Supergen Offshore Renewable Energy

Equality, Diversity and Inclusion in Engineering - Scoping Study Report

A Roadmap Towards Positive Change

Led by: aura, University of Hull

With support from: UK Research and Innovation, Engineering and Physical Sciences Research Council

Foreword

Melanie Onn

Deputy Chief Executive, RenewableUK
and OWIC representative

"We work for an exciting new industry with the opportunity to change the status quo on how we operate as a sector. This report on Equality, Diversity and Inclusion (EDI) sets a benchmark for the offshore wind and wider renewable energy industry. EDI is a fundamental issue for us all – industry and society – and we each have a responsibility to make real changes wherever we are – whether in education, academia or in industry at early or later career stages. We are a new industry and we have a real opportunity to get EDI right from the start so that it becomes integral to the way we think and act. This is a personal mission for me and something that I have been working hard for – in my previous role as the MP for Grimsby – and now in my role at RenewableUK. Let's take on board the recommendations in the Report and make a difference for good."

Prof Deborah Greaves OBE

Director of the Supergen ORE Hub
Head of School of Engineering, Computing and Mathematics (SECaM), University of Plymouth

"The importance of Equality, Diversity and Inclusion cannot be emphasised enough – the future of the renewable energy sector depends upon it. I have been a strong advocate for wider inclusion in renewable energy for most of my career, particularly with regard to encouraging more women into science, technology, engineering and mathematics (STEM) in academia and in industry. I am delighted that EDI sits at the very centre of the Supergen Offshore Renewable Energy (ORE) Hub with a work stream dedicated to ensuring that EDI becomes the foundation to the way we work in renewable energy and making the Hub a 'Beacon for EDI'. As the sector matures rapidly, there is an opportunity to shape its development and embed better EDI practice for the long term. It is in all our best interests to promote diversity; eliminate barriers to participation; and create a culture in which equality of opportunity is a priority for all researchers; employees; candidates for Fellowships; applicants for grants and awards; and others who engage with the Supergen ORE Hub. Let's work together to lead real change. This report, which I am pleased Supergen ORE Hub has funded, provides us with a clear understanding of where we are now and where we need to get to."

Prof James Gilbert

Co-Director, Supergen ORE Hub
Professor of Engineering, University of Hull

"Presenting this scoping report on Equality, Diversity and Inclusion, funded by the Supergen ORE Hub and produced through Aura at the University of Hull, is a real and tangible step forward in an area where there is still much progress to make. As a Co-Director of the Supergen ORE Hub with special responsibility for EDI, I am very pleased that this report provides us with a clearer understanding of the subject and where we stand – both in academia and with industry. There is a moral imperative to improve in all three areas – diversity, equality and inclusion – as well as it making business sense for higher education and industry. I think we have a clear action plan to start working together to achieve progress. We have set ourselves some ambitious targets – as a research consortium and also as a new and innovative industry – we need to start showing that we mean what we say so that we can be proud of our progress in all three areas of EDI - by 2030. Big things start small and I believe, and hope, that we can individually and organisationally begin to make the changes recommended in this report now."

Contents

Author – Stefi McMaster

Stefi is a Psychology PhD researcher at the University of Hull's Centre for Human Factors and has particular interest in employee wellbeing and equality, diversity & inclusion.

Led by:

aura

UNIVERSITY OF HULL

Key Findings

Confusion around definitions and what EDI means.

There is strong evidence that good EDI is good for business and the country's economy.

Many different aspects of EDI with gender by far the most mentioned topic.

Beware of intersectionality! A 'one size fits all' approach will not work.

The need for a consistent and connected approach to mending the Leaky Pipeline – a phenomenon common in most marginalised groups.

The need to find a different way to teach STEM subjects (from Primary through to Tertiary) to make them more attractive to different groups of people.

Low representation of female senior staff and ethnic minorities poorly represented in academia.

For business, retaining a diverse workforce is the challenge – corporate cultures don't foster inclusivity.

The issue of lack of diversity in senior positions is found across the board because a homogenous group of people is making key decision which exacerbates the lack of EDI at senior level.

Executive Summary

This report aims to determine the current state of equality, diversity and inclusion (EDI) in engineering, with a focus on the renewable energy industry and academia. From this, it will suggest an action plan, focused on improving EDI in this sector as well as in each stage of education and career development in line with initiatives such as the Offshore Wind Sector Deal.

Headline Findings

There is a need to improve EDI in engineering due to the Skills Shortage, there is a good a business case for it and it's a moral imperative.

There are official targets around recruitment of women and Black, Asian and Minority Ethnic (BAME) employees in the Offshore Wind Sector Deal and further targets are to be implemented for other under-represented groups.

Issues contributing to a lack of EDI in the sector are largely systemic. To address this, a holistic approach must be taken to target a 'leaky pipeline' of talent from each education and career stage.

There are many groups working towards the goal of improving EDI but there is a lack of collaboration. Groups and organisations should collaborate and cooperate better to work towards overall common objectives.

Section 1 – What is EDI and Why do we Need to Improve it?

Equality:
The state of being equal, especially in status, rights, or opportunities.

(Oxford English Dictionary)

Diversity:
A range of many people or things that are very different from each other.

(Oxford English Dictionary)

Inclusion:
The action or state of including or of being included within a group or structure.

(Oxford English Dictionary)

There has been a lot of talk about Equality, Diversity and Inclusion (EDI) in recent times. Organisations have steep 'EDI targets' to reach and there are many news articles about the 'gender pay gap' and unconscious bias. But what do these phrases actually mean and how do they link together?

EDI is a vast and complex concept - it refers to equality, diversity, and inclusion of all types of people. In 2010, the government passed the Equality Act, making discrimination of protected groups illegal.[1]

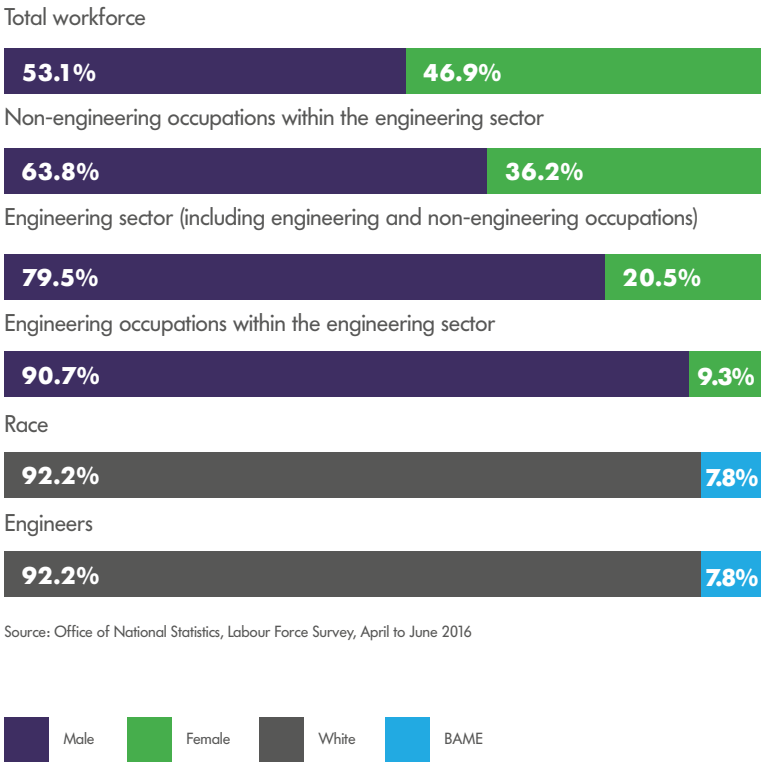
Protected EDI characteristics in the Equality Act, 2010

- Age
- Disability
- Ethnicity/race: Black, Asian and Minority Ethnic groups
- Gender reassignment
- Pregnancy and maternity/paternity
- Marital or civil partnership status
- Religion or belief
- Sex: women, men and transgender
- Sexual orientation

Although this was a good step forward, improving EDI is about more than avoiding direct discrimination of certain groups. It is about addressing the subtle factors that could discourage fair representation of society in our workplaces. As a new industry, the renewable energy sector, and offshore wind in particular, has a unique opportunity to prioritise EDI and to consider ways in which it can be addressed early on.

A call for greater EDI in workplaces is a movement towards a workforce that is representative of the diverse society in which it exists and doesn't place unnecessary judgement on employees due to factors that are not relevant to their work. This may seem obvious, but even in 2020, workplaces still have a long way to go to achieve diversity, especially in senior positions. In the US, male CEOs named John outnumber all female CEOs.[2] In the UK, 96.5% of leaders in the top 1000 companies are white.[3]

EDI also focuses on the less tangible aspect of inclusion. This means that once individuals become part of an organisation, they should feel valued and included in its mission. Inclusion relies on a positive culture and environment as well as other things such as a diverse range of role models and provision of mentoring support. Fostering a workplace that focuses on inclusion is the best way to retain a diverse workforce. EDI is not just about attracting diverse talent but retaining and nurturing that talent.



Source: Office of National Statistics, Labour Force Survey, April to June 2016

Why do we need more EDI?

There are many reasons that workplaces should aim for improved EDI. One of the most prominent is that there simply isn't enough of it in most industries. This is particularly true in engineering, which has a historically 'male and pale' workforce, especially in higher paid positions. It is a fact that 90.7% of engineers are male[4] and only 7.8% are BAME[5]. When considering that women account for 46.9% of the total workforce and BAME individuals account for 12%, there is a clear lack of diversity in the engineering sector. The following sections will explore key reasons behind the need to improve this.

Why does this matter?

The first argument for improving EDI is that it is the right thing to do. Our society is based on the principle of equal opportunities and that should be reflected in our workplaces. This is especially relevant in the renewable energies industry, where there is a strong movement towards social responsibility. A workforce that includes many representative voices of society, will ultimately be best placed to promote change and improvement in the way that we inhabit and treat the environment.

[1] Equality Act, 2010, www.legislation.gov.uk
[2] The New York Times, www.nytimes.com/interactive/2018/04/24/upshot/women-and-men-named-john.html
[3] Operation Black Vote, www.obv.org.uk/node/10792
[4] Engineering UK Report, 2018, https://www.engineeringuk.com/report-2018
[5] Association for BME Engineers, https://afbe.org.uk/about-us

EDI Business Case

As well as the ethical imperative to improve EDI, there is an excellent business case to be made. Much research has been conducted in this area and the results are overwhelmingly in support of greater EDI. The following sections will explore some of the key arguments in support of this.

Engineering skills shortage

The first thing to mention is the engineering skills shortage. It is estimated that 500,000 advanced technicians and engineers will be needed by 2022.[6] This means that the UK will need to double the number of graduates and apprentices entering engineering to fill this gap. In a 2015 engineering survey, 96% of companies said that they expected difficulties recruiting in the future and would like to broaden their recruitment pool.[7] Engineering is currently only tapping into a small section of the employment market and improving EDI is a sure-fire way of addressing the skills gap.

It makes financial sense

A recent analysis of 366 companies found a significant connection between diversity and financial performance. Companies in the top percentage for racial/ethnic diversity were 30% more likely to have above average financial returns and companies in the top quartile for gender diversity were 15% more likely to have above average financial returns.[8]

Lorna Bennet –
Mechanical Engineer and STEM Ambassador highlights another less tengible, yet powerful reason to diversify our workplaces;

> “Having such a homogenous group of people in engineering puts the sector at a disadvantage. ‘Group Think’ becomes a problem – similar people thinking in similar ways doesn’t tend to foster innovation and creative new ideas, so industry can become stagnant and not progress”

Employee motivation, performance, wellbeing and retention

The improvement in financial performance related to greater EDI in workplaces could be partly down to increased motivation experienced by the employees of diverse companies. Research suggests that when leaders are perceived by their teams as being inclusive, 84% report feeling more motivated and 81% say that it has a positive effect on their productivity.[9] Unsurprisingly, diverse workforces are shown to have a 22% lower turnover rate.[10] The benefits of good EDI can also be seen in customer relations. Organisations with an inclusive culture have 39% higher customer satisfaction rates than those that do not.[11] These benefits have also been shown for senior positions within organisations as companies with at least three female directors outperform those with no female directors across several metrics including return on sales, return on invested capital and return on equity.[12]

Greater diversity in workplaces also has important benefits for employee wellbeing and mental health. Multiple studies have highlighted that male dominated work environments are synonymous with higher instances of poor mental health and even suicide.[13] Indeed, recent primary research conducted in the wind industry has highlighted that the male dominated nature of wind technician teams can encourage the avoidance of reporting adverse mental health and safety issues and encourage greater risk taking behaviour. This could be improved if this population had a more even gender balance and greater diversity.

Research suggests that when leaders are perceived by their teams as being inclusive

84% report feeling more motivated

81% say that it has a positive effect on their productivity

Diverse workforces are shown to have a

22% lower turnover rate

Organisations with an inclusive culture have

39% higher customer satisfaction rates than those that do not

Benefits for the wider Economy

As well as direct business benefits, EDI improvements in the workforce will be realised in the wider economy. Estimates indicate that higher female participation and employment rates could lead to a GDP gain of 6% by 2030. Furthermore, GDP could be 1.3% higher (equivalent to about £24 billion per year) if black and minority ethnic (BAME) individuals were fully represented across the workforce in the same proportions as white individuals.

