ENGINEERING TODAY

THE SUPPLY & DEMAND FOR ENGINEERS IN THE UK

January 2018

CONTENTS

Introduction

Engineering plays an important role in all aspects of UK society. It contributes a significant amount to the UK economy, exports and infrastructure and provides a large part of the workforce with quality employment. Engineering touches all aspects of our lives from building homes, cleaning our air, producing our food and pharmaceuticals, to building energy plants and generating power. As the UK moves forward and prepares for a more technological future, ensuring the engineering workforce has the right skills to compete both domestically and internationally will be crucial.

This report collects data from secondary sources on the labour market for engineers, engineering technicians and skilled trades that work alongside engineering professionals. Using the data collected it describes the characteristics of the labour market for engineers and the other professions studied. The paper differs from other ECITB reports on the labour market as it takes a wider view of the engineering workforce, from engineering professions, to technicians and skilled and managerial professions that work alongside engineers across a range of sectors, and not solely the engineering construction industry. The paper does this in order to build a holistic view of the wider labour market in which engineering construction employers, including ECITB in-scope employers, operate in and recruit from. The final section of this report explores whether the UK is filling replacement demand and provides recommendations for further study.

465K ENGINEERS EMPLOYED IN THE UK

UP 8.76% SINCE 2009

ENGINEERING CONTRIBUTES UP TO 27% TO UK GDP

THE AVERAGE GROSS ANNUAL EARNINGS OF ENGINEERING PROFESSIONALS IN 2016 WAS OVER

42K

48.5% HIGHER THAN UK AVERAGE

30K+ ENGINEERING QUALIFICATIONS WERE AWARDED IN 2015/16

18,150 HIGHER EDUCATION

11,955 APPRENTICESHIPS

ENGINEERING APPRENTICESHIPS IN THE UK ARE SEEN AS THE **GOLD STANDARD**

ARE COMPLETED

COMPARED TO 67% FOR OTHER APPRENTICESHIP SUBJECTS

67.6%

OF ENGINEERING GRADUATES IN 2015/16 ENTERED FULL TIME EMPLOYMENT WITHIN 6 MONTHS

EMPLOYMENT

Engineering graduates are highly sought

CIVIL & MECHANICAL

ENGINEERING POSITIONS WERE THE MOST POPULAR AMONGST GRADUATES

120K ENGINEERING PROFESSIONALS

EXIT

WILL HAVE RETIRED BY 2026

INCREASED

INFRASTRUCTURE SPENDING

IS SET TO INCREASE THE DEMAND FOR ENGINEERS

KEY FINDINGS

Data for this study was drawn from Government published statistics, including the Office of National Statistics' Annual Population Survey, apprenticeship and vocational qualification datasets published by the Department for Education, Ofqual, and Skills Development Scotland and higher education statistics published by the Higher Education Statistics Agency.

465K

In 2016, there were just below 465,000 engineers employed in the UK, an 8.76% increase since 2009.

8.57%

8.57% of engineers in the UK are women, an increase by 5.31% in 2009.

38.45%

In 2015/16, 38.45% of higher education engineering graduates went into engineering professions 6 months after graduating, the lowest figure since 2012.

48.5%

In 2016, the average earnings of engineering professionals was just above £42,000, 48.5% higher than average earnings in the UK. Engineering graduates, from apprenticeships and higher education, earned £5,000 more than the average salary for graduates.

27K

Overall, engineering apprenticeship completers had the second highest average earnings and the highest among the major frameworks, at £27,000. Completers in certain industries and sectors made considerably more, with engineering construction completers earning an average of £34,100 one year after completing an apprenticeship.

90%

Engineering apprenticeships have a higher level of completions than average and a higher level of sustaining employment. In 2013/14 over 90% of engineering apprentices sustained employment compared to an average of 75% for all apprentices.

91k

By 2026, more than 91,000 engineers, or 19.56% of the workforce, will have retired or be close to retiring.

29k

Additionally, 29,000 engineering technicians, or 17.93% of the technician workforce, will have retired or be close to retiring by 2026.

1/3

Professions such as mechanical engineers, metal workers, estimators, assessors, pipe-fitters, and electronic trades as well as managerial and project management roles on construction sites could see between a quarter and a third of their workforce retire in the next 10 years.

Methodology and Definitions

To study the supply of engineers, the report uses data from sources including the **Office of National Statistics**, **Higher Education Statistics Agency**, **Ofqual** and **Skills Development Scotland**. To measure demand, the report draws on data from **EngineeringUK**, **EDF**, **The Royal Academy of Engineering**, the **Working Futures Report 2014**, **UK Commission for Employment and Skills**, the **Engineering Construction Association**, and the **Nuclear Skills Strategy Group's workforce assessment**. The report analyses these data to estimate if the UK has the capacity to fill replacement and new demand for engineers.

The report measures the supply of engineers by studying the **Standard Occupational Classifications (SOC)** codes for the engineering and related industries and **Joint Academic Coding System (JACS)** to analyse higher education qualifications and graduate destinations. SOC codes are a system of classifying occupations, making it possible to identify workers and analyse data on the workforce of any specific industry. JACS codes are a similar system used to classify academic subjects. The ECITB identified the relevant SOC and JACS codes for this report, which can be found in **Appendix A** and **B**.

While the employment and higher education figures presented in this analysis capture all individuals working in engineering occupations and engineering related occupations, it does not measure the type of work that any individual worker performs. A drawback of using SOC and JACS codes is that some workers in a given classification may not primarily be engaged in activities that contribute to the engineering field. Additionally, some workers may be classified wrongly or fall into less common classifications, meaning that their contribution should have been captured but was not.

The report differs from other ECITB studies as it covers the entire engineering workforce and not exclusively the engineering construction industry's workforce. The choice to study the larger engineering workforce also reflects the challenges of using existing datasets to measure the ECI labour market – in particular, the ECI does not have SOC codes that specifically identify it, making it harder to study education levels, the workforce and the supply and demands of the labour market.[1] The report differs from the footprint defined by EngineeringUK and other engineering associations as it looks at a narrower set of professions.

This report makes certain broad categorizations of professions and education levels[2]. The definitions follow below:

Engineer

This report defines an engineer as someone who works as a civil, mechanical, electrical, electronics, design and development, production and process engineer or other engineering professional and uses the SOC code classifications for these to study the workforce. The majority of engineers have a level 3 Regulated Qualifications Framework (RQF), Credit and Qualifications Framework for Wales (CQFW) qualification, a level 6 Scottish Credit and Qualifications Framework (SCQF) qualification or a Bachelors degree or above. Engineers as defined in this report are not limited to those who have achieved professional registrations such as C.Eng. or I.Eng.

Technician

Technician roles include electrical and electronics technicians, engineering technicians, building and civil engineering technicians and science, engineering and production technicians. The report uses the defined SOC codes for these professions to study the workforce. Technicians tend to be younger than professional engineers and most commonly have either a level 2 or 3 qualification RQF or CQFW qualification, a 5 or 6 SCQF qualification or are relatively recent Bachelor degree graduates. Engineering technicians as defined in this report are not limited to workers who are registered as EngTech.

Professions Related to Engineering, Skilled Trades and Managerial Roles

This report has identified a number of professions related to engineering, which are primarily skilled trades as well as various types of managers. Workers in these professions work side by side with engineers to lead projects and assist with carrying out the work which engineers design and develop. These roles are: Quantity surveyors, Construction project managers, Construction, manufacturing, energy and building supervisors, Quality control and planning engineers, Draughts-persons, Estimators, valuers and assessors, Sheet metal workers, Metal plate workers, and riveters, Welding trades, Pipe fitters, Metal machining setters and setter-operators, Metal working production, Operatives and maintenance fitters, Air-conditioning and refrigeration engineers, Electricians and electrical fitters, various Process operatives, Energy plant operatives, Electrical, electricians, electrical fitters and electronic trades, Steel erectors, Scaffolders, stagers and riggers, Industrial cleaning process occupations. The report uses the defined SOC codes for these professions to study the workforce. Many of these roles are skilled trades where most of the workforce has received a technical education; others are professions that engineering (and other) higher education graduates go into after university such as project managers and building supervisors.

[1] For a closer analysis on the Engineering Construction Industry, the size of the workforce and the industries contribution to the economy, see The economic footprint of engineering construction, CEBR/ECITB, November 2017.

[2] The definitions are based on the SOC codes found in Appendix A.

01 OVERVIEW OF THE CURRENT LABOUR MARKET AND **WORKFORCE CHARACTERISTICS**

The engineering sector represents a large portion of the UK workforce and contributes considerably to GDP. Sectors that employ engineers are estimated to contribute anywhere between **19%—27%** of the UK's GDP.[3] The engineering workforce has certain characteristics that make it unique. It is a comparatively mobile workforce where work is significantly affected by the economic climate, domestically as well as internationally. Examples of this can be seen in the current downturn in the oil and gas sector, which has led to engineers seeking employment elsewhere in the UK or in the world. There are several other examples which show that when a government decides to undertake large infrastructure projects they source engineering manpower from all over the world. The decision by the German Government to decommission its nuclear power stations in 2011 led to a decrease of resources elsewhere within the EU for specialist nuclear decommissioning engineers.[4]

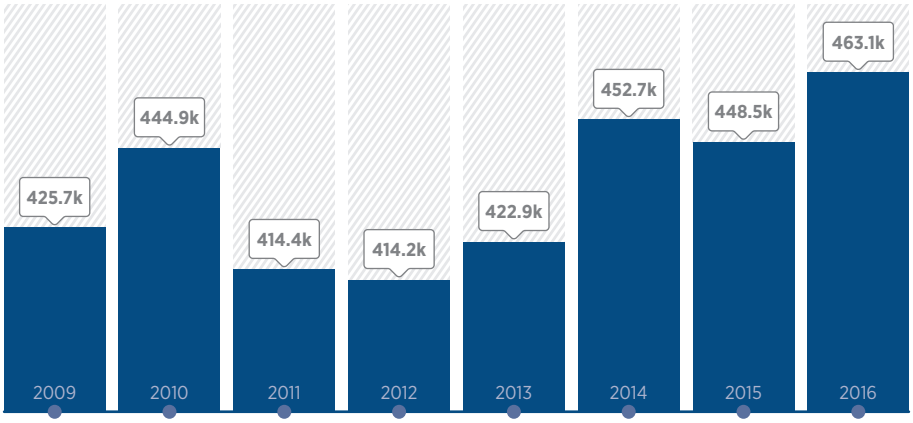


Figure 1

Engineering Workforce 2009—16.[5]

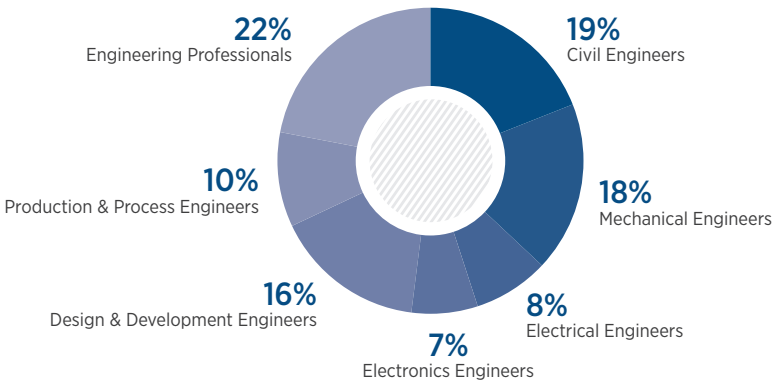


Figure 2

UK Engineering Workforce 2016.

