build on the findings of this report.

112   https://royalsociety.org/-/media/policy/Publications/2018/research-culture-workshop-report.pdf

6.0 Conclusions

In March 2019, Jennifer Rubin Executive Chair of the ESRC and Champion for Equality, Diversity and Inclusion at UKRI said[113]:

'In our research and innovation environment there are several ways we can improve (gender) balance and improve outcomes. First, we are seeking gender balance and greater overall diversity in leadership positions. Diversity in positions of leadership and influence is important for many reasons, including providing role models. […] Balance can also be sought in research, data and methods – in the kinds of funding on offer, in the fields and areas that are funded, and in the diversity of participant populations and data on which research findings and innovation are based.'

Our findings echo Professor Rubin's words, and we wholeheartedly agree with her when she says that the issues and solutions are interlinked and that *'progress has been too slow for too long'*. Like those who wrote the Science Grrl report in 2017[114], we have also *'encountered a cacophony of initiatives and organisations, who are often trying to achieve everything alone without taking advantage of the tremendous potential for synergy'*. There has been a long history of high-level pronouncements on gender imbalance but action has been piecemeal.

This is the moment to use the shift in the profile of EDI as UKRI gets established. This is an opportunity to create a real turning point for equality and we need substantive not symbolic action.

Our recommendations aim to move away from only using standard metrics because sustainable gender balance also requires a sea-change in cultural values if more female energy academics are to progress in their careers. There needs to be a focus on not only the overarching legislative frameworks and the organisational structures that support academic research in energy but also on building closer more cohesive relationships between universities, UKRI and the research councils and, most importantly, on finding out what women have to say. This report is a start, but we call for more research both nationally and internationally.

6.1 Key recommendations

6.1.1 Look at the data

- Understand the data and be transparent;
- Speak to female academics;
- Continue to improve gender balance on review panels and on funding panels.

6.1.2 Fund more women

- Funding structures can be a barrier – get the basics right;
- Part-time working and career breaks are perceived to slow progress – provide clarity on assessment;
- A lack of diversity of funding types impacts on women – innovate in funding structures.

113   https://www.ukri.org/research/themes-and-programmes/international-womens-day/balance-for-better-improving-outcomes-in-research-and-innovation/

114   https://sciencegrrl.co.uk/assets/SCIENCE-GRRL-Stem-Report_FINAL_WEBLINKS-1.pdf

6.1.3 Stimulate career progression for female energy academics

- Acknowledge and take action on the individualistic, long hours culture of academia;

- Institutional structures and cultures need an overhaul – review current measures of recognition and esteem;

- Build and tailor training, mentoring and support networks to help more women progress;

- Make female energy researchers more visible.

6.1.4 Build on what is working

- Publicise more widely what UKRI and other research councils are already doing to fund female energy academics and raise their profiles;

- Identify key points of engagement to build transition;

- Use a top-down and bottom-up approach – adopt systemic solutions, a piecemeal approach will not work;

- Ensure equality of voice – women's voices must be heard;

- Conduct more research studies on gender balance in the energy research portfolio (nationally and internationally) to build on the findings of this report.

Annex A: Methodology

1.1 Sources of quantitative data

The following section details how the research team approached the collection and analysis of quantitative data for the Gender Balance in UK Energy Research project. The aim of collecting data was to understand the current state of gender balance in the energy research portfolio and to track any changes since 2011-12. The sections that follow give an overview of available datasets, their limitations and describe difficulties in accessing comprehensive quantitative data.

1.1.1 UK Energy Research Centre data

The UKERC Energy Data Centre aims to provide an energy data service to the UK energy research community. One of the components is a Projects Catalogue[115] which aims to list energy research, development and deployment projects funded by various sources, including Research Councils, third parties, national and international funding. The energy relevance of funded projects is assessed manually by UKERC staff with a high level of energy expertise. The energy relevance along with the energy category of each project is assigned as a percentage. Even projects that are deemed to have a low energy relevance (around 5%) are included in the catalogue.