"It seems that improving EDI in workplaces should no longer be met with 'why?' but rather 'why haven't we already done it?"

Estimates indicate that higher female participation and employment rates could lead to a GDP gain by 2030 of

6%

If black and minority ethnic (BAME) individuals were fully represented across the workforce in the same proportions as white individuals GDP could be

£24 billion **per year**

EDI targets

Targets around representation have been set in offshore wind, which is the fastest growing energy source and represents a beacon of positive change within the energy industry. In the Offshore Wind (OSW) Sector Deal, the government set targets focusing on gender and BAME representation.

Gender-based targets state that females should represent 30% of the OSW workforce by 2030, ideally aiming for 40%.[16] This is ambitious, considering that the figure in 2018 was only 16%.[17] Targets for BAME employees were released in March 2020, with a drive towards increasing representation of this group from 5% to 12% by 2030.[18]

Clearly, work needs to be done to ascertain a way of recruiting and retaining this large increase in female and BAME employees if there is any hope of realising these aims.

Targets are a positive step towards tangible action. However, this is only the beginning for improving EDI within the sector and there are many other aspects to consider including other underrepresented groups, intersectionality, and the need for a holistic approach.

Gender-based targets state that females should represent

30%

of the OSW workforce by 2030, ideally aiming for

40%

This is ambitious, considering that the figure in 2018 was only

16%

Targets fto increase BAME employees from

5%

in 2020 to

12%

by 2030

[6] RAE Diversity Report, 2011-2016, https://www.raeng.org.uk/publications/reports/diversity-programme-report
[7] RAE Diversity Report, 2011-2016, https://www.raeng.org.uk/publications/reports/diversity-programme-report
[8] Hunt V, Layton D (2015), Why Diversity Matters, https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters
[9] Hunt V, Layton D (2015), Why Diversity Matters
[10] WISE Campaign (2018), Why Gender Diversity Makes Business Sense, https://www.wisecampaign.org.uk/what-we-do/expertise/industry-led-ten-steps/why-gender-diversity-makes-business-sense/
[11] Hater J & Schmidt F (2003), Employee Engagement, Satisfaction, and Business-Unit-Level Outcomes: A Meta-Analysis
[12] Morgan Stanley (2016), The Gender Advantage, https://www.morganstanley.com/pub/content/dam/msdotcom/ideas/gender-diversity-toolkit/Gender-Diversity-Investing-Primer.pdf
[13] Klingelschmidt et al (2018), Suicide among agricultural, forestry, and fishery workers: A systematic literature review and meta-analysis
[14] WISE Campaign (2018), Why Gender Diversity Makes Business Sense
[15] Ruby McGregor-Smith (2017), Race in the workplace
[16] Department of Business Energy and Industrial Strategy (2019) Industrial Strategy Offshore Wind Sector Deal
[17] Department of Business Energy and Industrial Strategy (2019) Industrial Strategy Offshore Wind Sector Deal
[18] Renewable UK- https://www.renewableuk.com/news/491745/Offshore-wind-industry-announces-targets-to-employ-3000-apprentices-and-a-more-diverse-workforce.htm

Section 2 – Under-represented Groups in Engineering

Although targets have recently been set for BAME representation, much EDI work so far has focused on increasing the number of women in engineering. There have been some notable gains in this area, but with many excellent opportunities for improvement still ahead. This will be considered more closely in the following sections. Although there has been a clear focus in this area, EDI efforts should encompass a wide variety of under-represented groups to promote a truly diverse, equal and inclusive workforce. The following sections will individually consider some key under-represented groups.

CASE STUDY

Dr Nike Folayan –
Engineer & Founder of Association for BME Engineers

"I think that we need to be more open…even at this stage in my career, I still sometimes feel like I'm on the outside."

Ethnicity

The most recent census of England and Wales in 2011 showed that around 14% of the working age population were non-white.[19] Interestingly, in 2018, 27% of UK domiciled engineering graduates were from BAME backgrounds.[20] However, currently, only 7.8% of professional engineers are BAME.[21] Clearly, there is a disparity between those studying engineering and those actually working in the engineering sector.

This evident disparity between those that intend to become engineers and those working in the field, could be partly attributed to a culture that is not as inclusive as it could be to minority employees. In a survey conducted by the Royal Academy of Engineering, white engineers were significantly more likely to 'feel included' in engineering than those from BAME backgrounds. The survey also showed that 85% of BAME engineers said that assumptions were made about them because of their ethnicity or nationality.[22]

It seems that inclusivity is an aspect of EDI that is more challenging to 'get right', but will be key to retaining a diverse workforce in this sector.

The most recent census of England and Wales in 2011 showed that around

14%

of the working age population were non-white

In 2018

27%

of UK domiciled engineering graduates were from BAME backgrounds

However, currently only

7.8%

of professional engineers are BAME

Sexuality

Tackling discrimination of Lesbian, Gay, Bisexual and Transgender (LGBT) people is perhaps even more challenging than it is for other groups. This is due to a variety of factors, some of which will be explored in the following sections.

Sexuality cannot be seen

One reason for this difficulty is that sexuality cannot be seen, and therefore LGBT people, often through fear of not being accepted, don't live openly and this contributes to a lack of role models and representation. This is especially prevalent in the engineering sector. A survey of 279 engineers found that 6% stated they were LGBT and 53% of these said that they were not open about their sexuality in the workplace.[23] This is compared to 34% of LGBT people who are not open about their sexuality in the general population. [24]

A survey of 279 engineers found that

6%

stated they were LGBT

53%

of these said that they were not open about their sexuality in the workplace

This is compared to

34%

of LGBT people who are not open about their sexuality in the general population.

Stigma

Another reason is that there is still a prevalent stigma attached to openly identifying as LGBT in engineering. A study conducted by the House of Commons and InterEngineering showed that less than half (46%) of gay engineers said that they would be comfortable in being open about their sexuality in the workplace. Worse still, this figure falls to only 8% of engineers working on construction sites. Even for those who are living openly, 83% of LGBT employees reported that they changed an aspect of their appearance or lifestyle to fit in at work. [25]

The study suggested that homophobia is one of the few aspects left directly unchallenged on site[26] resulting in direct discrimination towards gay engineers, 7.7% of which described open abuse and discrimination at work. [27]

The outcome of this kind of discrimination can be devastating in a personal and professional sense. It is estimated that the engineering industry loses 30% in productivity due to LGBT employees being unable to be open about who they are. It is also thought that the stress of trying to disguise their sexuality in anti-gay communities takes an average of 12 years off the life expectancy of LGBT people.[28]

There are glimmers of hope. Some major engineering firms have established networks for LGBT engineers, such as BP Pride, who host outreach insight days specifically for LGBT students. However, there is clearly much more that needs to be done to tackle this issue.

[19] Gov.uk, 2011 census data, https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/working-age-population/latest#:~:text=data%20shows%20that%3A-,according%20to%20the%202011%20Census%2C%20the%20total%20population%20of%20England,from%20the%20Other%20ethnic%20group
[20] Royal Academy of Engineering, https://www.raeng.org.uk/diversity-in-engineering/diversity-and-inclusion-at-the-academy/celebrating-leading-ethnic-minorities-in-engineer#:~:text=While%20the%20engineering%20profession%20is,graduates%20come%20from%20BAME%20backgrounds.
[21] Association for BME Engineers, https://afbe.org.uk/about-us
[22] RAE (2017), Creating a culture where all engineers thrive: A unique study of inclusion across UK engineering, https://www.raeng.org.uk/publications/reports/creating-cultures-where-all-engineers-thrive
[23] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[24] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[25] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[26] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[27] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[28] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering

Social mobility

'Social mobility' refers to the extent to which individuals move between socio-economic strata, both within one's lifetime and between generations. It relates to the extent to which our society is 'open' or 'fair'.[29]

Social mobility is a large and complex issue within EDI. It is an aspect that can be shared amongst all of society's groups. Coming from a disadvantaged background makes it difficult for anybody to prosper in the workplace and can make things far more difficult for those who are already in minority groups, with BAME women from disadvantaged backgrounds being reportedly the worst affected.

Statistics show that engineering is behind the curve in this area with 24% of the engineering workforce being from disadvantaged backgrounds, compared with 26% from the total labour force.[30]

"People see ethnic minorities as a homogenous group…if all your ethnic minority employees come from the same prestigious university, you've kind of missed the point. You also need to target things like social mobility."

Dr Nike Folyan, AFBE

Educational disadvantage

The first place where those from poorer backgrounds are affected is in the education system, with only 44% of pupils receiving free school meals (FSM) achieving grades A*-C at GCSE, compared to 71% of non-FSM pupils. In particular, for physics this figure is 8% compared to 23%.[31] Additionally, schools in disadvantaged areas often do not offer the opportunity to study for a triple science qualification, meaning that pupils are less likely to be able to study an engineering-facilitating subject at A-level. The outcome of this is that only 1 in 10 engineering and technology first year undergraduate students come from the most disadvantaged proportion of society.[32]

Poorer backgrounds are affected in the education system, with only

44%

of pupils receiving free school meals (FSM) achieving grades A*-C at GCSE, compared to

71%

of non-FSM pupils

In particular, for physics this figure is

8%

compared to

23%

Career progression

Those who do manage to secure roles in engineering also seem to face adversity when attempting to further their careers. Of those aged 30-39 in engineering careers in 2017, 71% of people from advantaged backgrounds worked at managerial level, compared with 49% from intermediate backgrounds and just 39% from disadvantaged backgrounds.[33] Interestingly, this figure is better in engineering than the population average of 33%.[34] This indicates that there are positive aspects in engineering that can be further improved upon.

More needs to be done to address social mobility in engineering, from improving prospects for disadvantaged pupils in engineering, to improving support and inclusion during the lifetimes of their careers. Furthermore, research should be conducted to help understand interplay between social mobility and other aspects of EDI, such as gender and BAME.

Of those aged 30-39 in engineering careers in 2017

71%

of people from advantaged backgrounds worked at managerial level, compared with

49%

from intermediate backgrounds and just

39%

from disadvantaged backgrounds

This figure is better in engineering than the population average of

33%

This indicates that there are positive aspects in engineering that can be further improved upon

Disability

'You're disabled under the Equality Act 2010 if you have a physical or mental impairment that has a 'substantial' and 'long-term' negative effect on your ability to do normal daily activities.' [35]

There is a lack of available statistics on disabled people employed in engineering, which hints at the vast amount of work that there is to do to improve knowledge on this issue. In the UK workforce, 7.6 million people of working age adults are disabled, which is 18% of the population. Of these, 51.7% of these are employed.[36] This is compared to 81.7% of people without disabilities who are employed.[37] When considering adults with learning difficulties, only 6% are employed, despite 60% stating that they would like to be in work.[38]

There is a very wide and varied spectrum of what it means to be disabled. This includes differences in learning ability such as autism, or a physical disability such as multiple sclerosis.[39]

Being disabled means that the world around you is not designed for you, and therefore simple things are significantly more difficult. Having a disability does not, however, necessarily mean that a potential candidate would be less capable of doing a job well. In fact, a disabled engineer is likely to be able to give a unique and interesting perspective to problem solving. After all, people with disabilities constantly must solve problems, just to live their daily lives.

Despite a lack of targets for disabled employment in engineering, the government has set a target for 4.5 million people with disabilities to be employed in the general labour market by 2027.[40]

Women are far less represented in engineering accounting for only

20.5%
of employees within the engineering sector

9.5%
of those working as engineers

Gender

Gender, or more specifically women in engineering, is by far the most mentioned topic when discussing efforts to improve EDI in the industry. This makes some sense, as women in the general population are by no means a minority; in fact, they outnumber men at 51%.[41] However, as mentioned, they are far less represented in engineering with women accounting for only 20.5% of employees within the engineering sector and 9.5% of those working as engineers.

The reasons for this are complex and even span back to cultural stimuli in early childhood. However, the conversation about women in STEM and engineering is very much underway, albeit a little late in the day. The contributing factors for this disparity and suggestions for improvement will be explored in greater detail throughout this report focusing on each stage of education and career.

Intersectionality

'The interconnected nature of social categorisations such as race, class, and gender as they apply to a given individual or group, regarded as creating overlapping and interdependent systems of discrimination or disadvantage.' [42]

An important thing to remember is that these groups are not homogenous and there shouldn't be a 'one size fits all' approach to overcoming issues with representation. People often do not 'neatly fit' into just one of these groups and their identity may fit into two or more groups, thus increasing their chance of encountering disadvantage and discrimination.

For instance, women are present in all of the above-mentioned minority groups, and when considering the most disadvantaged members of each of these groups, more often than not, it will be the women within them. For example, trends in nationwide employment show that a higher amount of men with learning difficulties are in paid work, at 6.4.% than women at 5.3%.[43] This trend is also shown in unemployment rates for BAME individuals, with the rate for BAME men at 6.5% and the rate for BAME women being significantly higher at 8.7%.[44] Therefore, a push towards greater EDI in all groups will, by default, improve representation of women. However, this should be done with an understanding of intersectionality in mind. This need is highlighted by Dr Nike Folyan, founder of the Association for BME Engineers.