[3] Engineering for a successful nation, Royal Academy of Engineering, March 2015 The contribution of engineering to the UK economy – the multiplier impacts, CEBR/EngineeringUK, January 2015 – This report uses a considerably wider definition of engineering than employed in this study.

[4] Lackmaker, J, Engineering Construction Industry Labour Market Intelligence Report, ECITB September 2015 Oil & Gas UK figures show impact of oil price downturn on jobs, Oil & Gas UK, June 2016.

[5] Graph starts at 380,000 to better graphically demonstrate the workforce. Data in this report relies on the Office of National Statistics' surveys, primarily the Annual Population Survey and the Labour Force Survey. The Annual Population Survey reaches 1% of the population and makes projections of the make-up of the economy. The Labour Force Survey reaches a slightly smaller percentage of the population. Therefore numbers in different sections of this report will be similar although not always add up to the same figure.

ECITB analysis of the latest ONS data finds that there were approximately **31.4** million people in work in the UK in 2016. Of these, just below **465,000** work as engineers, which is an **8.76%** increase since 2009.[6] The most popular engineering professions in 2016 were in civil engineering, which employed **18.79%** of all engineers, mechanical engineering, employing **17.75%** of engineers, and design and development, employing **15.7%** of engineers. **22.5%** worked as engineering professionals although were not defined in any category listed above.

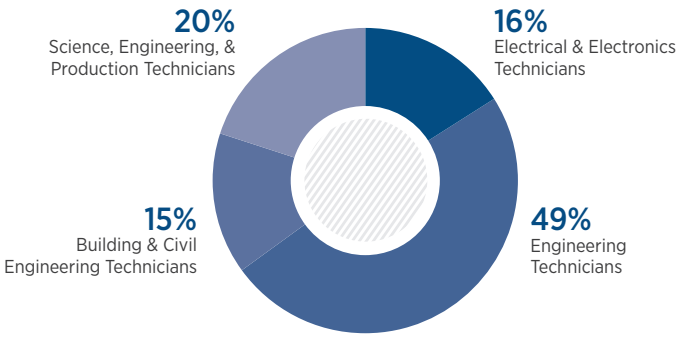


Figure 3

UK Engineering Technician Workforce 2016.

Engineers in these professions most commonly have an equivalent of a level 3 RQF qualification, a Bachelor's degree, or above. In addition, there were **162,330** workers employed as engineering technicians in the UK last year, a number which has remained largely stable over the past several years. These are generally younger workers, concentrated between the ages of **16—39** with a lower level of qualification, most commonly a level 2 or 3 RQF qualification or equivalent. Some recent engineering higher education graduates also start their careers as engineering technicians. Approximately half of the technicians studied for this report, **49.47%**, work as engineering technicians, whereas the others work in related fields as electrical technicians, **16%**, building and civil engineering technicians, **15%** (Figure 3).

The skilled trades that we have identified and have chosen to study for the purpose of this paper includes professions such as quantity surveyors, draughts-persons, pipe fitters, welders, metal workers electrical fitters, industrial cleaners, steel erectors, process operatives and scaffolders. A full list can be found in the methodology and in **Appendix A**. Most workers in these professions have a lower level of educational qualification. The skilled trades workforce studied in this paper totals some **1,210,948** employees. Workers in these professions are generally younger than the workforce as a whole with a majority being in the **16—44** age bracket. The related managerial and higher level positions this paper studies include production managers, construction project managers, quality control engineers and estimators and assessors. Workers in these positions often have a higher level of educational qualification. These positions employed **653,964** in 2016, with almost **60%** of the workforce aged **45** or above.[7]

1.1 Age Distribution and Projected Retirements

The UK engineering workforce is slightly older than the entire workforce. In 2015, the mean age of the engineering workforce was **41.75**, compared to **41.25**, the average age of all UK workers. While the engineering workforce has not aged significantly faster than the UK economy overall, some sectors that employ a large quantity of engineers and skilled trades professionals, such as the energy sector, report that they struggle to attract younger workers.[7] Of the engineering workforce studied approximately **91,000**, or **19.56%**, of the current workforce, will be close to or above retirement age by 2026.[8] The civil and mechanical engineering workforce will see a higher percentage, **20.1%** and **21%** respectively, retire or close to retirement age, while the engineering design workforce will see the lowest number of projected retirements, at **17.10%**.[9]

[6] Annual Population Survey 2009-2016, Office of National Statistics, 2017. Data requested and analysed by the ECITB August/September 2017.

[7] Annual Population Survey 2009-2016, Office of National Statistics, 2017. Data requested and analysed by the ECITB August/September 2017. Destinations of Leavers from Higher Education in the United Kingdom for the academic year 2015/16, Higher Education Statistics Agency, June 2017.

[8] State of Engineering 2017, EngineeringUK February 2017, Watt skills shortage? Report highlights skills needs of energy sector, UK Commission for Employment and Skills, 25 March, 2015 Ward, A., Oil industry struggles to fill hole left by baby boomers, Financial Times, October 2016.

[8] UK Retirement Age: The current state pension age in the UK is 66 for both men and women. The Government is planning further increases, which will raise the State Pension age from 66 to 67 between 2026 and 2028.

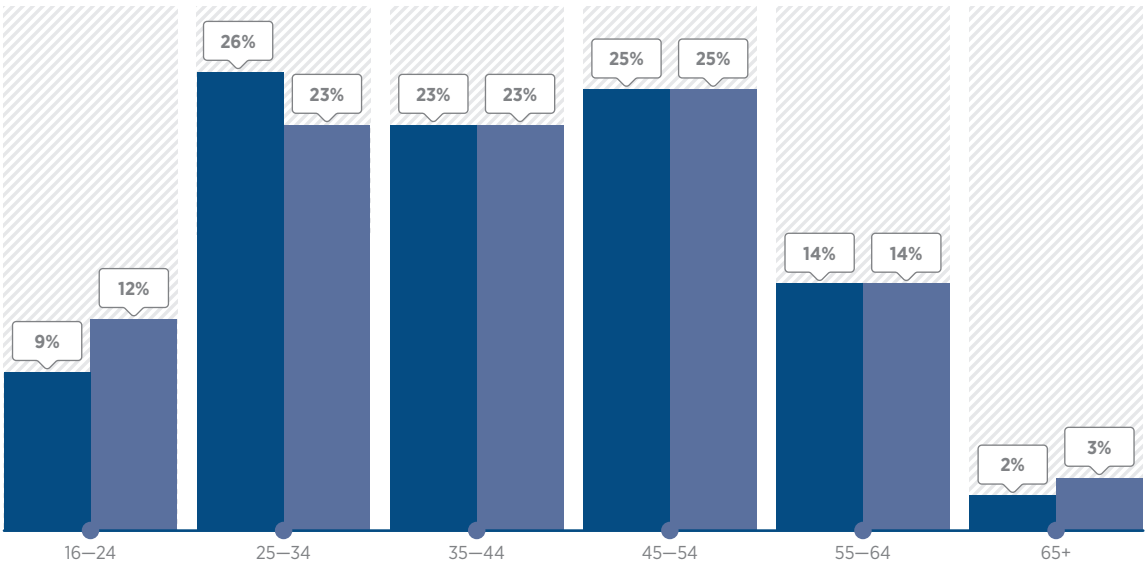
[9] Annual Population Survey 2009-2016, Office of National Statistics, 2017. Data requested and analysed by the ECITB August/September 2017. Engineering and Technology Skills and Demand in Industry, The Institution of Engineering and Technology, 2016 Sector insights: skills and performance challenges in the energy sector, UK Commission for Employment and Skills, March 2016.

Engineering technicians, who are on average younger than engineers and the related professions, will see fewer workers retire. Approximately **17.93%**, or **29,000** of the current workforce, will be close to or above retirement age by 2026. Of the skilled trades studied for this paper most retirements will come from those working in metal working, pipe-fitting and in electrical and electronic skilled trades. These professions could see between a quarter to almost a third of the workforce retire. Professions expected to have fewer retirees are metal plate workers, scaffolders, stagers and riggers, which will see between **4.3%** and **5.5%** of their workforce retire. The managerial professions studied for this paper are projected to have a considerably higher retirement rate, between **25%—31.6%**. These figures assume that no workers choose early retirement, a choice that has become more popular in the past several years, and that a significant percentage of the workforce does not chose to work much past the retirement age.[10]

By way of comparison, the age distribution in the engineering construction industry workforce is younger than the economy as a whole with **35%** of the workforce between the ages of **16—35** and **2%** being over the age of **65** (Figure 4).

Figure 4

Age Distribution of the Engineering Construction Workforce and all Sectors, 2014.



Approximately **14%** of the current ECI workforce are expected to retire within the next 10 years.[11]

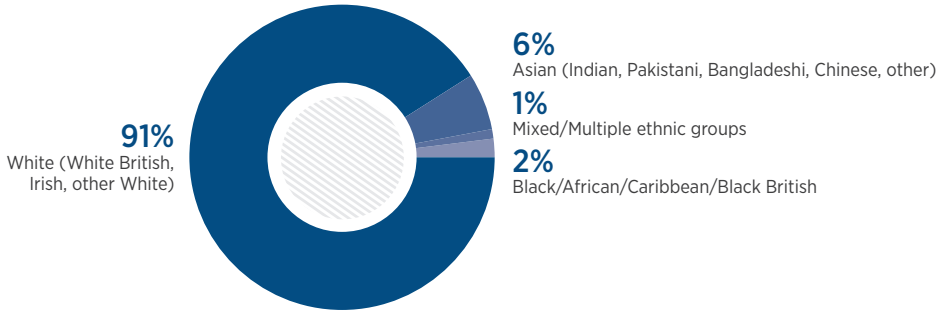
For a detailed breakdown on age distribution of engineering technicians and engineering related jobs and percentages of the workforce who will be at retirement age or above by 2026, **see Appendix C**.

1.2 **Ethnicity**

The engineering workforce, technician workforce and the skilled trade and managerial positions are overwhelmingly held by white employees. The engineering workforce is **91%** white, while the technician workforce and skilled trades are **96%** white. Certain professions, such as design and development engineers and metal workers, have a slightly higher number of non-white workers, although Caucasian workers still make up more than **86%** of all workers in both professions. For a detailed breakdown of all professions and ethnicity, see Appendix G.

Figure 5

Current Workforce by Ethnicity.



[10] Annual Population Survey 2009-2016, Office of National Statistics, 2017. Data requested and analysed by the ECITB August/September 2017. An Ageing Workforce, Parliamentary Office of Science and Technology, October 2011.

[11] The economic footprint of engineering construction, CEBR/ECITB, November 2017.

1.3 **Gender Breakdown**

The gender balance in engineering and engineering technicians is heavily skewed towards men, with **8.57%** of engineers in the UK being female, a number that has increased from **5.31%** in 2009. The gender gap is almost as wide for technicians with **13.38%** of technicians being women. The gender balance differs depending on engineering discipline with civil, production and process engineers as well as engineering professionals having an above average gender balance. The remaining disciplines, particularly mechanical, electrical and electronic engineers have a below average gender balance.