Our initial aim was to analyse all projects funded in the last ten years (since 2008) across a wide range of funders. We obtained a custom extract of the UKERC EDC data covering 2008 up until 20th March 2019 (for EPSRC and ESRC projects) and thirteen different funders including the Research Councils that fund energy related projects (EPSRC, ESRC, NERC, BBSRC and STFC) as well as Innovate UK, ENA Smarter Networks, ETI and RAEng. We also received confirmation that EU funded Horizon 2020 energy projects are not presently included in the database.

Limitations of the original UKERC data

- Upon closer examination much of the data from different funders was either incomplete or didn't cover the whole period of the analysis. Several funders such as Innovate UK and ENA Smarter Networks do not name the individuals involved in the project rendering a gender analysis impossible.

- Due to these limitations analysis was focussed only the projects funded by EPSRC and ESRC as these are the only funders from whom UKERC EDC receive an automated weekly data feed that includes researchers names and is comprehensive enough for the purposes of our study. It is important to note that EPSRC was by far the biggest funder of energy research in the original data set, with almost 59% of the projects funded by EPSRC.

- Analysis was focussed on data from 2011-12 to 2018-19 in order to allow comparisons with data obtained directly from EPSRC.

- As the data set includes projects that were announced up until 20th March 2019, the 2018-19 financial year doesn't quite cover the usual reporting period of up until 31st March

115 https://ukerc.rl.ac.uk/cgi-bin/era002.pl

Identifying gender

The design of this research was initially conceived as a cross-referencing exercise between the UKERC dataset that contains information on projects funded, researchers involved and grant value and data from EPSRC where the gender of the researchers is available through the information submitted via JeS accounts. Unfortunately the research team was unable to obtain this data from EPSRC, with data protection issues cited as the main barrier, as explained in section 1.3 of the annex.

The quantitative analysis of the project would be significantly compromised by a lack of access to this data, therefore gender was manually assigned to all EPSRC and ESRC funded projects in the EDC database from 2011-12 to 2018-19. Our method involved looking at individual researcher's academic profiles to assign their gender identity according to the gender pronouns they use, based on the principle that individuals have made their gender identity manifestly public.

We were able to assign gender to the Principal Investigators on 91.1% of the projects from gender pronouns used on academic profiles, personal websites, institutional websites, project websites and LinkedIn. Third party sources such as news articles were disregarded as sources of gender information. We weren't able to assign PI gender on 8.9% of the projects.

The original UKERC dataset after limiting our scope to projects funded from 2011-12 to 2018-19 by EPSRC and ESRC contained 1901 projects, after the assigning of gender was complete 59 projects were disregarded as the source of the gender data was inadequate and a further 3 projects where left out as there was no PI given.

Our final UKERC dataset that formed the basis of the PI analysis looked at a total of 1839 projects of which 272 projects were led by females, 1403 projects were led by males, 1 project was led by an individual who used both gender pronouns (this gender category was named 'Other' in line with the terminology used by HESA) and 163 projects where we were unable to assign gender.

We were unable to carry out a similar analysis of Co-Investigators in the UKERC dataset due to time and resource constraints.

1.1.2   Research Council's Diversity Data

The Research Councils have published high-level diversity data for several years. The fourth annual update was published in April 2018, the first one since UKRI was formed on 1st April 2018. In UKRI's own words the publication *'forms part of the information we are using and sharing to map our current situation and identify challenges with respect to equality, diversity and inclusion (EDI) so that we can take a strategic lead in working to address challenges and promote EDI within the research and innovation landscape. We will also continue to publish this data annually and monitor more detailed data so that we can track progress and see where issues persist or new challenges emerge'.*[116]

116   https://www.ukri.org/files/rcuk-diversity-headline-narratives-april2017-pdf/

The Research Council's currently gather data on four protected characteristics: gender, age, disability and ethnicity. This data is generated from what individuals enter on their JeS accounts while applying for funding as well as from the JeS Student Details Portal. The diversity data contains the following information for all seven research councils:

• Principal Investigator applications, awards and success rates

• Co-Investigator applications, awards and success rates

• Fellowship applications, awards and success rates

• Student population data (new starts each year)

Limitations of Research Council's Diversity Data

• As of May 2019 the fifth edition of the research council diversity data wasn't yet available. This didn't allow us to look at the trends in the 2017-18 financial year and to compare that to EPSRC Energy data and the UKERC data in that period.