[29] Engineering UK (2018), Social Mobility in Engineering
[30] Engineering UK (2018), Social Mobility in Engineering
[31] Engineering UK (2018), Social Mobility in Engineering
[32] Engineering UK (2018), Social Mobility in Engineering, https://www.engineeringuk.com/media/1762/social-mobility-in-engineering.pdf
[33] Engineering UK (2018), Social Mobility in Engineering, https://www.engineeringuk.com/media/1762/social-mobility-in-engineering.pdf
[34] Engineering UK (2018), Social Mobility in Engineering, https://www.engineeringuk.com/media/1762/social-mobility-in-engineering.pdf
[35] Equality Act, 2010, www.legislation.gov.uk
[36] People with disabilities in employment, Andrew Powell, House of Commons Briefing Paper, 2019
[37] People with disabilities in employment, Andrew Powell, House of Commons Briefing Paper, 2019
[38] Mencap, https://www.mencap.org.uk/learning-disability-explained/research-and-statistics/employment
[39] Equality Act, 2010 Guidance, Office for Disability Issues, HM Government, 2011
[40] People with disabilities in employment, Andrew Powell, House of Commons Briefing Paper, 2019
[41] Office for National Statistics (2018)
[42] Oxford English Dictionary
[43] Mencap, https://www.mencap.org.uk/learning-disability-explained/research-and-statistics/employment
[44] Unemployment by Ethnic Background, Andrew Powell, House of Commons Briefing Paper, 2019

Section 3 –
EDI in Engineering, Barriers and Areas for Action

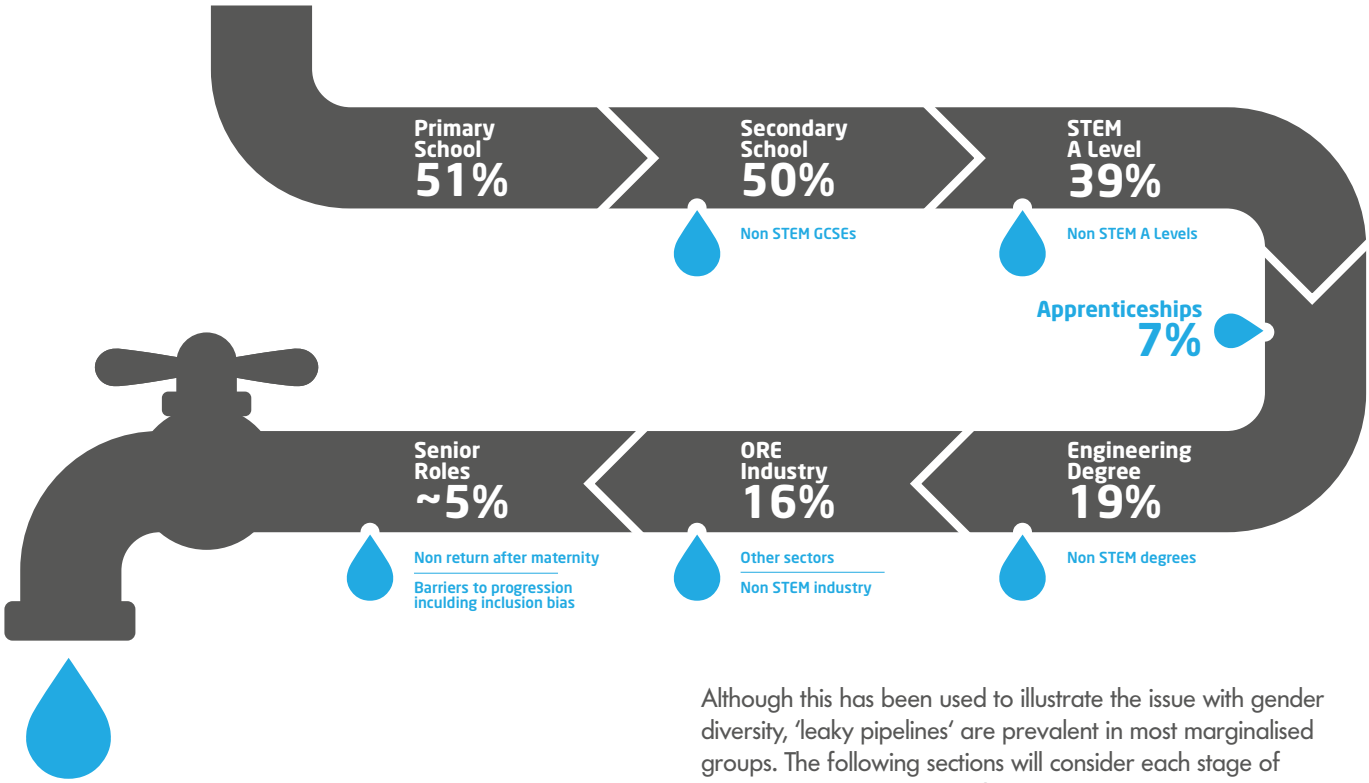
Barriers to achieving EDI will be discussed in this section, as well as potential solutions. This will be explored for each stage of education and career to address the 'leaky pipeline'. There is currently a bias towards supporting research around gender representation and an emerging presence of data focusing on diversity of ethnicity. However, there is a lack of data on other represented groups, further highlighting the fields' early stage of development in EDI progress. Therefore, this section will mainly focus on gender and ethnicity but will include other groups where possible.

The Leaky Pipeline

Much research focused on increasing EDI in STEM fields cites the 'leaky pipeline' as a major barrier to equal representation. This is particularly referred to when discussing gender but is likely to also be the case for other groups.

The 'leaky pipeline' refers to the notion that groups become less diverse at each major education or career stage (e.g. young women do well at science subjects at school, but then do not study STEM subjects at university and many of those that do study STEM at university decide not to work in a STEM-related job and those that do work in STEM jobs, on the whole, end up occupying less senior positions than men). This is illustrated for women's progression in engineering by the image below:

Leaky Pipeline –
Proportion of Females at Each Stage of Progression in the Energy/ORE Sector



Although this has been used to illustrate the issue with gender diversity, 'leaky pipelines' are prevalent in most marginalised groups. The following sections will consider each stage of the 'pipeline', with an aim of suggesting methods to improve representation of key groups. Unfortunately, there is not sufficient evidence about transitions for all the under-represented groups listed in the previous section. Therefore, this will mainly consider areas that have had the most research conducted into current statistics and potential solutions.

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

"I think the biggest problem is still societal stereotypes. There's a stereotype that women are more interested in the 'softer' more creative side of things, whereas men are more interested in the 'colder' more logical side, but I think most people are a mixture of both. I think it's 'public opinion' that puts people into these boxes.

Now it's the 100-year anniversary of Women's Engineering Society (WES) and we're still only at 12%...it's like pushing water uphill.

Of course, as well as a gender imbalance, there are lots of other areas of diversity that should be considered in terms of ethnicity, LGBTQ and disabilities. Being inclusive helps everyone.

We should also start capturing this data scientifically, otherwise we won't have any real markers of our progress."

Early Years and Primary School

This is one of the most important times to 'get things right' for the way in which issues around diversity are handled. By the time children reach primary school, they often already have a firm idea of their 'place' in the world. One of the most obvious displays of this is in girls and boys. Society is still largely segregated by gender, there is an emphasis on 'boys toys', which more often than not are designed around sport, fighting and building and 'girls toys', which are usually focused on caring, creating, and beautifying. This segregation is also shown in media and literary narratives, which can perpetuate an image of 'male' and 'female' jobs'.[45]

This can cause two main issues before girls have even started school. One is that because they generally have not been encouraged to play with toys that would actively develop skills such as spatial awareness, leaving them at a disadvantage during early education.[46] This is made worse by the way that STEM subjects are often portrayed. Children are told that they need to 'have a natural aptitude' for maths and science subjects if they want to study them and do well. This can lead to a general lack of confidence and detachment from the subjects for many young women.

These issues are compounded by the lack of diverse role models in STEM-related jobs in the media, popular culture and literature, meaning that children from under-represented groups can often reject a STEM career path at an early age.[47] This is not just the case for young women, but also for the other groups discussed in section 1. Therefore, increasing the diversity of role models would be a good step towards improving diversity in the field.

Primary Schools Current State – Summary:

- Psychological research suggests that gender beliefs and stereotypes are ingrained at an early age.
- Early gender segregation can leave girls at a disadvantage in skill development by the time they start school.
- STEM subjects often place emphasis on a 'natural aptitude' meaning that they can be seen as inaccessible for under-represented groups.
- There is a lack of diverse role models in media and representation in educational material.

[45] The Institution of Engineering and Technology (2016), https://www.theiet.org/media/press-releases/press-releases-2016/06-december-2016-parents-retailers-and-search-engines-urged-to-re-think-the-pink-next-christmas/
[46] The Institution of Engineering and Technology (2016), https://www.theiet.org/media/press-releases/press-releases-2016/06-december-2016-parents-retailers-and-search-engines-urged-to-re-think-the-pink-next-christmas/
[47] Bottia, Stearns, Mickelson, Moller & Valentino (2015), https://pages.uncc.edu/rootsofstem/wp-content/uploads/sites/529/2013/12/ROOTS_WP_103.pdf

Potential Solutions

Fun STEM lessons

One potential solution to this is to change the way that STEM subjects are portrayed in primary schools. One way of doing this is to show children that these subjects can be fun, creative and inclusive. Organisations such as 'Lab Rascal', based in Hull and East Riding, deliver fun and interactive science sessions to primary school children. Positive experiences such as this in early education have been shown to have lasting effects in later life.[48]

Image supplied courtesy of Harper-Collins

CASE STUDY

Dr Nike Folayan –
Association for BME Engineers (AFBE) Primary School Programme

We interviewed Dr Nike Folayan, Engineer and founder of AFBE, about the programmes that they offer at each stage of education and career in order to increase representation of BAME people in engineering.

Here, she explains their 'Next Gen' programme, designed for primary and secondary schools:

"For primary and secondary school children, we have a programme called **'Next Gen'.**[49] It's like an exhibition to give young people a visual representation of what engineers do.

In a Next Gen event, we will normally have a hall filled with stands from a diverse range of engineers.

We also have activities, one of my favourites is around oil extraction, where we bake a cake and use each of the different layers to represent a level of extraction, to teach the children about the process… and then you get to eat cake at the end, and who doesn't like cake?"

'You Can't Be What You Can't See' STEM Ambassadors in children's books

External cultural influences, such as books are important in the formation of how children see themselves in the world. There is a general gender imbalance in books written for young children, with an overwhelming majority of central characters portrayed as male and white.[50] This becomes more of a direct issue when portrayals of STEM job roles have an almost complete bias towards perpetuating representation of its already most over-represented group.[51]

Initiatives such as the Collins Big Cat Tara Binns series[52] help individuals from less represented groups to start to picture themselves in STEM roles from a young age. 'Tara Binns' is a series of children's books focusing on a central character, Tara, who explores different STEM careers. The project is supported by the WISE campaign, who have provided input from real women in STEM careers for the stories. Providing books such as these for young children could help to address pre-conceptions around STEM careers before they have a chance to form. This initiative could also be developed to increase representation of other groups, e.g. having BAME characters in similar book series.

STEM Ambassadors in real life

As previously mentioned, an effective way to increase the chance of a diverse range of children considering STEM careers in later life is to increase their exposure to role models who are like them. Recent research from Microsoft has shown that girls are more likely to embark on a STEM career if they have had female role models from an early age.[53] This could be done through organising a scheme for university engineering students and energy industry employees to visit primary schools and talk about their jobs or studies. Organisations such as STEM Learning have 'STEM Ambassador Schemes' in which engineers volunteer as ambassadors in schools across the country.[54]

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

We interviewed Lorna Bennet, Mechanical Engineer for OREC and STEM Ambassador and she told us about her experience of working in primary schools:

"As many of the negative stereotypes that prevent women from entering into engineering begin at a young age – I focus a lot of my work in primary schools.

When I go into a school, the first thing I do is talk about how engineering is absolutely everything in their daily lives…from their phones to their shampoo. It's about changing the stereotype of engineers. Because as far as many are concerned, engineers are just the mechanics fixing cars or the builders on the building site that they see at the end of the road.

It's also about trying to address this with parents and teachers, who also often hold stereotypical views around engineering. They're the ones that can offer consistent positive reinforcement to the children."

Potential Solutions for Primary Schools – Summary:

- Engaging, interactive STEM lessons can help to develop an interest in STEM at an early age, especially in girls.
- Exposure to role models in STEM can have a significant impact on under-represented groups if done from an early age.
- Children's literature with female STEM representatives is slowly becoming available – normalising this in primary schools can help prevent stereotypical views around who 'should' be included in STEM before they form.
- Groups such as AFBE have schemes designed around targeting under-represented groups in this transition stage.

[48] Department for Education, https://www.foundationyears.org.uk/files/2017/01/SEED-Good-Practice-in-Early-Education.pdf
[49] http://www.afbescotland.org/nextgen/
[50] McCabe J Fairchild E Grauerholz L Pescosolido B Tope D (2011), Gender in Twentieth-Century Children's Books
[51] www.independent.co.uk/news/science/childrens-books-peddle-sciences-gender-problem-a8511726.html
[52] https://collins.co.uk/pages/tara-binns
[53] Microsoft, https://news.microsoft.com/en-gb/2017/03/01/40431/
[54] https://www.stem.org.uk/stem-ambassadors

Secondary School

Secondary school highlights a 'fork in the road' for most students as they are presented with the choice of GCSE and A level subjects that can shape the course of their entire careers. Often these options are presented as a binary choice; they either do one 'type' of subject (e.g. STEM) rather than another (e.g. humanities or art). The narrative around this choice is an important consideration here, as well as the notion of social mobility and the fact that more deprived schools often do not offer triple science qualifications. This is a time when teachers and educational culture is extremely important for forming the future of EDI in fields such as engineering.