The skilled trades and other related professions studied have a similar gender gap to that of engineers and engineering technicians. Some of the skilled trades have virtually no women working in them, while others, such as quality control and planning engineers and estimators, valuers and assessors have almost reached gender parity. Looking at the engineering construction workforce as a whole, **92%** of employees are men. By way of comparison, women made up **46%** of the UK overall workforce in 2016.[12, 13] Previous studies and surveys of the current workforce have shown that women and men respond differently to careers advice. While male engineers state a contributing factor for entering the profession was financial reward women responded that they were driven by the prospects of an interesting job. A major contributor to the skewed gender balance in the engineering sector may be that careers advice is not tailored for women and that more efforts should be made to understand the different drivers behind why men and women enter into certain professions. [14]

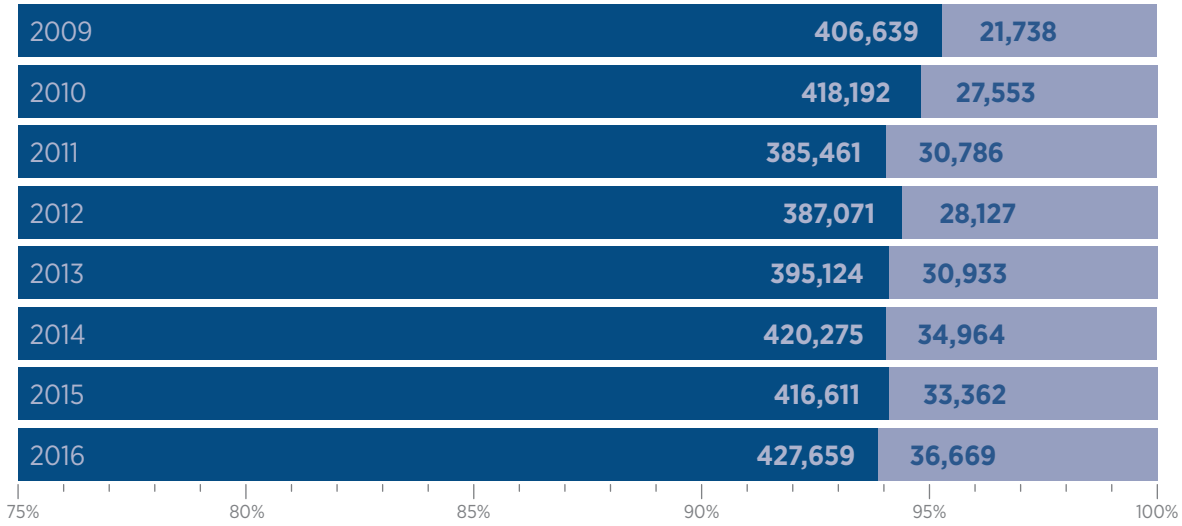


Figure 6

Current Workforce by Gender.

Men

Women

[12] Note that figures demonstrating gender in the engineering workforce start at 75% to better graphically display the percentage of women in the engineering workforce. The gender breakdown for electrical engineers in 2016 does not indicate any women working in the profession. This is due to the sample size being too small for ONS to project how many female workers there are employed in that profession.

[13] Annual Population Survey 2009-2016, Office of National Statistics, 2017. Data requested and analysed by the ECITB August/September 2017. The economic footprint of engineering construction, CEBR/ECITB, November 2017. Destinations of Leavers from Higher Education in the United Kingdom for the academic year 2015/16, Higher Education Statistics Agency, June 2017. Understanding the UK STEM technician workforce, Gatsby Charitable Foundation, September 2014.

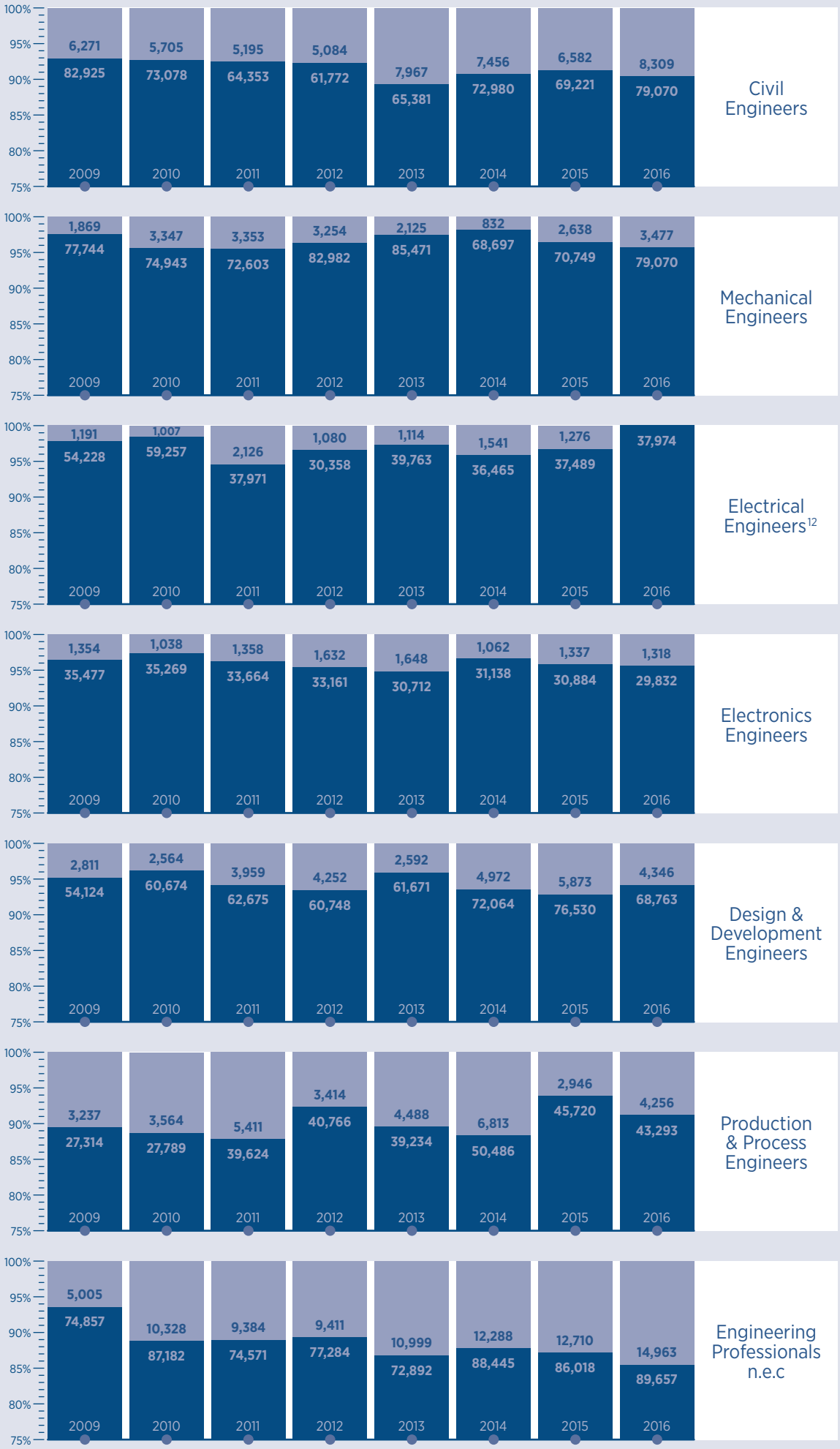
[14] Engineering Skills for the Future, SEMPTA, February 2017.

Figure 7

Gender Breakdown by Engineering Disciplines.

Men

Women



For a gender breakdown of the technician, skilled and managerial workforce, see **Appendix C**.

1.4 **Geographic Location of the Engineering Workforce**

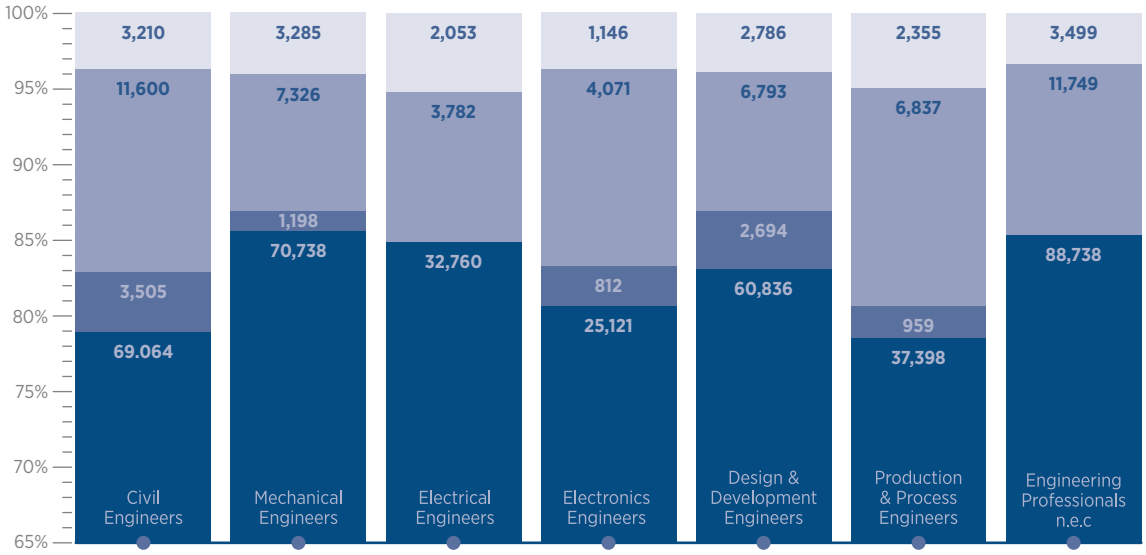


Figure 8

Geographic Location of Engineering Workforce, 2016.

- England
- N. Ireland
- Scotland
- Wales

The professions studied for this report are primarily based in England, which employs between **82-84%** of workers categorised by the SOC codes studied. Scotland employs a further **10%** with the rest being employed in either Wales or Northern Ireland. This mirrors the geographic location of employment in the UK as a whole to a certain extent. Some professions buck this trend however. Scotland employs a larger than average number of metal plate workers, pipe fitters, energy production managers and rubber process operative, professionals who are heavily employed in the oil & gas sector. Northern Ireland also employs an above average number of pipe-fitters, metal workers and metal process operatives. A full breakdown of geographic locations of all SOC codes studied can be found in **Appendix F**. [15]

1.5 **Earnings**

A distinct characteristic of the engineering professions is higher than mean earnings. Graduates that enter engineering professions earned on average **£27,000**, which is **£5,000** more than the average graduate salary. In their 2017 report EngineeringUK showed that there is no discernible gender differential across starting salaries in engineering, although there is for engineering graduates of Black, Asian and Minority Ethnic (BAME) status.[16] In 2016, the mean salary of all engineering professionals was just above **£42,000**, **48.6%** higher than the average earnings in the UK of **£28,306**. Engineering technicians also had above average salaries with engineering technicians earning on average **£35,459** a year in 2016. Other types of technicians, such as civil engineering and science, engineering and production technicians had lower mean salaries between **£29,248** and **£30,551** in 2016.[17] Earnings also differ depending on which industry workers are in. It is estimated that the earnings of the engineering construction workforce (including the professions studied in this paper) were **44%** higher than across all sectors of the economy in 2016.[18]

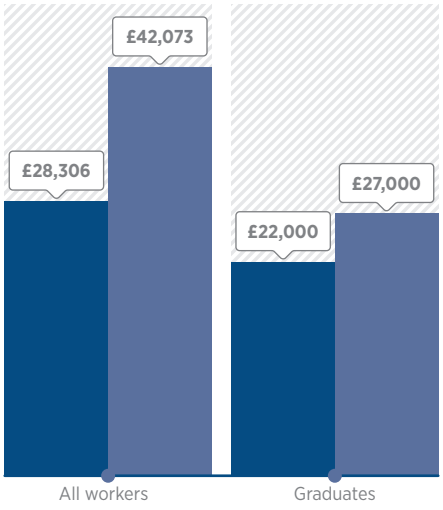


Figure 9

Annual Earnings, 2016.

- All
- Engineering

[15] Note that graphs demonstrating the geographic location of the engineering workforce start at 65% to better graphically display the percentage of where the workforce is based. Data is lacking for some professions in Northern Ireland as the sample size is too small for ONS to project how many workers there are employed in that profession

[16] Annual Survey of Hours and Earnings, Office of National Statistics, October 2016. State of Engineering 2017, Engineering UK February 2017.