• The datasets include the categories *'unknown'* and *'not disclosed'* where *'unknown'* refers to instances where individuals have not updated their details and *'not disclosed'* where individuals have chosen not to disclose their information. In some parts of the data the number of people who chose not to disclose personal information, or it remains unknown, can be significant. This coupled with the rounding and suppression methodology can make it hard to externally analyse the data. It is particularly interesting to note that a high proportion of individuals (up to 29.7% for new EPSRC Students in 2016-17) decided not to disclose their ethnicity.

• The rounding and suppression methodology used by UKRI is in line with HESA methodology designed to protect the confidentiality of individuals. It involves all raw data that is 0,1,2 to be rounded to 0 and all other numbers are rounded to the nearest multiple of 5.Totals are rounded based on unrounded values. Success rate percentages are calculated based on unrounded numbers, however if the denominator is less than 22.5 all percentages are supressed.

• In our analysis of gender balance we compared the data obtained for the EPSRC Energy portfolio to the Research Council's data on the whole of EPSRC, as EPSRC is by far the most significant funder of energy research. Analysis of our dataset derived from the UKERC data showed that in 2011-2019 the value of energy research funds distributed by EPSRC amounted to £2,062,327,214, while for ESRC it was £52,339,019. We didn't therefore draw comparisons between the UKERC EDC dataset and overall ESRC diversity data as the sample size was small.

• There are some limitations in the underlying data used to monitor diversity at research council level. The Research Council's diversity data is based on selecting the HESA cost centres that most closely reflect the Research Councils remit. These are divided into a series of traditional academic disciplines[117] and as such overlaps and gaps are likely. This highlights the lack of accurate data at the highest level of the individual research councils let alone in cross-cutting themes like energy (as described in section 2 of this report).

117   https://www.hesa.ac.uk/support/definitions/staff#cost-centre-staff

As mentioned in section 1.1 the original design of the research relied on obtaining gender data from EPSRC. EPSRC hold this data on their applicants, grant recipients and students via entries on the JeS system. Unfortunately we were not able to access this data due to concerns regarding data protection and privacy. EPSRC's interpretation of data protection legislation meant that gender data of the applicants could not be shared without contacting every individual for consent. The research team believed that sharing gender data for the purpose of monitoring and evaluating Equality, Diversity and Inclusion programmes does not conflict with current General Data Protection Regulations (GDPR) or with UKRI's Privacy Notice which makes provision for data to be shared with third parties to investigate the effectiveness of programmes, including evaluation of Equality, Diversity & Inclusion[118]. Additionally we believed there is a lawful basis under GDPR for third parties to access gender data based on *'Public task'* grounds where the processing of personal data is necessary to perform a task in the public interest. These differing interpretations of current regulations did not allow the research team access to detailed data for the purposes of this report.

Despite these difficulties we are grateful to EPSRC for carrying out energy theme specific analysis of existing diversity data and providing us with summary data following the format, and HESA rounding and suppression methodology, as the annual Research Council's Diversity Data. We obtained data detailing numbers of applications and awards in Responsive and Targeted Mode grants for Principal Investigators, and Co-Investigators as well as information on Fellowship applications and award numbers, the EPSRC Energy Student Stock and Membership of Peer Review Panels in EPSRC Energy.

Limitations of the EPSRC Energy data

- The data provided by EPSRC listed numbers of applications and awards together with the applicant's gender, age, ethnicity and disability (where disclosed) however it did not include any information on award values. We therefore manually assigned gender to the UKERC dataset to allow analysis of award value.

- The data on students in the EPSRC Energy portfolio showed all active students in year 1 to year 4 of their PhD while student numbers for EPSRC in the Research Council Diversity Data present new studentship starts in each year. Due to the varying methodologies these numbers were not directly comparable.

The benefits of the data included insight into the gender of members of Peer Review Panels as well as the fact that it covered the last seven financial years, from 2011/12 to 2017/18, which was more up to date than the Research Council's Diversity Data that stopped at 2016/17. Unfortunately this discrepancy meant that we were not able to accurately compare progress over the last two years across the whole of the EPSRC and the EPSRC Energy portfolio.