During secondary school, girls tend to perform around the same, if not higher in STEM GCSE subjects.[55] At A level, there is around an even balance of males and females who choose to study biology (59% girls) and chemistry (48% girls). However, other STEM subjects have a defined gender imbalance in their A level uptake, such as maths (39% girls), further maths (28% girls), physics (21% girls) and computing (8% girls).[56]

Social economic status (SES) has a significant influence on whether students choose to study STEM subjects at A level, with students eligible for free school meals being shown to have a notably lower uptake of STEM subjects.[57] A reason for this is the lack of specialist science teachers in schools located in deprived areas.[58]

In terms of racial diversity, there are some key differences between races in STEM uptake. Indian, Pakistani and 'other' ethnicity students are more likely to study STEM A levels than other students, whereas black students tend to have a lower uptake of STEM.[59] In all of these groups, females have a lower uptake of STEM A levels than males, apart from black female students.[60] This highlights the diversity within the BAME demographic and emphasises that efforts to improve racial diversity in STEM should not be conducted with a 'one size fits all' approach.

Secondary School Current State – Summary:

- Although they perform just as well as boys in STEM GCSEs, girls have a lower uptake of engineering – related STEM subjects such as physics and maths.
- Those from lower SES backgrounds have a significantly lower uptake of STEM subjects at GCSE and A level.
- Racial diversity is more complex at this age, with Indian, Pakistani and 'other race' students more likely to study STEM at A level, whereas black students have a lower uptake.

Potential solutions

There are large-scale approaches that need to be made by the government, schools and industry in order to address the diversity imbalances in STEM at A level. As with all EDI-related issues, this disparity will not be overcome with one method, but rather a combination of approaches all aiming to achieve the overarching goal of improving diversity in the study of key STEM subjects at A level and presenting engineering as a potential career to a diverse range of students from a young age.

STEM/ Humanities/ Arts

When considering the lack of female uptake of certain STEM subjects, there are many different factors to consider. One is that just as a gender imbalance exists in physics and maths, one also exists in subjects such as English, this time weighted more heavily towards girls. In 2015, English A levels were chosen by only 8.4% of boys compared to 22.2% of girls.[61] This is important as it signals that there is some amount of perceived polarisation between subject-types, with an emphasis on choosing 'all science and maths' subjects, or 'all humanities'.

This is likely to feel restrictive to both genders and is unnecessary for many careers at such an early stage in education. There is a growing trend towards a more integrated approach towards STEM subjects, humanities and the arts and a recognition that skills in both areas are useful, especially in engineering.[62] Talks from diverse role models about how they incorporate a wide range of skills in their STEM careers would be a positive step towards promoting this to secondary school students.

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

"

'I didn't come across engineering until my penultimate year of high school and it was a chance encounter, when my art and design teacher convinced me to go to the Glasgow School of Art Open Day.

During the Open Day, I stumbled across Product Design Engineering. It was so creative and hands on that I knew it was exactly what I was looking for. Combining my passion for art and interest in science, that's when I decided to do engineering at university.

In fact, I have heard from many people that it is very common for women to come to engineering through creative routes, whereas it's often directly through an interest in science and maths for men.'

"

55 WISE Campaign, https://www.wisecampaign.org.uk/wpcontent/uploads/2018/04/WISE_UK_Statistics_2014.pdf
56 WISE Campaign, https://www.wisecampaign.org.uk/wpcontent/uploads/2018/04/WISE_UK_Statistics_2014.pdf
57 Improving Diversity in STEM, www.sciencecampaign.org.uk
58 Improving Diversity in STEM, www.sciencecampaign.org.uk
59 Codiroli(2017), Who studies STEM subjects at A level and degree in England? An investigation into the intersections between students' family background, gender and ethnicity in determining choice
60 Codiroli(2017), Who studies STEM subjects at A level and degree in England? An investigation into the intersections between students' family background, gender and ethnicity in determining choice
61 Ofsted (2015), A-level subject take-up Numbers and proportions of girls and boys studying A-level subjects in England
62 Procedia Computer Science (2013) Full STEAM Ahead: The Benefits of Integrating the Arts Into STEM

Making STEM 'for them'

As with primary school children, there can be issues that female A level students do not see a utility in studying STEM subjects such as physics and maths because they don't perceive careers in this area to be 'for them'. The WISE campaigns' 'My Skills, My Life' resource directly challenges this. They invite female students to undertake a personality quiz that links them to interesting STEM career opportunities that they might not have otherwise considered.[63]

Another project aiming to change perceptions around STEM careers for young people, and especially girls is 'Girls into Global Stem' (GIGS). This is a three-year Erasmus+ Key Action 2 project. The project aims to get to the heart of the issue of poor diversity uptake in STEM and make positive changes in the way that it is taught in schools. Through trailing workshops in schools, it aims to create new teaching materials based around using STEM to tackle global challenges, thus highlighting the direct usefulness of studying STEM.[64]

Potential Solutions for Secondary School – Summary:

- Address the polarisation between STEM and other subject fields – welcome a variety of knowledge bases at this stage of education.
- Help students from under-represented groups identify with potential careers in engineering through improved careers guidance.
- Forge links between under-represented groups in different cultures through diversity schemes.
- Include teacher training in initiatives as they are a constant presence in students' lives.

CASE STUDY

Dr Nike Folayan –
Association for BME Engineers (AFBE) Secondary School Programme

"We have a programme called 'Making Engineering Hot' for secondary school pupils. This is mainly about encouraging students to consider STEM subjects as options for their GCSEs and A levels. We also make sure to engage the teachers by explaining to them exactly what it is that we're trying to achieve.

We go to schools in more deprived areas. Especially in London where our focus is on social mobility, we prioritise schools that are in areas below the poverty line and have been ranked as 'needs improvement' or are in special measures.

We focus on those schools because they're often the ones that are so dedicated to trying to get everything right that they forget to engage with external organisations for things like careers events.

We offer a range of activities like 'the day in the life of an engineer', where an engineer comes in and talks about their job.

We also offer mentoring, where students are matched with mentors who come in once per month and work on goal setting with them. We don't want to come in and tell them that they have to be engineers, we would rather help them with other things in their lives and then leave them with the memory of having a positive experience linked to engineering.

We focus on consistent interventions; we don't just do one-off events. **We make it so that over a period of time, they learn about engineering, they meet engineers and they gradually gain an understanding of what a career in the field would be like.**

We use the programme as a springboard to encourage students to do work experience in engineering companies. **It's all about employability."**

Apprenticeships

Engineering apprenticeships offer a direct route into the industry without having to continue in academic education. Encouraging more people to start apprenticeships is an excellent way of addressing the skills gap. Unfortunately, the gender bias in engineering apprenticeships is currently very pronounced, with females making up only 7.4% of engineering apprentices.[65] This lack of diversity is also seen in the statistic that only 4% of engineering apprentices come from BAME backgrounds.[66]

Apprenticeships are often heralded as a means of encouraging social mobility in the engineering sector. However, this has not been reflected in the figures, with only 7% of Level 3 apprentices having been eligible for free school meals, compared to 14% of the population. It seems that engineering stands in contrast to other vocational qualifications, who are more likely to have apprentices from this background.[67]

Apprenticeships, Current State – Summary:

- Gender and racial bias is very severe – females make up only 6% of engineering apprentices and BAME only 4%
- Could be a good way of improving representation of lower SES groups, but this is not always the case.

Potential Solutions

Gender

To address the gender disparity in engineering apprenticeships, WISE, Semta and the Institution of Civil Engineers have launched an Apprenticeship Toolkit. This focuses on attracting, engaging, supporting and retaining more women in engineering apprenticeships. This evidence-based guide is ideal for companies to use in order to recruit more female engineering apprentices.

BAME

The Technical Apprenticeship Consortium has produced a good practice guide for increasing diversity in apprenticeships, with emphasis on BAME inclusion.[69]

Social mobility

There are several schemes working to increase social mobility in engineering apprenticeships. This includes GSK who use existing apprentices and STEM ambassadors to engage with young people from disadvantaged backgrounds. Network Rail work with the Prince's Trust to provide young people with the necessary skills to start a Level 2 apprenticeship and Jacobs who run a residential week focusing on students from disadvantaged backgrounds with a 50:50 gender split, and a 50:50 BAME split in each cohort.[70]

Apprenticeships, Potential Solutions – Summary:

- Toolkit available to improve female representation in apprenticeships
- Guide focusing on BAME inclusion is also available
- Prominent engineering companies and youth groups are working to address SES mobility.

[63] WISE, My Skills, My Life, https://www.wisecampaign.org.uk/what-we-do/expertise/welcome-to-my-skills-my-life/
[64] http://www.gigsproject.eu/
[68] https://toolkit.wisecampaign.org.uk/apprenticeship-toolkit/attract
[69] Apprentice recruitment: Accessing untapped talent A good practice model for employers and professional institutions, www.raeng.org.uk/publications/reports/tac-apprentice-recruitment
[70] EngineeringUK briefing, Social mobility in engineering, https://www.engineeringuk.com/research/briefings/social-mobility-in-engineering/

University

Undergraduate

In 2018, a report was produced by the Higher Education Academy (HEA) detailing diversity statistics for university students in the years 2016/17.[71] The results were illuminating when considering diversity statistics in engineering compared to other subjects.

Disability

Overall, the number of students who disclosed disabilities increased from 5.4% to 12% between 2003/4 and 2016/17.[72] However, rates of students with disabilities were notably higher amongst students in creative subjects such as art and design compared to science-based subjects such as computer science and engineering. This disparity was also seen in attainment, as students with disabilities who studied non-science subjects were more likely to achieve a 2:1 or first-degree classification compared to those who studied science-based subjects. Even within it's subject field, engineering had the lowest rates of students with disclosed disabilities (see figure below). More needs to be done to determine the reasons for this disparity and to devise solutions to improve support for engineering students with disabilities.

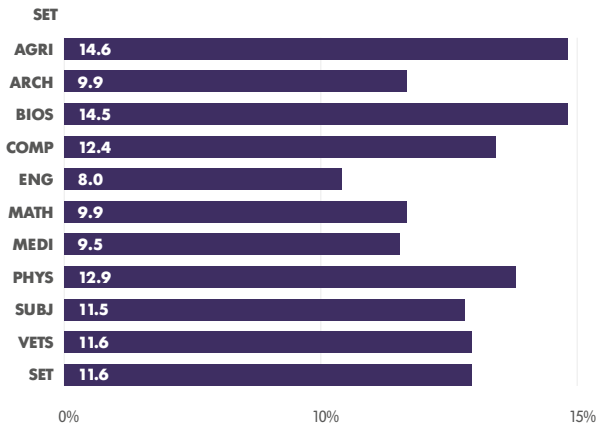
Ethnicity

Between the years 2003/4 and 2016/17, numbers of BAME university students have increased by 60%. Interestingly, when specifically considering science-based subjects, BAME students were found to outnumber white students (49.8% compared with 47.1%).[73] BAME students made up 26.3% of engineering students, which is notably high, even in comparison to most other science-based subjects (with the notable exceptions of medicine and computer sciences).

However, despite encouraging student figures, there is a disparity between BAME students studying STEM in university and those working in STEM-related jobs. It seems that more support and initiatives are needed during university courses for marginalised groups to facilitate successful transition from university to engineering careers.

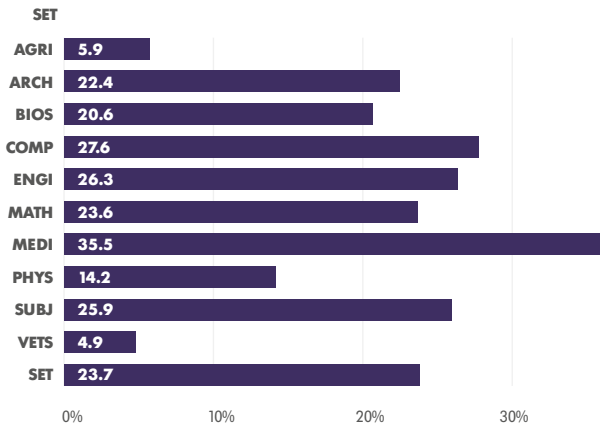
Graph depicting percentage of engineering ('ENGI') students with disclosed disabilities compared to other science-based subjects.

(HE diversity statistics report)



Graph depicting percentage of BAME engineering ('ENGI') students compared to other science-based subjects.