[17] Annual Survey of Hours and Earnings, Office of National Statistics, October 2016. Understanding the UK STEM technician workforce, Gatsby Charitable Foundation, September 2014.

[18] The economic footprint of engineering construction, CEBR/ECITB, November 2017.

While there is virtually no gender difference in earnings for graduates starting out as engineers[19], there is a differential among all engineering professionals and engineering technicians. Male engineers earned on average **14.39%** more than women in 2016. The same is true for engineering technicians, where men earned **12.65%** more. Earning differentials between the genders differ widely among the skilled trades. Among the electrical and electronic trades men earn on average **4.2%** more than women, whereas among trades such as process operatives annual earnings can differ as much as **79%**. Electrical engineering is the only profession studied where women earn more than men, with mean earnings being **0.76%** higher for women in 2016.

1.6 **Earnings by Geography**

Engineering earnings vary not only by gender but by geographic location as well. London, Scotland and the South East generally see the highest earnings for engineers, while the South West and the North of England see the lowest mean salaries. Earnings are likely to be affected by shortages and difficulties of recruiting specific types of engineers in regions; for instance, while engineers in Wales have a lower average earnings than many regions of the UK, it has the highest mean earnings for mechanical engineers which could be due to difficulties in recruiting in the region.[20]

Role	Mean Highest Salary (2015)	Mean Lowest Salary (2015)
Civil Engineers	Scotland - £48,600	South West - £32,051
Mechanical Engineers	Wales - £61,758	North East - £28,644
Electrical Engineers	London - £54,586	Wales - £32,442
Electronics Engineers	South East - £52,352	London - £35,978
Design and Development Engineers	London - £61,164	North West - £35,354
Production and Process Engineers	London - £45,018	East of England - £34,067
Engineering Professionals	Scotland - £49,568	Yorkshire & The Humber - £34,816
Engineering Technicians	London - £38,359	West Midlands - £28,646
Building and Civil Engineering Technicians	Scotland - £41,259	South West - £24,065
Science, Engineering and Production Technicians	London - £31,624	North east - £24,484

[19] Women in STEM, Deloitte, 2016 *www2.deloitte.com/content/dam/Deloitte/uk/Documents/Growth/deloitte-uk-women-in-stem-pay-gap-2016.pdf*
[20] Annual Survey of Hours and Earnings, Office of National Statistics, October 2016. State of Engineering 2017, EngineeringUK, February 2017.

02 | EDUCATION QUALIFICATIONS

2.1 **A-levels and Higher Education**

Increasing the number of people with STEM qualifications has been a priority of successive governments over the past decades. The years 2010—2015 saw a rise in the number of students studying science, computing and mathematics A-levels or equivalent qualifications. In 2015, **29%** of A-level students took Maths compared to **25%** in 2010. A-level students taking Chemistry increased from **15%** to **16%** and students taking physics rose from **10%** to **11%**. There are several reasons behind the rise in A-level science subject participation. Recent initiatives by government and industry, such as Maths Hubs and the Your Life campaign, have emphasised the importance of scientific and engineering careers to students.[21]

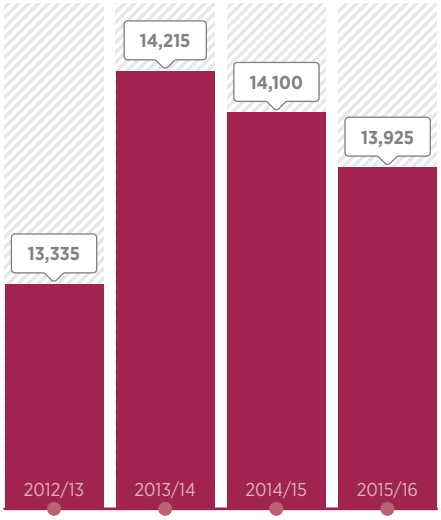


Figure 10

Higher Education Undergraduate Degrees Awarded in Engineering.

While the number of students taking STEM subjects at A-level has increased, the number of qualifications awarded in engineering subjects at higher education institutions has remained stable over the past 5 years, with approximately **18,000** qualifications awarded each year at undergraduate or postgraduate level.[22] In 2015/16, in the UK there were **18,150** engineering graduates, a **2.5%** increase since 2012/13. Of these, **13,925** graduated with an undergraduate degree (most commonly a BA, BSc or BEng) in an engineering subject, a **4.4%** increase from 2012. The number of masters degrees awarded have in the same period declined by **6.0%**, which is perhaps an indicator of an improving economy with graduates choosing to enter – and young professionals staying in – the workforce rather than up-skilling; a phenomenon which has been observed across higher education.[23] Doctorates in engineering have, however, increased by **6.8%**. The most popular subjects were general engineering, civil engineering, mechanical engineering as well as electronic and electrical engineering, which accounted for **68.9%** of all graduates.[24]

[21] The UK STEM Education Landscape, Royal Academy of Engineering, 2016, Science and Innovation Investment Framework 2004-2014, *www.news.bbc.co.uk/nol/shared/bsp/hi/pdfs/science_innovation_120704.pdf* Revised A-level and other level 3 results in England, 2014-15, Department for Education, January 2016Jobs of the Future, EDF Energy/Social Market Foundation, November 2016.

[22] The Higher Education Statistics Agency lists that there are approximately 3,900-4,500 'other undergraduate degrees' awarded each year between 2012-2016. These diplomas are various types of VQ's and diplomas. Out of caution this report has not included them so as not to double count data collected by Ofqual, Skills Development Scotland, the Education and Skills Funding Agency and the Department for Education.

[23] Overview of Postgraduate Education, Higher Education Funding Council for England, March 2017.

[24] Higher education student enrolments and qualifications obtained at higher education providers in the United Kingdom 2015/16, Higher Education Statistics Agency, January 2017. Analysis by the ECITB.

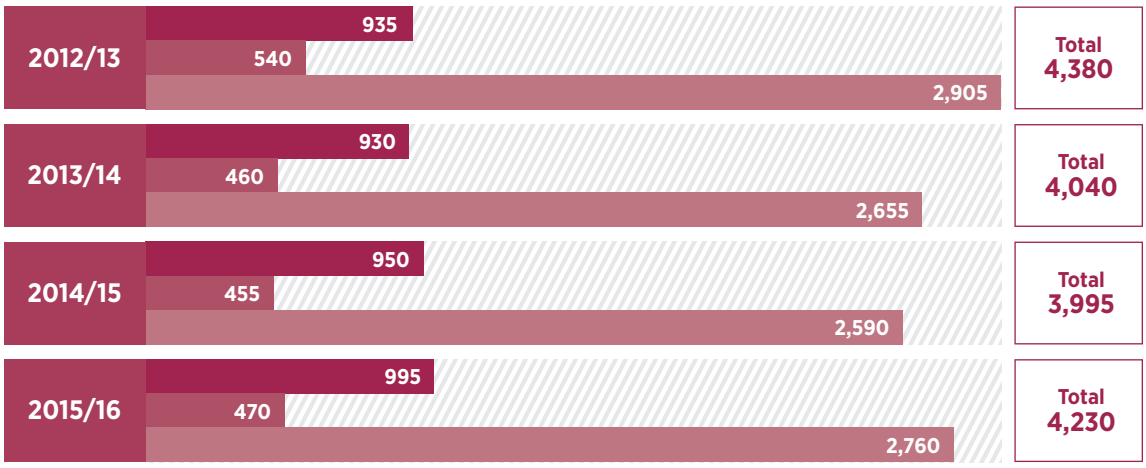


Figure 11

Higher Education Post Graduate Qualifications Awarded in Engineering.

- Doctorate
- Other PG
- Masters

2.2 Destinations of 2015/16 Engineering Higher Education Graduates 6 months after Graduation

Engineering graduates are some of the most sought after graduates. The subjects studied at university including maths, science, IT, are wanted and transferable to many industries.[25] Of those who left a UK university in 2015/2016 with a degree in engineering, **67.6%** went into full-time employment and **13.3%** were in part-time employment 6 months after graduating. Approximately **30%** of those in part-time employment were completing further studies while working. The flow chart opposite shows the status of higher education engineering graduates 6 months after graduation and not only those who gained employment. The widths of the bands, and percentages, are directly proportional to the number of graduates and their destination. Out of the respondents to the Higher Education Statistics Agency's Leavers Survey who graduated with engineering degrees in 2015/16, **38.45%** went in to either a full or part-time job in engineering six months after graduating. This is slightly lower than the past 3 years when the number of graduates entering engineering professions has been between **41—42.4%**. It is also lower than the proportion of other STEM graduates joining the workforce of the subject they studied.[26]

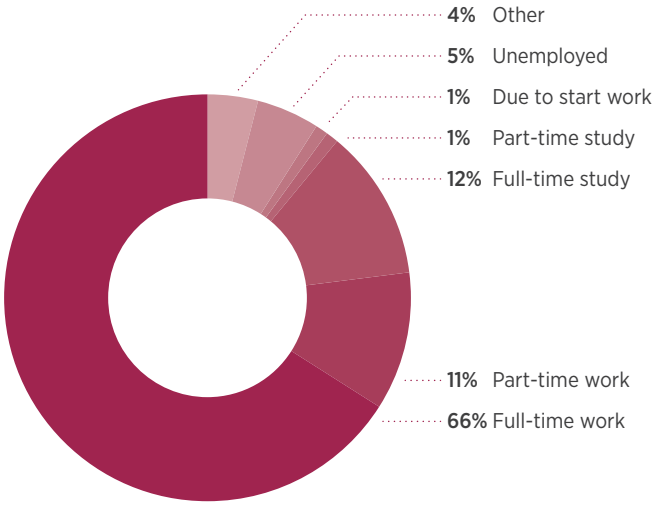


Figure 12

Outcomes for Engineering Graduates 2015/16.

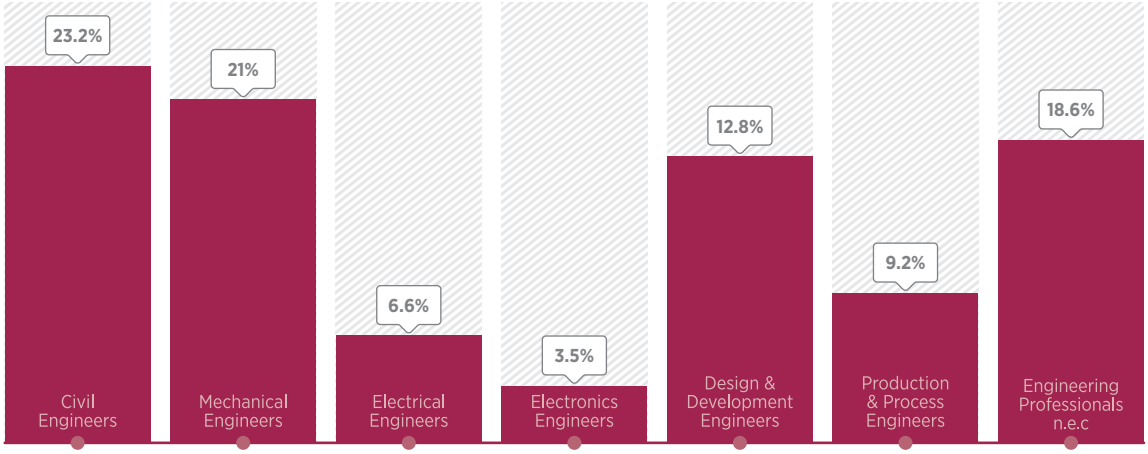


Figure 13

Leavers in Engineering Professions 2015/16.