118 https://www.ukri.org/privacy-notice/

1.1.3 Horizon 2020 and BEIS Data

The definition of the energy research portfolio adopted at the start of our research incorporated European Union funded projects led by UK institutions. EU research funding over the period analysed in our study (2011-2019) spanned two funding programmes – Framework Programme for Research and Technological Development 7, also called FP7 that ran from 2007 to 2013 and its successor Horizon2020 that covered 2014 to 2020.

The CORDIS (Community Research and Development Information Service) database[119] is the European Commission's primary source of information about projects funded by the EU and their results. However publically available CORDIS datasets only contain information on the institution, the coordinator country, participant institution and participant countries and no data on individual researchers was available. We contacted the CORDIS Help Desk to ask if they hold any data on the individuals involved in the projects but were informed that CORDIS does not have such data. They suggested contacting the European Commission funding and tender opportunities portal. The response from their Research Enquiry Service was that there was no such data for Horizon 2020 and the restricted information they had on individuals involved in FP7 projects listed total numbers of the gender of *'contact persons'* and gave no insights into to make up of research teams including the gender of Principal and Co-Investigators. Due to the unavailability of the Horizon 2020 data as well as the limited usefulness of the FP7 figures, data on EU funded energy research had to be excluded from the analysis.

The research team continued data collection efforts by looking at data available through BEIS (Department for Business, Energy and Industrial Strategy). BEIS publishes information on UK participation in Horizon 2020[120], however this was based on the CORDIS datasets and only provided the summary of the types of institutions the funding went to, as well as the top 50 Universities in receipt of EU funding.

119 https://cordis.europa.eu/
120 https://www.gov.uk/government/statistics/uk-participation-in-horizon-2020-may-2018

1.2 Qualitative data: Interviews and focus groups

Science-led priorities and methods are not enough to uncover the whole picture for gender balance in energy academia and qualitative data was collected and used to provide more detailed insights of the *'lived experience'* of female energy academics.

The qualitative phase of the research involved interviews with 29 female energy academics spread across the career trajectory; namely, 9 early career researchers (ECRs); 12 mid-career researchers (MCRs); 7 senior academics (SNRs); and 1 independent energy consultant. Interviewees came from a range of universities and departments, including life sciences, social sciences and engineering and worked across a range of energy supply and demand technologies. Some of the women worked full-time, others part-time, others worked flexibly, and their duties covered a variety of research, teaching and administrative roles. The women had a range of employment histories where some had moved up the career ladder in academia, some had moved into academia from the private sector or the third sector, others had taken career 'gaps' (due to maternity and other caring responsibilities), and others had worked in other European countries. Two focus groups with a total of 30 early career researchers from a wide range of institutions and disciplines also took place. A number of informal detailed conversations with others, including a university research manager, also informed this report.

Table 2 Career stage and number of institutions for interviewees

Career stage	Number
Early Career Researcher	9
Mid-career Researcher	12
Senior Academic	7
Independent Energy Consultant	1
Number of different host Universities across the UK	19

After an extensive literature review, in December 2018 an initial mailing (by email) was sent to 54 female energy academics who had been identified from a range of different sources. Thirty academics responded positively to our invitation to take part in an interview on gender balance, and this was followed up with the project Information Sheet and a request to sign and return the Informed Consent form.

Almost all of the semi-structured interviews were conducted by phone or skype between January and March 2019. All interviews followed the same format, using a semi-structured interview guide that covered key areas of interest for the research project; education and career progression, balance and barriers experienced by women within higher education, experience of funding, recommendations for what higher education and research councils should do to make progress on gender balance, and recommendations on how to empower more women to lead and

excel in energy research and academia. Each interview took between 30 – 45 minutes and was recorded and transcribed.

Similarly the focus groups were based around a small number of prompt questions centred on the same key areas as the interviews. All participant were provided with an information sheet outlining the aims of the project, the use of data and the format of the session. Each session was recorded and transcribed.

In order to provide more detailed insights into the *'lived experience'* of female energy academics and better understanding of the varying factors that impact on the overall trends that we can see in quantitative data, the transcripts were analysed according to key areas of interest: balance and barriers; research council funding; ideas and recommendations to improve gender balance for the higher education sector and the research councils. The results have shaped our thinking and have been incorporated throughout the report using anonymised direct quotations where they add to the weight of the findings. The recommendations, contextualized by the in-depth literature review, emerged through this iterative process.