(HE diversity statistics report)



Gender

The majority of students in the UK are female (56.7%). They outnumber men in both science (51.5%) and non-science-based subjects (61.1%). Female students are also more likely to achieve a 2:1 or first-class degree than their male counterparts. Despite this, male students are more likely than female students to be in professional employment six months after finishing university.[74]

There is a notable lack of female students in engineering compared to other science-based subjects. A disparity that is matched only by computer science (see graph below). 83.4% of engineering students are male, contributing to the current state in which the UK is only producing 12,000 engineers per year, with 54,000 vacancies to fill.[75]

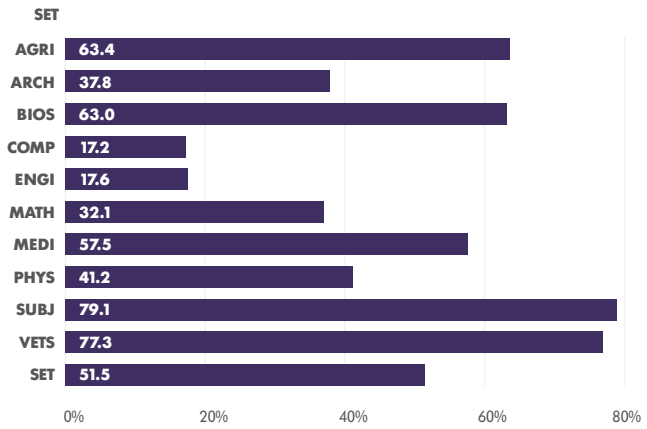
Postgraduate

A postgraduate qualification is useful in many engineering roles, particularly at senior level. Additionally, it is generally a pre-requisite for engineering-related careers within academia. Therefore, it is important to monitor EDI statistics within post-graduate study separately to undergraduate level.

Overall, it seems that for most categories of EDI, the student population becomes less diverse as qualifications increase. Social mobility is likely to become more of a barrier in post-graduate study (see section below) as well as disability, with a greater proportion of students disclosing a disability at undergraduate level compared to post-graduate.[76] There are interesting trends around ethnic and gender diversity at post-graduate level, which are both positive and negative (see below sections).

Graph depicting percentage of female engineering ('ENGI') students compared to other science-based subjects.

(HE diversity statistics report)



[71] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[72] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[73] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[74] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[75] https://www.wisecampaign.org.uk/wp-content/uploads/2018/06/not_for_people_like_me-full-report.pdf
[76] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-057/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf

Social mobility

A study conducted by Welking and Hampden-Thompson from the University of York in 2013 suggested that there were differences in students who carried on to post-graduate study, which were influenced by social mobility. Indeed, students who attended private schools were over-represented in post-graduate student populations (11% vs 7% in the general population).[77/78] Additionally, those whose parents had attended higher education were also more likely to enter into post-graduate education than those who had not (see table below).[79]

Interestingly, the study found that for master's degrees, there was no significant difference in method of funding (e.g. those who had higher social mobility were not more likely to self-fund master's courses than those with lower social mobility). Therefore, direct access to funding was not determined to be a barrier for students with lower social mobility. It seems that the issue is perhaps more subtle and is likely to be a product of academic culture and perceived accessibility. This is an area that requires further research for worthwhile interventions to be developed within universities to promote greater social mobility in postgraduate study.

Table depicting percentage of postgraduates who went to private school and who's parent attended higher education in 2009-2011.

(Welking and Hampden-Thompson, 2013)

	Progressed to taught higher		Progressed to research degree	
Background characteristic	**2009/10**	**2010/11**	**2009/10**	**2010/11**
School type				
Private school	12.3	12.5	2.5	2.5
State school or college	7.9	8.5	1.9	1.8
Unknown	15.5	17.6	2.2	2.2
Parent higher education qualification				
Yes	13.0	12.3	1.6	2.2
No	8.9	8.3	1.0	1.4
Refused	9.6	9.7	1.1	1.9
Unknown	8.2	8.9	2.7	2.2

Ethnicity

In 2016/17, engineering post-graduate courses saw a reduction in BAME students compared to undergraduate courses (22.9% compared to 26.3%).[80] However, this is still an over-representation compared to ethnic minorities present in the general population. Compared to other science-based subjects, engineering had one of the highest rates of ethnic minority representation (see graph below).

These figures are reassuring for promoting diversity in postgraduate courses. However, it must be highlighted that BAME engineers are still highly under-represented in senior positions within industry and academia suggesting that postgraduate courses should have a stronger emphasis on career transitions for these students.

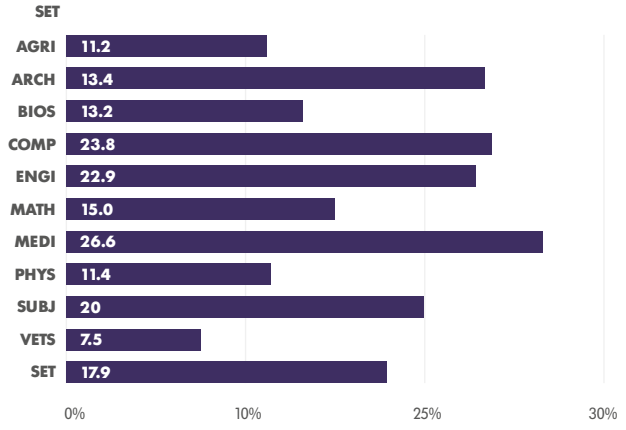
Gender

Men slightly outnumber women in postgraduate study (51% of postgraduate students were male in 2016/17).[81]However, in a study conducted by WISE in 2014, gender segregation was found to be less marked in engineering for women at postgraduate level. In 2014, 24% of engineering postgraduate degrees were awarded to women compared to 14% of undergraduate degrees.[82] However, engineering and physical sciences still has the highest gender disparity in students compared to other subjects, as can be seen by the graph depicting proportions of PhD students below.[83]

As with ethnic minority groups, it is still the case that women are under-represented in senior positions in both industry and academic careers. Therefore, as with other under-represented groups, it is important that post graduate courses focus on career transitions to address this later disparity.

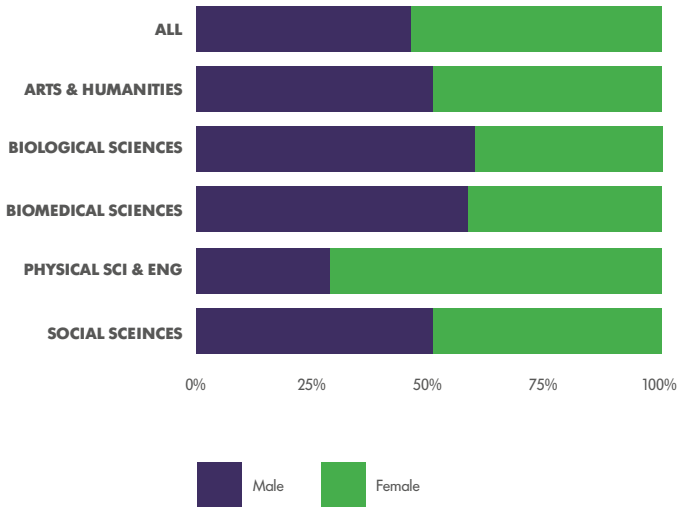
Graph depicting percentage of BAME engineering ('ENGI') postgraduate students compared to other science-based subjects.

(HE diversity statistics report)



Graph depicting percentage of female PhD students vs male per subject.

(Vitae.ac.uk)



[77] Wakeling, P., & Hampden-Thompson G (2013), Transition to higher degrees across the UK: An analysis of national, international and individual differences
[78] *Note: just 7% of the UK population are privately educated; https://www.gov.uk/government/news/elitism-in-britain-2019#:~:text=Britain's%20most%20influential%20people%20are%20over%205%20times%20more%20likely,of%20those%20in%20top%20positions.
[79] Wakeling, P., & Hampden-Thompson G (2013), Transition to higher degrees across the UK: An analysis of national, international and individual differences
[80] HE diversity statistics report(2018), https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[81] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[82] WISE(2014), https://www.wisecampaign.org.uk/wp-content/uploads/2018/04/WISE_UK_Statistics_2014.pdf
[83] Vitae, Who does doctoral research in the uk? https://www.vitae.ac.uk/doing-research/are-you-thinking-of-doing-a-phd/who-does-doctoral-research-in-the-uk

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

Lorna reflects on her university experience:

"I studied Product Design Engineering, which was seen as 'the girl's course'…, which is funny because there were 64 students in my first year and only 12 of us were women'.

Although my university experience was largely positive, I know that for many women it can be a really difficult and isolating time. University is an important time to target resources into retaining diverse talent in the sector. A report done recently showed that 73% of female engineering students don't enter into engineering careers following university. That is a massive loss of qualified talent, especially when industry is struggling with a technical skills gap.

If you've struggled to feel part of a group for four of five years at university, being the only girl in your class, that can seriously wear you down."

University, Current State – Summary:

- There is a notable gender imbalance in engineering uptake at university, women only represented 15% of students.
- BAME students well-represented, but less represented in engineering careers (lack of continuity).
- University is an important time to target resources into retaining talent in the sector as many female engineering students do not go into engineering jobs after completing their courses.

Potential Solutions

There is a temptation to attempt to overcome issues such as low uptake of engineering at university with one-off solutions, such as inspiring talks from female engineers in schools. Although this is likely to make some positive difference in encouraging young women to think about engineering as a potential career, it will not overcome years of societal conditioning. Therefore, longer-term interventions are needed.[84]

Networks

Universities can help to encourage applicants to engineering courses by ensuring that women and other under-represented groups feel that they will be in a supportive environment during their time studying. Schemes such as Equate,[85] provide a network for female engineering students in Scotland, along with conferences, mentoring, workshops and informal events. This addresses the feelings of isolation experienced by female engineering students who are often in the minority on their courses. Women in Engineering and Science (WES) offers a similar scheme, along with the option for universities to set up their own student groups with the support of their organisation.[86] For BAME engineering students, the Association for Black and Minority Ethnic Engineers (AFBE) offers similar opportunities.[87]

Finances

Finances are a barrier for many students entering university and can act as further reasons for under-represented groups not to pursue STEM subjects, especially those from disadvantaged backgrounds. There are grants available for women who pursue STEM subjects at university, of which the WISE foundation keeps an up to date list.[88] Engineering currently offers the highest amount of scholarships to potential students.[89] Highlighting these opportunities to under-represented groups as they are making decisions about what to study at university could provide the encouragement needed to pursue further study in STEM.

Mature students

Another thing to remember when considering STEM uptake at university is that not all students enter university straight from school. Targeting a more mature demographic of potential students could be a key strategy to increasing diversity in engineering courses as mature students are more likely to be BAME, female, have a disability and come from disadvantaged backgrounds. Therefore, ensuring that STEM courses cater to mature students is important. The majority of mature students fit their courses around paid employment (often full time) and caring responsibilities, making flexibility in course design important. Isolation is a potential issue for under-represented groups in engineering courses and it is can be even more of a problem for mature students who often lack confidence in a university environment.[90] Therefore, initiatives to build network groups within universities should be designed with mature students in mind.

Accessibility in courses

It is also important to design courses that are accessible to disabled students, who are likely to feel disadvantaged in a learning environment that is generally catered towards the mainstream. The DART project, run by Loughborough University focused on creating an academic resource for disabled students. Research such as this is a step in the right direction and further initiatives based around accessibility and training of university staff on how to effectively teach and mentor disabled students is important.

[84] https://www.wisecampaign.org.uk/wp-content/uploads/2018/06/not_for_people_like_me-full-report.pdf
[85] https://equatescotland.org.uk/student-services/
[86] https://www.wes.org.uk/students
[87] https://afbe.org.uk/membership/student
[88] https://www.wisecampaign.org.uk/wise-network/funding/
[89] https://www.thescholarshiphub.org.uk/blog/engineering-scholarships
[90] https://www.nus.org.uk/PageFiles/12238/2012_NUS_millionplus_Never_Too_Late_To_Learn.pdf
[91] https://www.nus.org.uk/PageFiles/12238/2012_NUS_millionplus_Never_Too_Late_To_Learn.pdf
[92] https://www.nus.org.uk/PageFiles/12238/2012_NUS_millionplus_Never_Too_Late_To_Learn.pdf
[93] Maddocks A, Crawford A & Dickens J(2018), Creating a positive experience for disabled engineering students

CASE STUDY

Dr Nike Folayan –
Association for BME Engineers (AFBE) University Programme

"For university we have the 'Transition' programme, which comes at the critical time of students leaving university and looking for job.[94]

We found that one challenge affecting ethnic minority engineering students in particular is that they don't have existing networks of people who already work in engineering. Because of this, they often don't have previous exposure to engineering companies before they start to apply for jobs, which can make the process very overwhelming.

We aim to expose them to interviews with professionals, like a practice run of the real thing, so that when it comes to the real interview, they perform as they would, rather than being held back.

This scheme has been really successful — in a survey that we did in 2016, we found that out of all the people that took part in the scheme, 70% of them went on to get jobs in engineering.

We also have 'Real Projects' in which people talk about the projects that they're working on to university students. Often you can study things at university without gaining an understanding about how they would work in industry.

Real Projects connects engineers with students to give them an insight about how engineering projects like HS2 work in practice."

University, Potential Solutions – Summary:

- Focus on consistency, rather than one-off schemes
- Networks are very important for under-represented groups
- Financial help can be important
- Focus on mature students
- Ensure that courses are accessible for disabled students

Academic Careers

Addressing diversity within academia is extremely important when attempting to improve diversity in the engineering field. Industry innovation is usually driven by research conducted within academia and academics are responsible for teaching and nurturing the next generation of engineers. Therefore, it is imperative to ensure that EDI is championed by academia as an example and driver for industry.