[25] The Graduate Market in 2016, High Fliers Research Limited, 2016. The Graduate Market in 2017, High Fliers Research Limited, 2017
Rodionova, Z., Engineers and teachers top list of sought after graduates in 2016, The Independent, February 5, 2016.

[26] The Supply of and Demand for High-Level STEM Skills, Evidence Report 77, UKCES. 2013.

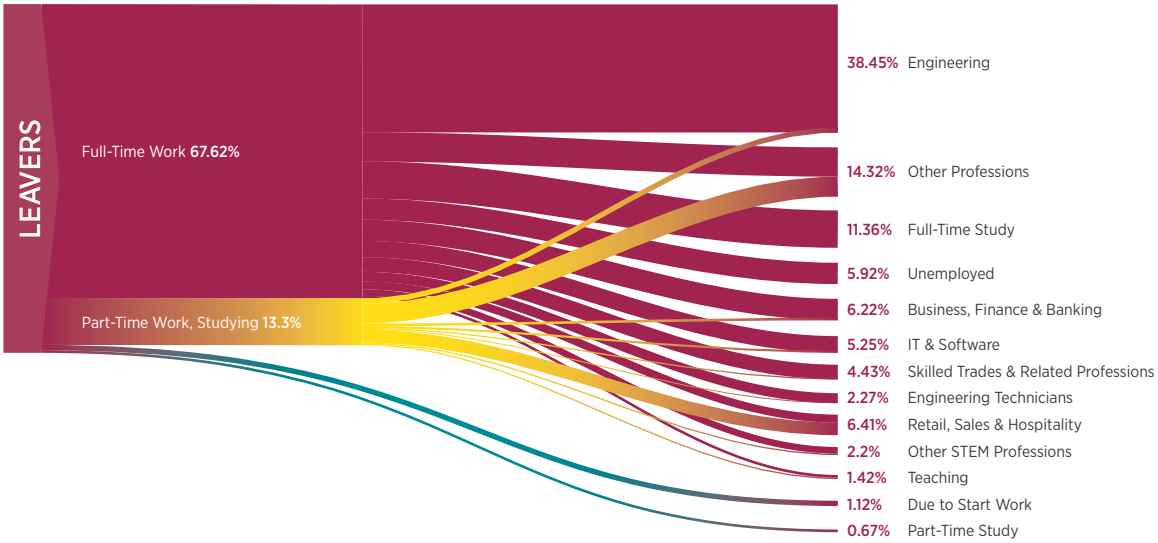
Of the **38.45%** of the graduates who entered into an engineering profession **23.2%** became civil engineers. The second and third most popular fields were mechanical engineering and design and development engineering at **21%** and **17.8%** respectively. The least popular was electronics engineering.[27] There were an additional **2.27%** employed as technicians and **4.43%** employed in a related skilled trade or in a managerial role in engineering or construction job in 2015/16. Out of the **54.85%** of engineering graduates who did not take up work in an engineering or related field **6.22%** went into business, banking and finance, **5.25%** of graduates sought employment in the IT or software field, and **6.41%** of graduates were employed in the retail or hospitality sector. **11.36%** of graduates continued their studies.

Despite being highly sought after, 6 months after graduation unemployment among 2015/16 engineering graduates stood at **5.92%**, compared to **5%** of all graduates. The same is true for all STEM subjects, which have higher than average rates of unemployed graduates.[28] Unemployment levels varied largely depending on qualification level; **3.3%** of those with doctorates were unemployed 6 months after graduation, compared to **6.96%** of those with Masters and other postgraduate degrees, and **5.8%** of undergraduates. Unemployment 6 months after graduation has fallen gradually over the past several years with the same figure in 2012/13 standing at above **7%**, this most likely a sign of an improving economy.[29]

In a 2016 report, the Royal Academy of Engineering studied engineering graduates from the 2010/11 cohort which showed a substantial increase in graduates in an engineering occupation **3.5** years after graduating (as compared to 6 months after graduation). Of the 2010/11 cohort, **47.1%** held an engineering occupation 6 months after graduating rising to **68.9%** **3.5** years after graduating. Similarly the unemployment rate among engineering graduates dropped from **9.8%** 6 months after graduation to **2.5%** after **3.5** years.[30]

Figure 14

Destinations of Higher Education Engineering Graduates 6 Months After Graduation.



Analysis by EngineeringUK shows there is no discernible difference in employment status by gender, although ethnicity plays a large role in the employment outcomes for engineering graduates, compared to graduates generally. They showed that, in 2015, **71%** of white engineering graduates were in full-time work 6 months after graduation compared to **51%** of Black, Asian, and minority ethnic graduates. Those figures for all graduates are **59%** and **53%** respectively.[31]

[27] For a full breakdown of which engineering professions graduates at different levels entered and a comparison of what percentage of graduates entered engineering professions over the past years see Appendix E.

[28] The graduate employment gap: expectations versus reality, CIPD, November 2017.

[29] Unemployment figures include those who have taken time off to go travelling or volunteer. Destinations of Leavers from Higher Education in the United Kingdom for the academic year 2015/16, Higher Education Statistics Agency, June 2017. Data on engineering graduates requested and analysed by the ECITB. Data on university leavers is based on the Higher Education Statistics Agency's Leavers survey of UK domiciled graduates. Out of the 18,150 graduates in engineering 13,240 responded. HESA considers the survey to be representative of graduate destinations.

[30] Employment outcomes of engineering graduates: key factors and diversity characteristics, The Royal Academy of Engineering, November 2016. This data is not entirely comparable to the data presented earlier in this report. The Royal Academy of Engineering uses a slightly larger footprint when defining engineering than what the ECITB does. The Higher Education Statistics Agency also changed its methodology in its leavers survey in 2012.

[31] State of Engineering 2017, EngineeringUK, February 2017. Destinations of Leavers from Higher Education in the United Kingdom for the academic year 2015/16, Higher Education Statistics Agency, June 2017. Data on engineering graduates requested and analysed by the ECITB.

03 VOCATIONAL QUALIFICATIONS AND APPRENTICESHIPS

3.1 **Vocational Qualifications**

The state of engineering vocational qualifications shows a mixed picture. In 2016 there were **43,420** qualifications awarded at level 3 in engineering subjects in England, Wales and Northern Ireland, which is a decline of **13.4%** from 2012. It has been suggested that a decline in vocational qualifications obtained could be a result of several FE colleges closing and merging.[32] Higher level qualifications, levels 4—7, have on the other hand seen an increase by **66.5%**, from **3,135** to **5,220** qualifications awarded each year. This is a promising figure as higher level qualifications show an increasingly higher skilled technical workforce. The most commonly awarded qualifications over the past 5 years have been in electrical and electronic engineering, electro-technical engineering, mechanical engineering, general engineering, computer aided design and in operations engineering.[33]

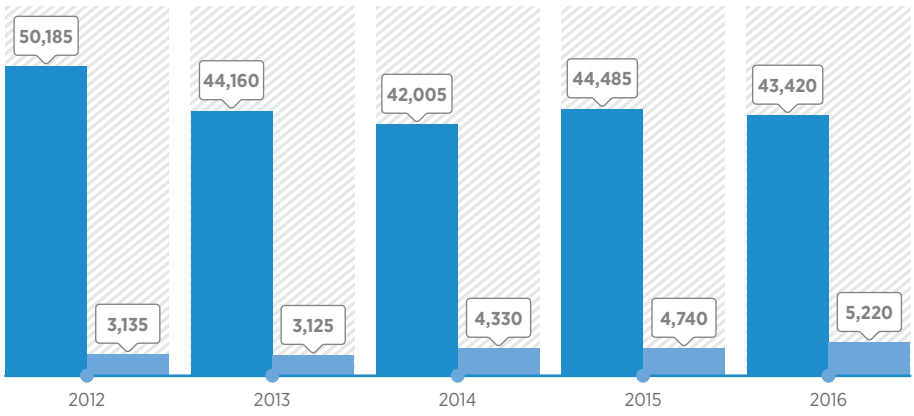


Figure 15

Level 3 and Level 4-7 Vocational Qualifications Awarded.

Level 3
Level 4—7

[32] An Analysis of College Merger Issues, Association of Colleges, April 2016.
[33] Vocational qualifications datasets for England, Wales and Northern Ireland, Ofqual, September 2017.

3.2 Apprenticeships

Engineering apprenticeships in the UK are seen as the gold standard of apprenticeships, and in surveys professionals currently working as engineers see them as the best way to get into the profession.[34]

In 2015/16, **10,750** apprentice engineers in England Wales and Northern Ireland completed their courses, an overall decrease of **7.25%** since 2012. Out of these **2,210**, **20.56%**, were intermediate apprenticeships (Level 2, GCSE equivalent) and **8,420**, **78.3%**, were advanced apprenticeships (Level 3, A-level equivalent) while **120**, or **1.12%** completed a higher apprenticeship. Higher apprenticeships were primarily in engineering technology frameworks. While intermediate apprenticeships have decreased by approximately **60%**, advanced apprenticeships have increased by **42%**. Out of the **10,750** apprenticeship achievements, **430** were in engineering construction. There is a large gender difference in engineering apprenticeships, with an average of **7%** of apprentices being female.[35]

Engineering apprenticeships' popularity differs depending on region, with the apprenticeships being most popular in the West Midlands, the South East, Yorkshire and the Humber and the North West and least popular in London. The same trend holds true for apprenticeships in all STEM subjects.[36]

3.3 Modern Apprenticeships in Scotland

In 2016 there were **1,205** modern engineering apprenticeship completions in Scotland; approximately **4.5%** of those were in engineering construction. Scotland has seen an overall rise of **21.7%** in engineering modern apprenticeships achievements since 2012, while at the same time seeing a decrease of approximately **18.2%** in engineering construction apprenticeships, possibly a reflection of the decline in the oil & gas sector in the UKCS. The most popular apprenticeships are Maintenance, Manufacturing, Fabrication and Welding, Mechanical Manufacturing, Technical Support, Design & Draughting. The gender gap in engineering apprenticeships in Scotland was wider than in the rest of the UK, with **3.1%** of engineering apprenticeship graduates and **9.25%** of engineering construction apprenticeship graduates being women. As a comparison women made up **41.3%** of all apprenticeship completions in Scotland in 2016/2017.[37]

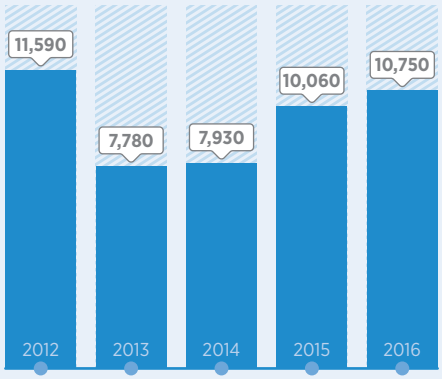


Figure 16

Engineering Apprenticeship Achievements in England, Wales and Northern Ireland.

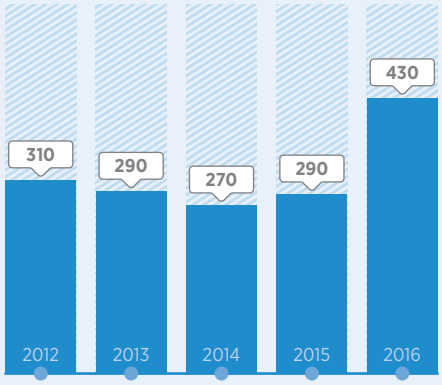


Figure 17

Engineering Construction Apprenticeship Completions.