Diversity within academia seems to be improving, however there are still notable areas that are in severe need of development. Factors such as unconscious bias, lack of networks, issues with flexible working and career breaks (discussed further in the Industry section) are all barriers to optimal EDI in academia, as well as some issues that seem to be unique to the field. This will be discussed in the below sections which will focus on specific groups and their representation within engineering focused academic careers.

Disability

Research conducted in 2016/17 highlighted that disabled staff were under-represented in academia, particularly for engineering disciplines. 4.7% of staff working in HE disclosed a disability and this figure was only 2.1% in engineering. Rates of staff with disclosed disabilities decreased with seniority and a pay gap of 8.7 percentage points was found between disabled and non-disabled staff. Just as with students, more needs to be done in academia to promote increased accessibility and decreased bias for academic staff with disabilities.

Ethnicity

In general, ethnic minorities are poorly represented in academic staff, with just 9.4% of HE staff identifying as BAME.[95] As with disabled staff, there is a trend for numbers of BAME staff to decrease in positions of seniority, In 2016/17 only 0.8% of departmental heads identified as ethnic minorities.[96]

As well as diversity, there seems to be issues with equality as the mean pay gap between UK white and BAME university staff members were found to be 2.4 percentage points. Actions clearly need to be taken to address the pay disparity and under-representation of BAME employees in higher education.

Despite overall trends, representation of ethnic minorities was found to be significantly higher in electronic (18.6%) and chemical engineering (20.2%).[97] These encouraging statistics highlight that perhaps something could be learned from engineering in promoting ethnic diversity in higher education staff. It would be beneficial for research to focus on why there is a greater representation of ethnic diversity in these particular fields so that this could be replicated in other subject areas.

[95] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[96] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[97] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf

Gender

There is clear and prevalent gender disparity within academia. Although women are over-represented in academic staff (54.2% vs 45.8%), they are under-represented in senior academic positions. In 2016/17, only 24.3% of heads of department were women and 75.4% of professors were men. Furthermore, men made up the majority of senior managers at 60.9%. Specifically, engineering was found to have one of the highest proportions of male staff, with men accounting for over 80% of employees.

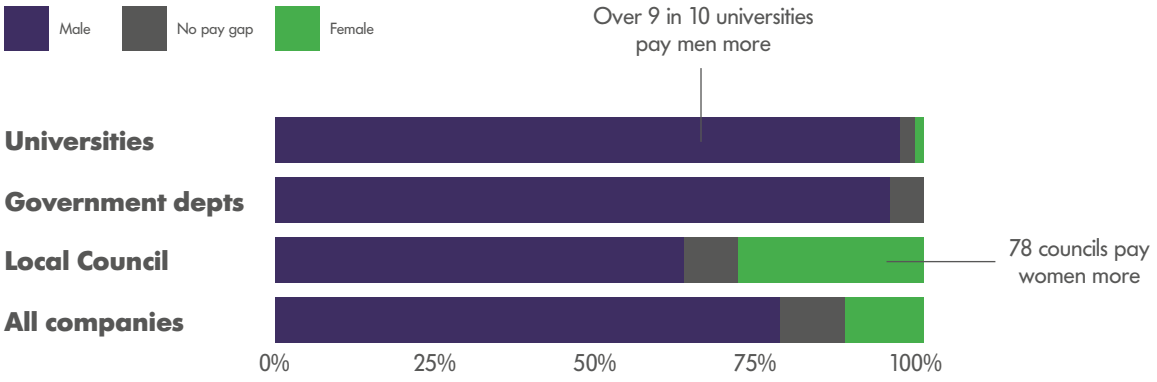
Unsurprisingly, there was a pronounced pay gap between male and female university staff with the proportion of female academics on the highest pay spine being only half that of men (10.2% women, 20.9% men). The mean pay gap between male and female staff was 17.2 percentage points, which was higher than both disabled and BAME staff members.[98] In 2019, the gender pay gap in academia was revealed to be 4.6 percentage points higher than the national average, with nine out of ten universities found to pay men more than women (as shown in the graph below).[99/100]

A study conducted by Cardiff University found a negative link between being a woman and the likelihood of being employed at a senior level.[101] This was the case even after accounting for personal circumstances such as dependent children and household chore allocation. The study also accounted for professional factors such as rank of qualifications and amount of authored publications. Put simply, the research found that when considering a man and woman with identical credentials and personal circumstances, the man was more likely to have a higher professional rank than the woman.[102]

Academic Careers, Current State – Summary:

- Disabled and BAME people are under-represented amongst HSE staff.
- Amounts of disabled and BAME staff decrease as seniority increases.
- Women are over-represented in university staff populations but are under-represented in senior positions.
- There are pay gaps for people who are disabled, BAME and female.
- The largest pay gap exists between men and women, even after accounting for qualifications, publications, age and personal circumstances.

Gender pay gap favours...



Organisations that have reported on gov.uk as of 29 March 2019

Potential Solutions

The above statistics present some worrying trends for EDI in academia. However, they also highlight a multitude of opportunities for positive progress.

The need for more research

Although helpful and relevant research has been conducted on some key areas of diversity, there is a lack of readily available data on other key areas of diversity such as social mobility. It would be beneficial for EDI in academia to be researched in a more comprehensive manner and for this data to be widely disseminated.

There is also a lack of prominent research that attempts to uncover the 'root cause' of poor diversity in academic staff (e.g. cultural issues within the field). This means that attempts to address EDI issues within academia will struggle to achieve long term success. Conducting studies into underlying causes of poor diversity, particularly in senior positions would be a good first step to addressing systemic diversity issues in academia.

In terms of gender inequality, research has shown that female academic staff tend to have a higher teaching load than their equally qualified male colleagues.[103] Teaching is generally viewed as a less prestigious work activity than research and is less associated with progression to senior positions.

Research has also suggested that the short-term contracts associated with academia are particularly detrimental to female staff who want to have children. A large proportion of female academics hold off having children until later in life when they have secured open ended contracts and subsequently face difficulties in advancing their careers from this point.[104] These issues should be addressed when considering how to address the prevalent gender pay gap in academia.

Charter membership

There are several charters that universities can sign up to in order to make a visible agreement for positive change around EDI. These charters are often focused on a specific underrepresented group.

Athena Swan

The Athena Swan Charter managed by Advance HE has been shown to have a positive impact on gender equality in academia.[105] In 2005, they released the 'Athena Swan Charter', aiming to improve gender diversity in STEM-related fields. Universities can apply for bronze, silver or gold awards based on their levels of gender equality, in doing this, they commit to adopting principles that promote and support gender equality within their organisations. Being part of the Athena Swan Charter is a visible agreement to work towards positive change. However, this must be supported by less formal action 'on the ground'.

Race Equality Charter

The ECU Race Equality Charter also managed by Advance HE works similarly to Athena Swan's charter but addresses representation of minority ethnic groups amongst academic staff.[106]

While it is positive that these two areas of diversity have been addressed through the implementation of specific charters, academia clearly still has a long way to go to address systemic issues with poor diversity.

Other factors

Many of the diversity issues within academia can be linked to factors such as unconscious bias and lack of networks, which will be discussed with regards to industry in the following sections.

Academic Careers, Potential Solutions – Summary:

- Further research is needed to identify the underlying causes of poor diversity in academia.
- Working in line with the Athena Swan and Race Equality Charters will help to improve gender and race diversity in HE organisations.
- More needs to be done to widen the scope of diversity initiatives in this area.
- Factors that affect diversity in career entry and progression are relevant here and will be further explored in the following sections.

[98] HE diversity statistics report- https://www.advance-he.ac.uk/sites/default/files/2019-05/2018-06-ECU_HE-stats-report_students_v5-compressed.pdf
[99] https://www.bbc.co.uk/news/business-47723950
[100] https://www.psa.ac.uk/psa/news/why-do-uk-universities-have-such-large-gender-pay-gaps
[101] Santos & Dang Van Phu (2019), Gender and Academic Rank in the UK
[102] Santos & Dang Van Phu (2019), Gender and Academic Rank in the UK
[103] Santos & Dang Van Phu (2019), Gender and Academic Rank in the UK
[104] Santos & Dang Van Phu (2019), Gender and Academic Rank in the UK
[105] Athena Swan, https://www.ecu.ac.uk/equality-charters/athena-swan/
[106] Race Equality Charter, https://www.ecu.ac.uk/equality-charters/race-equality-charter/

Industry Career Entry

For those in under-represented groups who have pursued engineering as a career through apprenticeships or university, entering a career in this field is not always straightforward, especially for women and BAME graduates. In 2017, 65.6% of white engineering students entered into a full-time engineering position within 6 months of leaving university, compared to 48.6% of those from an ethnic minority.[107] In terms of gender, although similar numbers of men and women enter into full-time work within 6 months of completing their degrees, there is a marked difference in career types. 35.7% of women were in non-engineering roles compared to 29.6% of men.[108]

Unconscious bias

There are many reasons for this disparity, some of which have been covered in previous sections (e.g. lack of encouragement to pursue STEM careers from an early age). As well as the lack of existing networks that less represented groups will have in engineering careers, there is also the issue of unconscious bias in recruitment. Unconscious bias is something that everybody has. It stems from the brain's way of making short cuts based on existing information. For example, if we are used to seeing powerful work positions being occupied by white men, we are more likely to associate the qualities needed for this position with a white man in real life.[109] This is an issue in job recruitment, not just at physical assessment stages, but also right at the beginning of recruitment.

Research by writing platform, Textio, found that job applicants are influenced by the type of wording used in job descriptions. Using the word 'sympathetic' in a job advert is more likely to yield female applicants, whereas the word 'exceptional' encouraged more males to apply. They found that job descriptions more stereotypically associated with male employees (e.g. wind technicians) tended to be written with a bias towards 'male wording'.[110] Indeed, research by Total Jobs found that the 'science' industry had one of the strongest biases towards masculine-worded job adverts (62% male bias in 677 job adverts).[111] This form of unconscious bias can deter women and other under-represented groups from engineering roles at the first stage of recruitment.

Unconscious bias can affect the chances of under-represented groups entering into a job at every stage:

Job adverts – often written with a typical employee in mind (e.g. a white man). People from under-represented groups feel less confident in applying.

Job applications – Bias has been shown to exist at this stage, particularly in STEM jobs. Research from Yale University showed that a job application was more likely to be selected for a job if it had a male name than it was with a female name. [112]

Interviews/assessment centres – Bias and stereotyping are an issue here. Research has shown that women are at a disadvantage in interviews, particularly for male-dominated roles.

There are many barriers that prevent under-represented groups from entering engineering careers. Some of these can be tackled immediately, and others will take time and effort over a much longer period.

Career Entry, Current State – Summary:

- There are a lack of existing networks focusing transitions from university to industry careers.
- Issues such as unconscious bias in recruitment, gender bias in job adverts, lack of transparency over salaries and a perceived lack of inclusivity in culture are barriers for diverse employees entering into engineering.

[107] Engineering UK (2018) Synopsis and recommendations
[108] Engineering UK (2018) Synopsis and recommendations
[109] Noon(2018), Pointless Diversity Training: Unconscious Bias, New Racism and Agency
[110] Textio, https://textio.ai/pink-collar-language-f2412ddce6f3
[111] Total Jobs bias decoder findings, https://www.totaljobs.com/insidejob/gender-bias-decoder/#findings
[112] Midura (2013), John Vs. Jennifer: A Battle of the Sexes

Potential Solutions

Career-focussed networks

Professional and student networks, such as the aforementioned WES and AFBE can help to tackle issues with transition from university to engineering careers. Both networks offer job advertising space meaning that engineering companies can specifically post job vacancies to their websites to ensure that members of these groups are aware of these opportunities and feel included in their dissemination.[113/114]

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

Lorna Bennet discusses how her workplace strives to recruit with diversity in mind for their summer internship:

"Rather than looking for students with the best grades and most experience, we see the internship more as an opportunity to the students who will benefit most from it. We look for motivated students who don't necessarily already have work experience.

We use 'positive action', rather than 'positive discrimination' to encourage a more diverse applicant pool. This means that rather than discounting applicants who are not from under-represented groups, we make sure that we target advertisement of placements to diverse groups to try and gather more applications from these areas.

We found that by putting our advert on Equate Scotland's Careerwise page, we had twice as many women applying for internships than we would have received otherwise."

Tackling unconscious bias – Gender Decoder

There are easily accessible tools that companies can use to ensure that their job adverts appeal to a diverse range of potential employees. WISE have released a 'gender decoder' guide for organisations to follow.[115] Job website Total Jobs offers a tool that automatically highlights masculine or feminine words in job adverts.[116] This would be an excellent first step in improving EDI in the recruitment process.