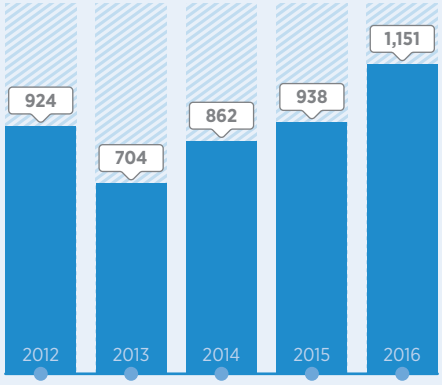


Figure 18

Engineering Modern Apprenticeship Completions.

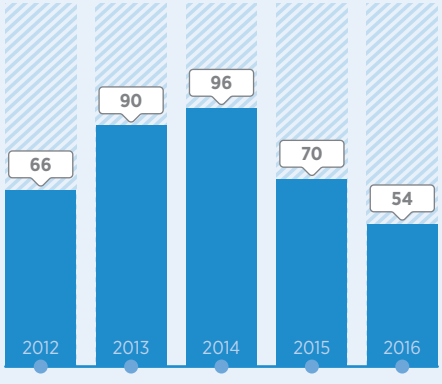


Figure 19

Engineering Construction Modern Apprenticeship Completions.

[34] Engineering Skills for the Future, SEMPTA, February 2017.

[35] Apprenticeship Participation by Region and Sector Subject Area (2009/10 to 2016/17- Reported to date), Education and Skills Funding Agency, September 2017.

[36] Apprenticeship frameworks defined as engineering include: engineering, engineering construction and engineering technology.

[37] Modern Apprenticeship Starts, Leavers, Intraining and Achievements by framework and gender, Supplementary tables quarter 4 2016-17, Skills Development Scotland, June 2017. Data analysed by the ECITB. Engineering achievements with VQ title from 2012-13 to 2016-17, Skills Development Scotland, August 2018 Data requested and analysed by ECITB.

3.4 Apprenticeship Completion Rates, Outcomes and Earnings

Earnings after Apprenticeship Completion (England, 2012/13)[38]

Aim / Framework Title	Earnings 1 Year after Study	Earnings 2 Years after Study	Percentage Increase
Electrotechnical	£25,400	£27,900	9.84%
Engineering	£28,300	£29,900	5.65%
Engineering Construction	£34,300	£35,200	2.62%
Gas Industry	£29,000	£32,900	13.45%
Plumbing and Heating	£21,900	-	-
Power Industry	£35,500	£41,100	15.77%
Water Industry	£30,800	-	-

Apprenticeship outcomes are not as well documented as higher education outcomes. The following section is drawn from data presented by the Department of Education and Skills Development Scotland on engineering, engineering technology and engineering construction frameworks. The statistics on apprenticeship outcomes and earnings in England and Wales relies on experimental data from the Department for Education and should be treated with caution.

Apprenticeships in engineering have a higher completion rate than the national average. In 2015/16 the completion rate for all engineering apprenticeships stood at **75%** compared to an average of **67%** for all apprenticeships. In Scotland the completion rate for Modern Apprenticeships in engineering was **84%** compared to an overall average of **78%**. Engineering Construction has a yet higher completion rate at **84.4%** in England, Wales and Northern Ireland, and **93%** in Scotland. Women had a higher completion rate than men.[39]

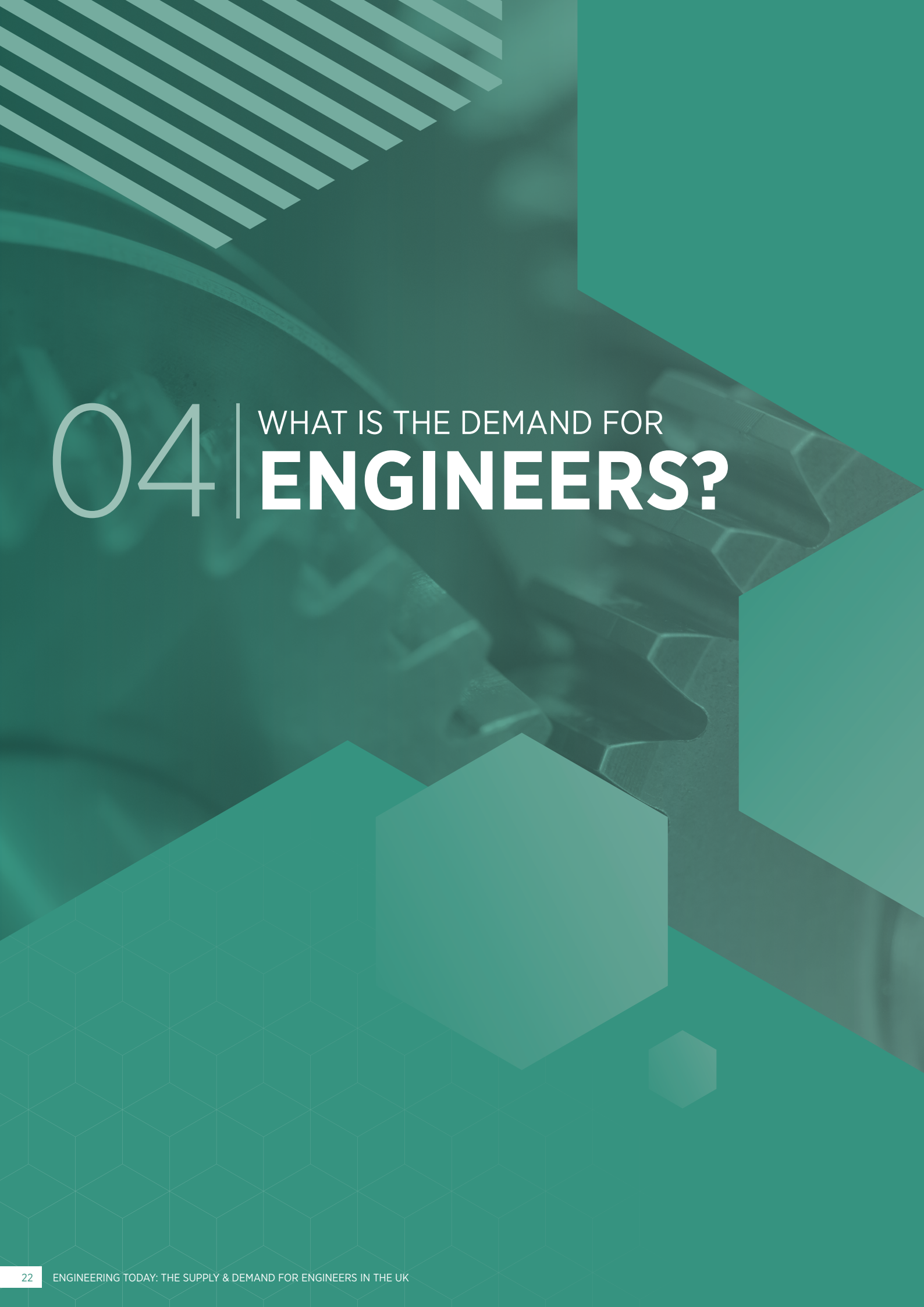
Engineering apprenticeship completers are more likely to gain employment after their apprenticeship; with over **90%** of completers of a level 3 apprenticeship sustaining employment after completing their apprenticeship, compared to a national average of **75%** for level 3 apprenticeships. Overall, engineering apprenticeship completers had the second highest average earnings and the highest among the major frameworks, at **£27,000**.[40] Completers in certain industries and sectors made considerably more, with engineering construction completers earning an average of **£34,100** one year after completing an apprenticeship.[41]

[38] Adult further education: outcome-based success measures; Additional tables standard measure by sector subject area: SFR52/2016, Department for Education, December 2016. This data is considered experimental and should be treated with caution. Modern Apprenticeships Supplementary Tables, Quarter 4, Skills Development Scotland, January, 2017. Information on engineering and engineering construction completion rates and gender requested by the ECITB.

[39] Statistical Working Paper: Average earnings post apprenticeship, England, 2010/11 – 2014/15, Department for Education, December 2016.

[40] Average earnings post apprenticeship, England, 2010 to 2015: experimental data, Department for Education, December 2016. This data is considered experimental and should be treated with caution.

[41] Infrastructure and Construction Pipeline, December 2016.



04 | WHAT IS THE DEMAND FOR ENGINEERS?

Due to the nature of the engineering workforce estimating the demand for engineers will always be a complicated task and there will always be limitations associated with the results. The main limitation to consider is the risk of double counting of demand when looking at different reports. Double counting could occur as much of the workforce is mobile and in many sectors and industries often move between projects. This section of the report will start by looking at replacement demand for the workforce then summarise secondary sources on projected demand.

By 2026, **91,000** engineers and **29,000** engineering technicians in today's workforce are expected to have either retired or be close to retiring; this is almost **19.6%** of the entire engineering workforce and almost **18%** of engineering technicians. This means that on average **9,100** engineers and **2,900** engineering technicians will be retiring every year. In addition, there will be **233,503** retirements among the skilled trades and **176,633** retirements among the managerial and other related professions studied for this report. Retirement rates will be especially high among skilled workers in the electrical and electronic trades, estimators, valuers and assessors and metal workers, where between one-fourth and fifth of all workers will be close to or have reached, the retirement age of 66 by 2026. Among the construction, manufacturing and production manager professions studied, close to a third could have retired or be close to retiring by 2026.

Concurrently, the UK is spending a record amount on infrastructure maintenance and expansion. The December 2017 issue of the National Infrastructure and Construction Pipeline contains **£462.7 billion** to be spent on **694** projects including large scale infrastructure projects, such as the expansion of Heathrow and other airports, Hinkley Point C, Sellafield decommissioning, Crossrail 1 & 2 and HS2 in the coming years.[42] These large scale projects will create an increased demand for highly skilled labour, which emphasises the need to ensure transferability of skills with a highly skilled workforce. The demand will have a marked impact on the supply of engineers, technicians and skilled trades across-sectoral and industry boundaries. The following section will look at a number of reports, some cross-sectoral others studying a specific sector, to study how demand will evolve as well as draw on analysis of government data to estimate how many engineering jobs will need to be replaced and how many new engineering jobs will be created.

[42] Engineering our Future – Stepping Up the Urgency on STEM, Confederation of British Industry, 2014.

4.1 Summary of Other Literature on the Demand for Engineers in the UK

There is an increasing amount of literature on the demand for engineers. Reports from industry bodies frequently suggest a skills crisis in engineering and in all STEM occupations. In 2014, the Confederation of British Industry reported that around **40%** of employers have difficulty recruiting skilled engineers.[43] Many of the reports summarised in the next section have a considerably wider definition of engineering than the definition taken in this report. Demand will therefore be higher than the replacement demand mentioned in this paper.