Blind recruitment

Unconscious bias is a complex issue to tackle. Many organisations implement unconscious bias training for employees with recruitment responsibilities. However, research suggests that not all this training is effective, and in some cases, it can actually make unconscious bias worse.[117]

Therefore, care must be put into addressing unconscious bias in instances such as interviewing. Unconscious bias can be in part tackled by using 'blind' applications (e.g. omitting details such as names, gender and school/university attended from application forms). This ensures that details such as race, gender and socio-economic status do not influence the decisions of recruiters.[118]

Blind recruitment was one of the key recommendations from the 2016 Bridge Report around increasing diversity in the Civil Service Fast Stream[119] and the NHS and Civil Service are set to use blind recruitment by 2020.[120] This will be particularly helpful in application stages; however more will need to be done to tackle bias in interviews and assessment centres. As with other initiatives, a consistent and approach will need to be employed in to tackle unconscious bias in this stage, including the appointment of diverse interview panels and regular, evidence-based unconscious bias training.

CASE STUDY

Baroness Brown of Cambridge, DBE –
Sector Champion for the Offshore Wind Sector Deal as part of the Government's Industrial Strategy

"We need a more radical approach to recruiting female engineers if we're going to meet the target.

Ensure that 50% of interview panels are female to tackle unconscious bias.

If there are lots of applicants, make it so that 50% of the shortlist have to be women.

If a woman doesn't quite meet the standard of a man, take a chance on them."

Career Entry, Potential Solutions – Summary:

- Networks remain very important at this career stage – targeting networks for under-represented groups in job posting can help to reach people that would not have ordinarily applied.
- Gender decoders a good first step to increase female job applicants.
- Unconscious bias training is not always helpful – it needs to be well researched and consistently applied.
- Blind recruitment is useful and should be applied whenever possible.

[113] WES job page- https://www.wes.org.uk/job-listing
[114] AFBE job page- https://afbe.org.uk/jobs
[115] WISE gender decoder, https://www.wisecampaign.org.uk/wp-content/uploads/2018/06/WISE_-_Gender_Decoding_Your_Job_Adverts.pdf
[116] Total Jobs gender decoder, https://www.totaljobs.com/insidejob/gender-bias-decoder/#methodology
[117] Noon M(2018) Unconscious Bias, New Racism and Agency
[118] CIPHR, https://www.ciphr.com/features/what-is-blind-recruitment/
[119] Socio-Economic Diversity in the Fast Stream, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/497341/BG_REPORT_FINAL_PUBLISH_TO_RM__1_.pdf
[120] https://www.gov.uk/government/news/pm-time-to-end-discrimination-and-finish-the-fight-for-real-equality

Career Journey

There is a danger in thinking that increasing the amount of employees from under-represented groups is the sole aim of EDI initiatives. However, this is really only half the battle. The other half is to retain a diverse workforce and ensure that they have equal opportunities for advancement. This is where inclusion becomes particularly important. There are numerous issues for individuals from under-represented groups in engineering careers. These include practical matters, such as PPE generally being designed for male body types, meaning that female engineers are often uncomfortable and even unsafe.[121] There are also less visible issues, such as 33% of LGBT employees reporting that they felt their sexuality acted as a barrier to their career progression.[122] It is clear that there are barriers, both in fostering a culture of inclusivity and in less represented groups being able to rise through the ranks.

Senior positions

The first thing to note is that 75% of board positions in private engineering firms are held by men.[123] This is in line with trends in wider business, it is an often-quoted fact that men called John are statistically more likely to occupy CEO positions in FTSE 100 companies than women of any name.[124] In engineering specifically, when considering the top 100 firms by revenue, women make up 18.5% of board members and executives and 32 of these companies had no female representation at all. In terms of ethnicity, 5.7% of boards and executive positions are held by BAME individuals.[125]

This highlights two main issues for EDI. The first is that it is clearly more difficult for women, and likely other minority groups, to progress to these senior positions. The second is that if homogenous groups of white men from similar backgrounds have the responsibility for making key decisions for a company, policies and culture are less likely to be catered towards under-represented groups.

CASE STUDY

Dr Nike Folayan –
Association for BME Engineers (AFBE) Leadership Programme

"We're releasing a project called 'Chess Club', which focuses on leadership.

This is about identifying the skills needed for leadership and planning to gain these skills and get to leadership levels."

Inclusivity/culture (disparity)

A study conducted by the Royal Academy of Engineers (RAE) investigating the culture around diversity and inclusivity in engineering highlighted some revealing findings.[126] Male engineers were found to be almost twice more likely than their female colleagues to perceive the culture of engineering to be 'very inclusive' (21% of men, compared to 11% of women). Men were also more likely to feel 'very included' than women were (35% vs 23%). This disparity was also seen when comparing white and BAME engineers, with 25% of BAME engineers stating that they felt 'not very included' in the engineering profession, compared to 15% of white engineers. These findings are highly significant and highlight reasons why underrepresented groups may not choose to stay in engineering throughout their careers.

This is supported by findings from a survey of 1,464 women about why they chose to leave engineering and found that two of the most common reasons were dissatisfaction with effective utilisation of their maths and science skills, and unmet needs with regard to lack of recognition at work and adequate opportunities for advancement.[127] Indeed, the survey showed that female engineers were less likely than males to feel that work was fairly allocated (63% vs 73%). This finding was replicated with BAME engineers (63% vs 72%).[128]

Engineering was said to have a culture 'heavily focused on tradition' and one in which 'banter' is a popular way in which to relate to one another. A traditional culture can often signal a reluctance around change, therefore potentially limiting the success of EDI interventions. This highlights an inclusion bias in that issues around inclusivity do not seem to be as readily recognised by those not negatively affected by it.

The RAE study found that BAME and female engineers were more likely to describe the culture as 'slow to change' than their white or male colleagues. It also found that women were twice as likely as men to include 'offensive language and behaviour often get passed off as banter' in their top five descriptions of how engineers relate to each other.[129] This exemplifies the pervasive overall finding that there was a significant difference in perceptions between over and under-represented groups. Clearly, steps need to be taken to address the cultural issues preventing inclusivity goals being realised.

CASE STUDY

Lorna Bennet –
Mechanical Engineer
& STEM Ambassador

Lorna Bennet discusses her experiences in engineering:

"Generally, the culture has been really welcoming, although in some workplaces there was a bit of a culture around being 'macho' and a stigma against showing emotions.

There were a couple of people who were keen to perpetuate the 'hysterical woman' trope, just 'for a laugh'.

But then, I know that men can also find that kind of culture difficult and uncomfortable, that's why a movement towards a more inclusive culture will help everyone."

[121] https://www.wes.org.uk/content/progress-ppe-all
[122] Shelbrooke A Mcbride-Wright M Micheme C (2016), Tackling Homophobia in Engineering: Interengineering
[123] IRENA (2019) Renewable Energy, A Gender Perspective, https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
[124] https://www.cips.org/en-GB/supply-management/analysis/2018/february/a-ftse100-ceo-is-more-likely-to-be-called-john-than-be-a-woman/
[125] https://www.inclusiveboards.co.uk/wp-content/uploads/2019/10/Women-in-Engineering-2019-Report-by-Inclusive-Boards.pdf
[126] https://www.raeng.org.uk/publications/reports/increasing-diversity-and-inclusion-in-engineering
[127] Chang, Wan, Singh(2018), Women's reasons for leaving the engineering field
[128] Chang, Wan, Singh(2018), Women's reasons for leaving the engineering field
[129] https://www.raeng.org.uk/publications/reports/increasing-diversity-and-inclusion-in-engineering

Age and career breaks

Research conducted by the Royal Academy of Engineering showed that employees' feelings of inclusivity seemed to decline with age, with engineers aged 46 and above more likely than those under 25 to say that they feel 'not very included' in the profession (18% and 12% respectively).[130] This can occur when 'career journeys' are perhaps not as well managed as they could be, with potentially a greater focus on recruiting staff, but less of a focus on development over the course of their careers.

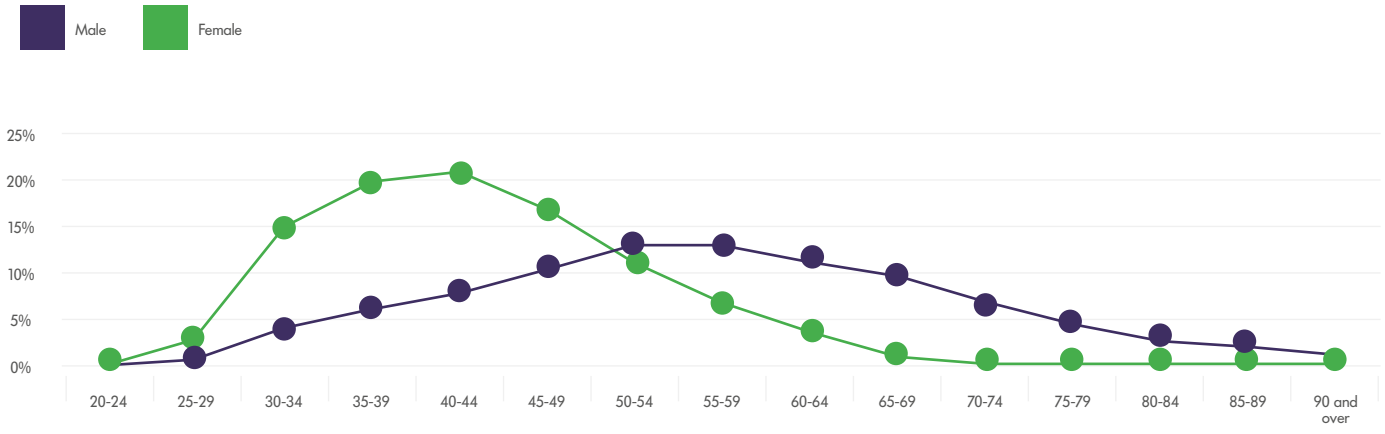
Another issue linked to this is around employees returning to work after a career break (e.g. to bring up children). Although men are increasingly taking on this role, currently, significantly more women are affected by this.[131] A study conducted by WES found that 57% of female engineers drop off the register of professional engineers under the age of 45 compared to only 17% of men, with lack of support in returning from a career break being a key factor in this.[132]

The above graph signifies the final 'leak' in the pipeline for women in engineering, with a rapid decline of women working in the field from the age of 40 onwards. These findings highlight the need to address practical and cultural factors in order to ensure that EDI initiatives do not 'fall at the final hurdle' and that the all-important inclusivity aspects are fulfilled to ensure that diverse workforces are celebrated and supported throughout their careers.

Career Journey, Current State – Summary:

- Minority groups under-represented in senior positions signals two issues; one is the lack of career progression for people in these groups and the other is their lack of power for decision-making.
- Cultural factors likely to challenge inclusivity – 'inclusion bias' seems to exist.
- 'Leaky pipeline' still evident for women during their careers.
- Practical considerations such as correct fitting PPE still not fully addressed.

Age profile in percentages of male and female members of professional engineering (Engineering Council).



Potential solutions

CASE STUDY

Increasing diversity in conference industry conference speakers – interview with Alicia Green, Policy Analyst at RenewableUK and major contributor to the formation of Switch and Switch List[133]

How did Switch come about?

Our deputy CEO is invested in working towards improving gender diversity and she encouraged me to use my initiative to think of ways to accomplish this. Because we have access to our different member companies and different perspectives, I thought we'd be uniquely placed to make a difference, so that's where Switch came about.

We set it up through an internal women's committee. All the female members of our office sit on the committee and we meet up once a month.

It's a safe space for women to come and talk about what might be on their minds, but also to drive forward our diversity projects.

The Switch List came about as we found that we wanted to promote more diverse events, because time and time again people would come and say 'I've been to an event and there was no diversity' and so we said 'let's do something in our own events'.

Tell me about Switch

A problem identified within our events team was that they were working towards tight deadlines, and it was therefore a challenge to find a diverse pool of speakers quickly. This often meant having to go back to previous programmes and re-invite the same speakers, who were often men.

From our own learning, we've realised that there are areas of the sector that are not as diverse and even identifying women can be quite challenging, so the more word that we can get out to drive that forward, the better.

That's been reflected in our 30% female speaker pledge at our events.

The team are not just thinking about deadlines now, they're also thinking about the diversity of the programme and that really helps make a big change!

Why do you think it's so important to have female representation at sector events?

I think it goes back to showcasing roles to the younger generation and women within the industry looking to progress their careers.

Women are more likely to be confident to put themselves forward for opportunities if they see other women represented in the field.

Have you been able to achieve your 30% target since it was set?

Last year we had 33% women speakers, which was great when considering the year before we only had 20% and the year before that was 8%.

So the initiative does seem to be making a difference.

Have there been any challenges with meeting the 30% female speaker pledge?

In the run up to Global Offshore Wind 2019 we did some analysis and found that in the more technical spaces, it's harder to get female representation and that's where attracting women into more STEM-focused roles is going to be really important.

The other thing to consider is the diversity of the delegate list. I did some analysis on our last event and found that the delegate list was only 17% women — so we need to think of ways to address this as well.

We have been able to see now that in less STEM-focused roles, such as policy, we have been able to identify so many talented women and it's like 'how did we ever have non-diverse panels in these areas before?'

I've been to some conferences where they've filled the whole programme with just women — so it's like 'they're there!'

[130] https://www.raeng.org.uk/publications/reports/increasing-diversity-and-inclusion-in-engineering
[131] http://corp.womenreturners.com/research/
[132] Bonfield(2016) WES RETURN Project, https://www.wes.org.uk/sites/default/files/RETURN%20Project%20Report%20Final%20March%202016%20Final.pdf
http://corp.womenreturners.com/research/
[133] https://www.renewableuk.com/page/Switch

Flexible working

Another potential solution to make engineering more inclusive to a diverse range of employees is to champion flexible working. Encouragingly, the RAE survey found that 73% of managers were in support of flexible working. However, women and BAME engineers are significantly less likely than their colleagues to think that utilising flexible working represents 'no barrier' to career progression.[134] This highlights that although flexible working is becoming more common, there is still a stigma attached to it.