The Working Futures Report and EngineeringUK both project significant growth in the demand for engineers and related professions. They estimate that the wider engineering workforce will need to fill **186,000** engineering related jobs every year until 2024. Their report looks at the wider engineering workforce, including several construction related professions.[44] This demand includes a need to fill **57,000** level 3 engineers, technicians and skilled craftsmen annually and **101,000** level 4 or above engineers, technicians and skilled craftsmen annually. These figures include both replacement demand and growth demand. Demand for engineers will be felt in the construction sector as well as in the communications and manufacturing sectors. London and the South East of England will see the highest demand, although England and all of the devolved nations will see an increase in demand for engineers.[45]

The energy sector is one area of the workforce where demand for engineers is expected to grow heavily in the next few years. The Nuclear Workforce Assessment 2017 estimates that the nuclear industry alone will need an annual inflow of **3,380** engineers; this includes both replacement and expansion demand. As the chart below[46] demonstrates the industry will see a growth in demand for engineers until 2022, largely due to the building of Hinkley Point C at which point more than 20,000 engineers will be working in the industry. A further **20,000** skilled tradesmen and women will be employed in the nuclear sector at the same time. The report believes that the industry is most in need of engineers working in nuclear safety, control and instrumentation, commissioning engineers, site inspection and electrical engineers.[47]

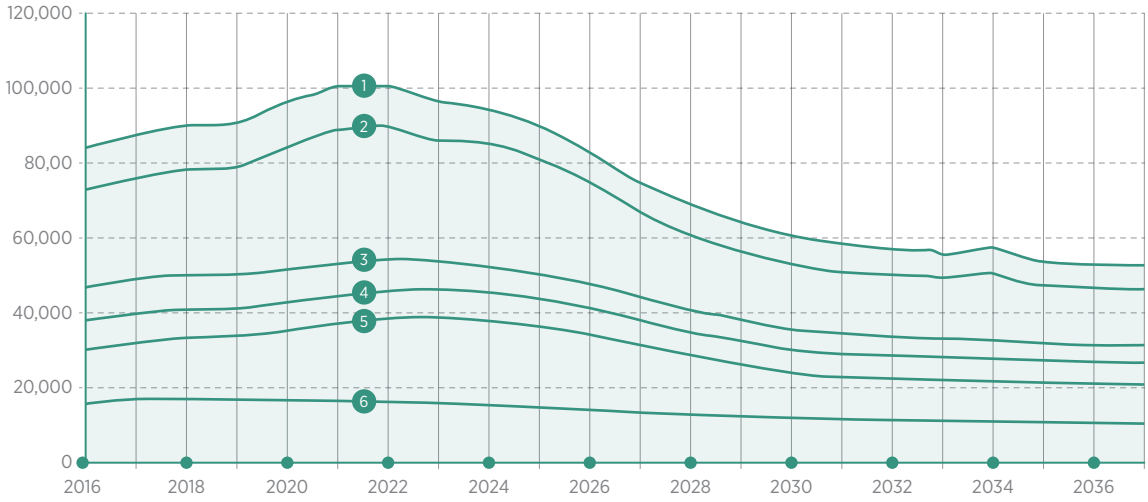


Figure 20

Future Workforce Demand of the Nuclear Industry.

Source

Nuclear Workforce Assessment 2017.

1. Operations
3. Engineering
3. Project & Programme management
4. Science, technical health safety & environment
5. Trades
6. Business functions

A 2017 report by think tank the Social Market Foundation, for EDF Energy, estimates that by 2023 the UK will need to fill **24,000** specialised construction jobs (including site engineers, geotechnical engineers), **13,000** civil engineers and specifically **10,000** engineers and engineering technicians working in the energy and electricity field. These figures are largely in line with the demand that will come from projected retirements in the workforce.[48]

[43] EngineeringUK's definition is considerably wider than the definition used in this report, and includes most SOC codes studied in this report along with professions in construction, maintenance, inspectors and manufacturing. The SOC codes studied by EngineeringUK can be found here: *www.engineeringuk.com/media/1350/EngineeringUK-Report-2017-Annex.pdf*

[44] Working Futures 2014-2024, Evidence Report 100, UK Commission for Employment and Skills, April 2016, UKCES, 2014 State of Engineering 2017, EngineeringUK February 2017.

[45] Chart from Nuclear Workforce Assessment 2017, Nuclear Skills Strategy Group, July 2017.

[46] Nuclear Workforce Assessment 2017, Nuclear Skills Strategy Group, July 2017.

[47] Jobs of the Future, Social Market Foundation/EDF Energy, November 2016.

[48] ECIA Manpower Data, Engineering Construction Industry Association, June 2017 *www.njceci.org.uk/publication/major-projects-rm-scope-manpower-june-2017/wppa_open*

Other reports project a lower demand for engineers going forward. The Engineering Construction Industry Association and the National Joint Council on the Engineering Construction Industry estimate that demand has been flat over the past few years and will remain so in the engineering construction industry, even though it has shifted in sectors within the industry.[49] The National Infrastructure Plan for Skills estimates the future demand for engineering construction workers to be over **150,000** by 2020, an increase from **140,000** in 2015.[50] Assuming that replacement demand is **2%** a year, with an additional **10,000** entering the industry, that would mean an estimated **24,000** new workers need to enter the ECI between 2015 and 2020. In addition, the report estimates that there will be a need to retrain and up-skill approximately **250,000** workers in engineering, engineering construction and in construction by 2024. New technical skills that will be required include digital and technology skills, such as Building Information Modelling (BIM) which is increasingly being deployed on the majority of infrastructure projects. Civil, structural, mechanical and electrical engineers will be in high demand as these roles are generally required throughout the life cycle of a project. Areas that will see the highest increase in demand are those with the largest infrastructure projects including the Heathrow expansion in the South and High Speed 2 in The Midlands.[51] Projects in the plan are expected to generate a total workforce demand of approximately **425,000** by the end of the decade, the majority of these jobs will be in construction.[52]

Similarly the CEBR, in work commissioned by the ECITB, also projects increased demand in the core engineering construction workforce by **14.6%** by 2026. Major growth in employment will come in the years leading up to 2021 due to the large infrastructure projects planned. After 2021 workforce demand will be gradually subdued although still forecast to grow above **1.5%** every year until 2026.[53]

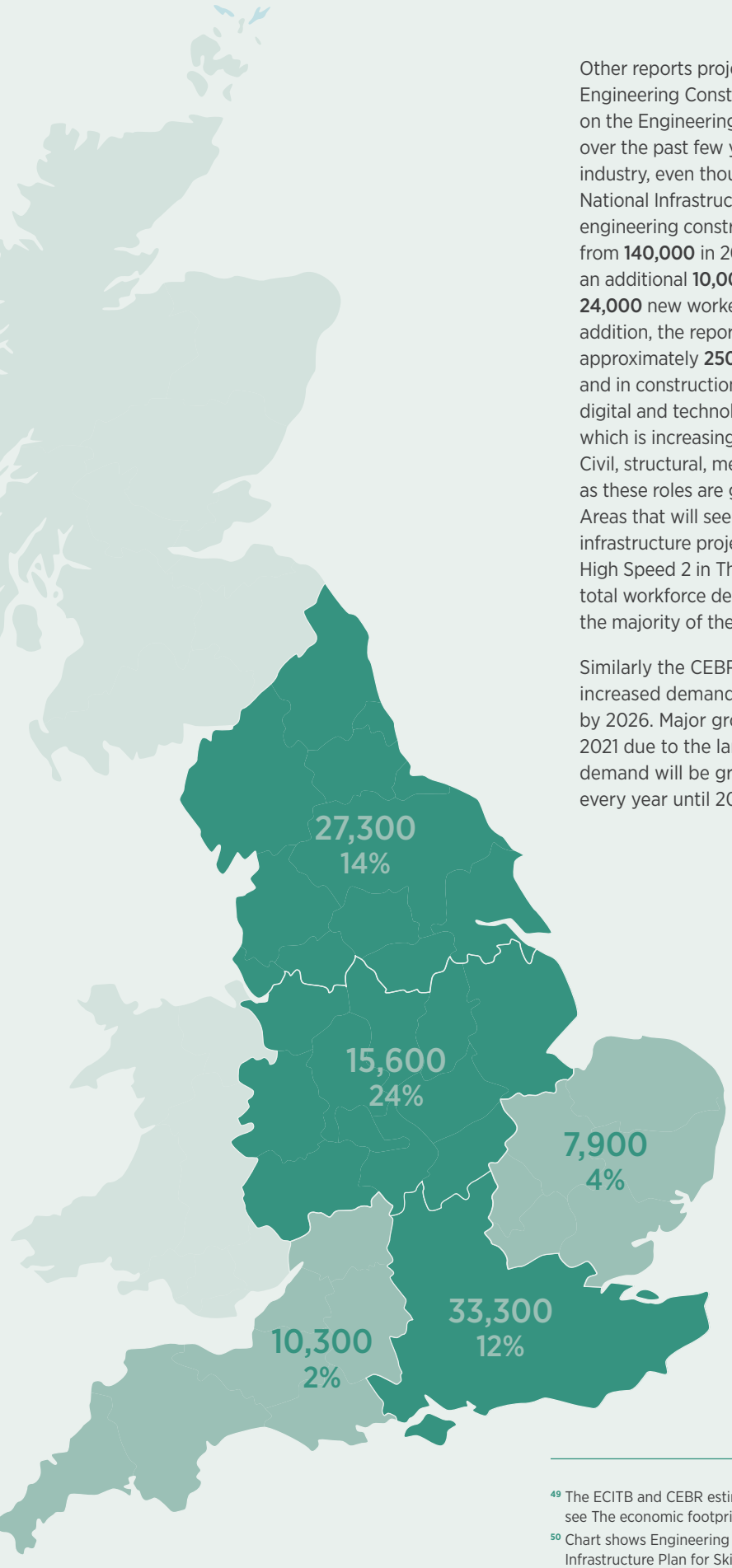


Figure 21

Demand for engineering and technical skills in England in 2020 (% increase over 2015 supply).

Source

National Infrastructure Plan for Skills, HM Treasury, September 2015.

[49] The ECITB and CEBR estimate that 188,100 work in the UK engineering construction industry in 2017, see The economic footprint of engineering construction, CEBR/ECITB, November 2017.

[50] Chart shows Engineering and technical skills demand increases from 2015 supply. Chart from National Infrastructure Plan for Skills, HM Treasury, September 2015.

[51] National Infrastructure Plan for Skills, HM Treasury, September 2015.

[52] The economic footprint of engineering construction, CEBR/ECITB, November 2017.

[53] Learning to grow: what employers need from education and skills: education and skills survey, Confederation of British Industry, 2012, Engineering and Technology Skills and Demand in Industry 2015, Institution for Engineering and Technology, 2015.

4.2 **Is the UK Fulfilling Demand?**

Demand is set to grow for engineers, engineering technicians and related professions in the UK due to increased infrastructure spending. A key question for policymakers and industry is whether or not the UK is meeting replacement demand or if there is a looming supply crisis in the engineering workforce.

In 2015/16, the UK produced **18,150** new engineers through the higher education system and **11,955** through intermediate and advanced apprenticeships, bringing the total number who were awarded qualifications in engineering to **30,105**. Replacement demand for engineers over the next 10 years will be approximately **91,000**. Replacement demand for engineering technicians will be approximately **29,000**. As the data shows between **38.5%** and **42%** of higher education graduates enter engineering professions each year, which in 2015/16 was equivalent to approximately **6,990** graduates going into the engineering workforce. While data for specific employment destinations for apprenticeships is not available, **75%** of engineering apprenticeship graduates in England and Wales and **84%** in Scotland, sustained employment after completing their apprenticeship. If all apprenticeship graduates who gained employment entered into either an engineering profession or an engineering technician profession, that would bring the annual entrants into the engineering workforce up to approximately **16,000**. In our best estimate, this would be enough to fill the estimated replacement demand of **120,000** engineers and engineering technicians over the next 10 years.

This data would suggest that there is no supply shortage of engineers graduating with qualifications; the UK produces enough engineers every year to fill demand. However, this would only be true in an ideal world if all engineers went into the engineering workforce, which they do not, and the skill mix of new engineers exactly matched the employer/occupational requirement. In spite of this, business reports difficulties in recruiting engineers, suggesting that engineers do not have the necessary hard or soft skills to be hired. This indicates that the problem facing the engineering workforce is that it is not receiving the right education for today's economy. Skills that employers report lacking in new recruits are STEM qualifications, workplace experience and soft and interpersonal skills whereas experienced recruits lack leadership and management skills.[54]

[54] Learning to grow: what employers need from education and skills: education and skills survey, Confederation of British Industry, 2012 Engineering and Technology Skills and Demand in Industry 2015, Institution for Engineering and Technology, 2015.