A potential solution for this is to highlight the benefits of flexible working for all employees, rather than just new mothers. There are many options now available for flexible working plans in engineering.[135] Research supports that this is beneficial for improved work-life balance, health and productivity in all workers, rather than just new parents.[136] However, research also suggests that flexible working can have negative consequences for diversity if it is not managed effectively, with employees who are able to stay later due to a lack of caring responsibilities being favoured over those who cannot.[137]

Research conducted by Swiss pharmaceutical company Roche gained a deeper insight into this issue.[138] **They found that although flexible working is available, it is under-utilised by staff. A reason for this was found to be that managers were often reluctant to encourage flexible working because not having staff in the office at the same time requires a different approach to leadership that they did not feel confident to employ.** Therefore, resources need to be placed into researching the best flexible working options for organisations and training managers with new leadership strategies.

Career breaks

Two methods could tackle the loss of diverse engineers through them not returning after a career break. The first is encouraging engineers to remain a part of their professional network, such as The Engineering Council throughout the course of their career break. Professional associations such as this can be vital in supporting women to return to work following an extended maternity or career break, as their previous organisation often will not offer support after a statutory maternity period ends.[139] Therefore, membership of professional networks should be promoted to female engineers before, or during, career breaks.

Another way of tackling this issue is to encourage women to join professional networks devoted to supporting women in their return to work. 'Women Returners Professional Network' offers specific returner programmes, which includes initiatives such as 'returnships' in which engineers can undertake structured work programmes designed to support their return into their careers.[140]

Cultural issues

As with all cultural changes, a long-term, consistent approach is needed to tackle the current cultural challenges around inclusivity in engineering. Often, this approach needs to be threaded into all strategic decisions made at senior levels of companies. This is difficult to do if boards themselves do not represent the diversity that companies are striving for. Therefore, seeking advice from organisations with expertise in this area is essential. RAE offer a 'diversity toolkit'.[141] However, it could be more beneficial for companies to take this a step further and seek 'diversity advisors' to contribute to board decisions and ensure that EDI remains accounted for.

The RAE study highlights the importance of publicising the benefits of EDI to everyone, rather than just those in minority groups. Ultimately, they state that formulating a group of 'white male allies' will be important for the success of EDI initiatives.[142] This approach will require research, planning and consistency, but could lead to substantial gains.

Schemes such as 'reverse mentoring' can help to overcome the decline in feelings of inclusion with increasing age. This is where a younger colleague is paired with a more senior colleague and they mentor one another in key areas. Often the junior colleague focuses on areas such as IT and social media and the more senior colleague provides general mentoring around their wealth of experience. This scheme had positive results in decreasing feelings of division in employees in Switzerland[143] and could be beneficial in UK engineering companies.

Career Journey, Potential Solutions – Summary:

- Stick to the 30% representation pledge and ensure that female, and other minority group speakers are championed at industry conferences.
- Flexible working is positive for EDI but has the potential of stigmatising mothers. Strategies around this should be employed for all workers but should be underpinned by research and training.
- Employees returning from career breaks should be seen as a key demographic in maintaining talent and diversity. Engagement and support should be offered by the profession throughout their career breaks and companies should invest in supporting their return to work.
- Cultural changes should focus on promoting the benefits of EDI for everyone and tackle 'inclusion bias'.
- Advice should be sought from EDI specialists when making company decisions.
- Schemes such as 'reverse mentoring' can help tackle age bias in workplaces.

[134] https://www.raeng.org.uk/publications/reports/increasing-diversity-and-inclusion-in-engineering
[135] https://www.raeng.org.uk/policy/diversity-in-engineering/diversity-inclusion-toolkit-resources/a-practical-toolkit/tips-for-good-practice/flexible-working
[136] https://www.acas.org.uk/media/4901/Flexibility-in-the-Workplace-Implications-of-flexible-work-arrangements-for-individuals-teams-and-organisations/pdf/Flexibility-in-the-Workplace.pdf
[137] https://www.acas.org.uk/media/4901/Flexibility-in-the-Workplace-Implications-of-flexible-work-arrangements-for-individuals-teams-and-organisations/pdf/Flexibility-in-the-Workplace.pdf
[138] https://avroche.ch/en/news/flexible-working-more-attractive
[139] https://www.wes.org.uk/sites/default/files/RETURN%20Project%20Report%20Final%20March%202016%20Final.pdf
[140] http://wrpn.womenreturners.com/
[141] https://www.raeng.org.uk/policy/diversity-in-engineering/diversity-inclusion-toolkit-resources
[142] https://www.raeng.org.uk/publications/reports/increasing-diversity-and-inclusion-in-engineering
[143] https://www.roche.com/sustainability/reverse-mentoring.htm

Section 4 – Addressing the Leaky Pipeline Action Plan

There is clearly a moral, social and financial impetus to improve EDI in STEM, and particularly engineering. Although awareness around this is increasing, success will depend on a long-sighted and holistic approach, focusing on education and career journeys, as well as considering the impact of linked sectors such as academia. There are steps that can be taken by organisations interested in furthering this cause, both in the short, medium and long term.

Short-term initiatives

Start to have high profile, open discussions about EDI, inviting employees who represent minority groups to the table even if they do not currently hold senior positions within the organisation.

'Bridge the gap' between industry EDI strategy and experiences of employees on the ground through research and open discussion about EDI.

Ensure that job adverts are inclusive to diverse candidates – using tools such as the gender decoder and job boards aimed at diverse talent pools.

Take steps to ensure that interview panels are as diverse as possible.

Consider using blind recruitment methods.

Champion EDI at the next event or conference by ensuring that speakers are representative of as many groups as possible.

Take steps to facilitate a collaborative approach between organisations in their EDI initiatives.

Medium-term initiatives

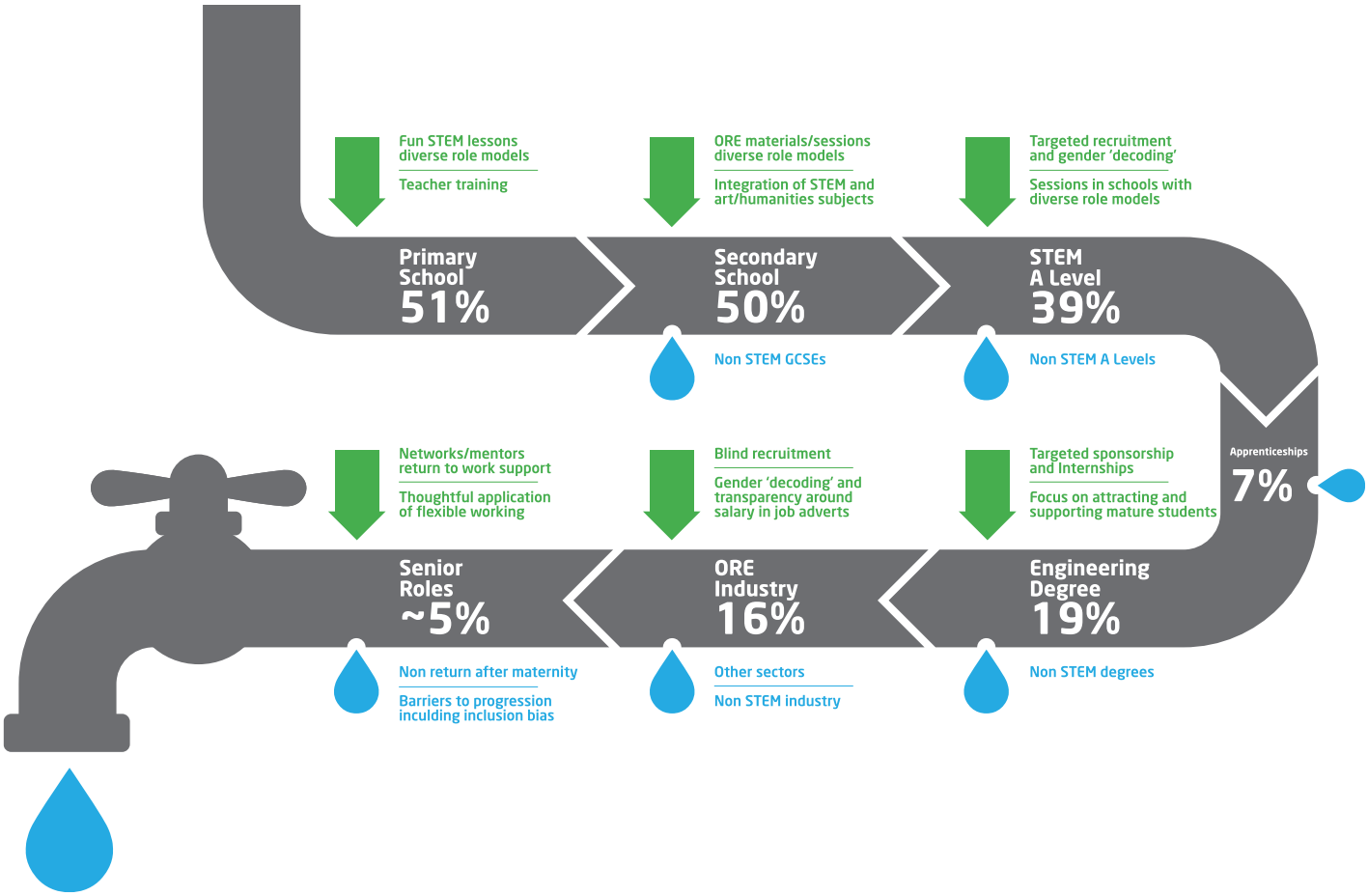
- Collate data and set EDI targets for a wider range of under-represented groups, e.g. people with disabilities and place an emphasis on intersectionality.
- Liaise with diversity-focused organisations and determine how collaborations could help to achieve EDI objectives.
- Encourage the formation of networks for under-represented groups.
- Start a reverse mentoring scheme.
- Organise outreach initiatives in primary schools and community groups to educate a diverse range of people about the sector and your organisation.
- Ensure that pictures on promotional documents represent a diverse range of people.

Long-term initiatives

- Address unconscious bias and develop an evidence-based approach including training in this area.
- Research into how the culture of your organisation is affecting EDI and how to change negative aspects of it.
- Determine whether current working time arrangements are affecting EDI and make positive changes (e.g. flexi-time, shared parental leave).
- Investigate how workloads and division of work tasks could be impacting on how people from under-represented groups are able to progress in your organisation and formulate a plan to address this.
- Consider how EDI in your organisation may be affected by society and education — take steps to tackle this.

Addressing the Leaky Pipeline

Leaky Pipeline –
Proportion of Females at Each Stage of Progression in the Energy/ORE Sector



Appendix – Overview of EDI Groups

Organisation	Website
Equal Engineers	https://equalengineers.com/
STEM Women	https://www.stemwomen.co.uk/about
Women's Engineering Society	https://www.wes.org.uk/
The WISE Campaign	https://www.wisecampaign.org.uk/
POWERful Women	http://powerfulwomen.org.uk/board-statistics-by-company/
Athena Swan	https://www.ecu.ac.uk/equality-charters/athena-swan/
Switch	https://www.renewableuk.com/page/SwitchList
Entrepreneurial Women in Renewable Energy (EWiRE)	https://www.regen.co.uk/project/entrepreneurial-women-in-renewable-energy-ewire/
Equate Scotland	https://equatescotland.org.uk/
Girls into Global STEM	http://www.gigsproject.eu/
Association for Black and Minority Engineers (AFBE)	https://afbe.org.uk/programmes/roundtable
BBSTEM	http://bbstem.co.uk/about-us/
BAME Apprenticeship Alliance	http://bameaa.co.uk/about-us/
Pride in Energy	https://www.energy-uk.org.uk/energy-industry/equality-and-diversity/pride-in-energy-lgbt-network.html
InterEngineering	http://interengineeringlgbt.com/
STEMM Disability Advisory Committee	http://www.stemdisability.org.uk/about-us/about-us/

Organisations Behind the Report

Supergen Offshore Renewable Energy

The Supergen ORE Hub is an Engineering and Physical Sciences Research Council funded research consortium. It provides research leadership to connect academia, industry, policy and public stakeholders in order to maximise social value in offshore wind, wave and tidal energy.

aura

Aura is a collaborative initiative for the offshore wind industry and low carbon energy sectors. It is a key delivery partner in the government's Offshore Wind Sector Deal and works to drive innovation in research and development in the Humber region, nationally and internationally in relation to the talent pipeline and wider industry engagement and enterprise.

UNIVERSITY OF HULL

The University of Hull is committed to promoting equality of opportunity for all, giving every individual the chance to achieve their potential, free from prejudice and discrimination. Through its Aura initiative, the University has been pleased to join with the Supergen ORE Hub to further knowledge and promote real action to make progress in bringing EDI into all aspects of STEM subjects and academia . This scoping report was researched and written Stefi McMaster, a PhD student in Psychology and part of the Centre for Human Factors at the University of Hull.