05 CONCLUSIONS AND RECOMMENDATIONS

This paper set out to study the characteristics of the engineering workforce and to determine the supply and demand of workers. The findings indicate that while supply should fill demand, a significant number of graduates commence employment in other fields. Based on these findings we recommend the following:

Address the mismatch between employers and engineering graduates.

As the data shows, only 40.7% of higher education engineering graduates became either engineers or engineering technicians six months after graduation, while a higher than average number of graduates were unemployed or in low-skilled professions. To further improve the supply of a skilled engineering workforce more should be invested into understanding why graduates with sought after degrees are not employed to their skill level. More should be done to increase the availability to high-quality careers advice and improve communication between employers and graduates, to show graduates the benefits of what a career in their field of study holds.

Address the skills needs of employers.

A reason for employers reporting difficulties in recruiting could be that universities and schools do not teach students the job-ready skills employers want and need. Previous research has shown that STEM graduates lack the experience and soft skills employers are looking for. To combat this, Higher and Further Education institutions should be in open dialogue with business to ensure that graduates receive the education they need for employment and to prepare graduates for future technologies.

Encourage more women and BAME communities into engineering.

Most professions studied in this report were over 90% white. To improve diversity there needs to be concerted efforts by government, businesses and employer organisations to reach out to these communities to attract them into the engineering careers. Careers advice and guidance should better recognise the different careers motivations of students and attitudes towards engineering and be tailored accordingly. Therefore efforts to improve diversity should study how best to communicate the benefits of careers in engineering to women and BAME communities.

Improving data on apprenticeship outcomes.

In order to encourage more students to pursue technical education and apprenticeship, and boost the parity of esteem with academic education, more resources need to be invested into research on apprenticeship outcomes for all subjects (not just engineering). Information that exists, some of which is used in this report, is experimental and does not paint a full picture of which professions apprenticeship graduates enter nor what their earnings are. As this report has shown engineering apprenticeships lead to stable and well-paid careers, however, more evidence is needed to highlight their benefits to encourage greater uptake among young people to improve the skills of the UK workforce and increase social mobility.

Improving the evidence base.

The previous recommendations show a need to further study the engineering workforce, to ensure that our nation has a diverse and skilled workforce to build, maintain and safely decommission our nation's critical infrastructure. There is also a need for better sector specific data on the demand for and supply of engineers. The ECITB has recently launched a new programme of labour market research, to improve the evidence base of the ECI labour market. The program will survey ECI employers, the supply chain and clients to determine business confidence, the current and future needs of the labour market and how technology is changing the industry. Our first report will be released in the first half of 2018.

Appendix A

Definition of Occupations

Occupations defined as ***engineering***

SOC Code	Occupation
2121	Civil engineers
2122	Mechanical engineers
2123	Electrical engineers
2124	Electronics engineers
2126	Design and development engineers
2127	Production and process engineers
2129	Engineering professionals n.e.c.

Occupations defined as ***engineering technicians***

SOC Code	Occupation
3112	Electrical and electronics technicians
3113	Engineering technicians
3114	Building and civil engineering technicians
3119	Science, engineering and production technicians n.e.c.

Occupations defined as ***related to engineering, skilled trades and managerial***

SOC Code	Occupation
2433	Quantity surveyors
2436	Construction project managers
1121, 1122, 1123	Construction, manufacturing and building supervisors
2461	Quality control and planning engineers
3122	Draughtspersons
3531	Estimators, valuers and assessors
5213	Sheet metal workers
5214	Metal plate workers, and riveters
5215	Welding trades
5216	Pipe fitters
5221	Metal machining setters and setter-operators
5223, 8125	Metal working production, operatives and maintenance fitters
5225	Air-conditioning and refrigeration engineers
5241	Electricians and electrical fitters
8111, 8112, 8114, 8115, 8116, 8117, 8118, 8119	Process operatives
8124	Energy plant operatives
5241, 5249	Electrical, electricians, electrical fitters and electronic trades n.e.c.
5311	Steel erectors
8141	Scaffolders, stagers and riggers
9132	Industrial cleaning process occupations

Appendix B

Engineering Degrees

The following degrees were awarded in engineering by UK universities in 2016:

The following undergraduate and postgraduate degrees were awarded in engineering by UK universities and used for this analysis:

Code	Degree
H100	General engineering
H110	Integrated engineering
H120	Safety engineering
H121	Fire safety engineering
H122	Water quality control
H123	Public health engineering
H130	Computer-aided engineering
H131	Automated engineering design
H141	Fluid mechanics
H142	Solid mechanics
H143	Structural mechanics
H150	Engineering design
H190	General engineering not elsewhere classified
H200	Civil engineering
H210	Structural engineering
H220	Environmental engineering
H221	Energy resources
H222	Coastal decay
H223	Environmental impact assessment
H230	Transport engineering
H231	Permanent way engineering
H232	Pavement engineering
H240	Surveying science
H242	Engineering surveying
H250	Geotechnical engineering
H290	Civil engineering not elsewhere classified
H300	Mechanical engineering
H320	Mechanisms & machines
H330	Automotive engineering
H331	Road vehicle engineering
H340	Acoustics & vibration
H341	Acoustics
H350	Offshore engineering
H360	Electromechanical engineering
H390	Mechanical engineering not elsewhere classified
H600	Electronic & electrical engineering
H610	Electronic engineering
H611	Microelectronic engineering

Code	Degree
H620	Electrical engineering
H630	Electrical power
H632	Electrical power distribution
H640	Communications engineering
H641	Telecommunications engineering
H642	Broadcast engineering
H643	Satellite engineering
H644	Microwave engineering
H650	Systems engineering
H651	Digital circuit engineering
H660	Control systems
H661	Instrumentation control
H670	Robotics & cybernetics
H671	Robotics
H672	Cybernetics
H674	Virtual reality engineering
H680	Optoelectronic engineering
H690	Electronic & electrical engineering not elsewhere classified
H700	Production & manufacturing engineering
H710	Manufacturing systems engineering
H711	Manufacturing systems design
H713	Production processes
H720	Quality assurance engineering
H730	Mechatronics
H790	Production & manufacturing engineering not elsewhere classified
H800	Chemical, process & energy engineering
H810	Chemical engineering
H811	Biochemical engineering
H812	Pharmaceutical engineering
H821	Nuclear engineering
H830	Chemical process engineering
H831	Bioprocess engineering
H840	Gas engineering
H850	Petroleum engineering
H890	Chemical, process & energy engineering not elsewhere classified
H900	Others in engineering
H990	Engineering not elsewhere classified

Appendix C

Retirements

Engineers – Age distribution.

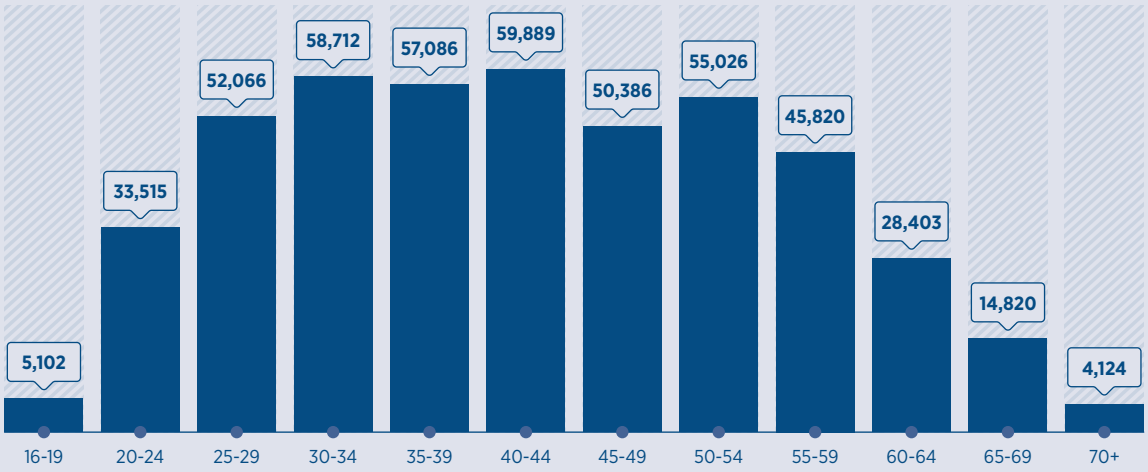


Figure 22

Engineering Workforce age Distribution.

Type of Engineer	Workforce	Retirees by 2026	Percentage
Civil engineers	87,379	17,561	20.10%
Mechanical engineers	82,547	17,398	21.08%
Electrical engineers	38,595	7,342	19.02%
Electronics engineers	31,150	6,059	19.45%
Design and development engineers	73,109	13,387	18.31%
Production and process engineers	47,549	8,131	17.10%
Engineering professionals	104,620	21,068	20.14%
Total	**464,949**	**90,946**	**19.56%**

Engineering Technicians – Age distribution and projected retirements by profession.

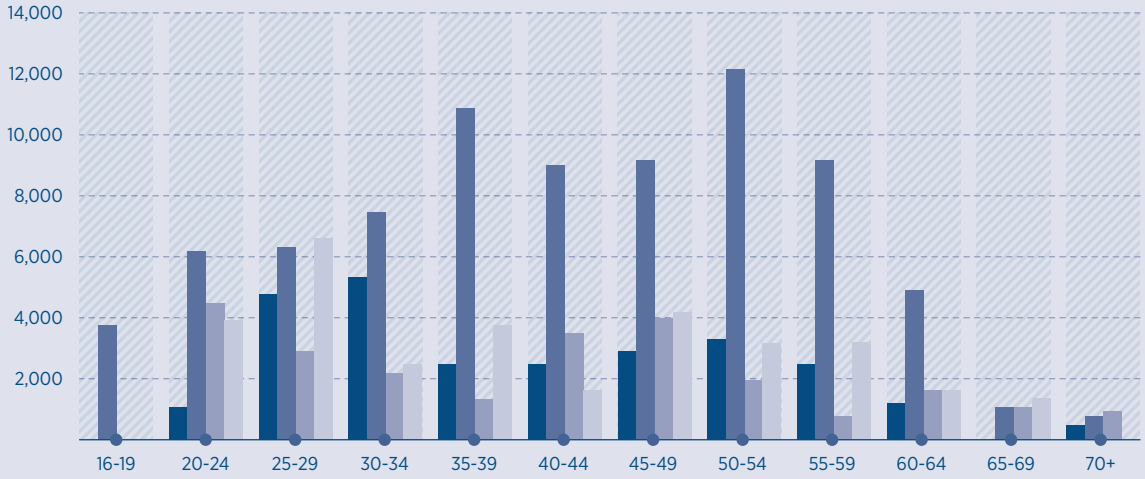


Figure 23

Engineering Technicians Age Distribution, 2016.

- Electrical & Electronic Technicians
- Engineering Technicians
- Building & Civil Engineering Technicians
- Science, Engineering, Production Technicians

Role	Workforce	Retirees by 2026	Percentage
Electrical and electronics technicians	25,948	3,756	14.48%
Engineering technicians	80,309	15,552	19.37%
Building and civil engineering technicians	23,811	3,971	16.68%
Science, engineering and production technicians n.e.c	32,264	5,830	18.07%
Total	**162,332**	**29,109**	**17.93%**

Appendix C

Retirements

Related professions.

Skilled Trades			
Profession	**Workforce**	**Estimated Retirees by 2026**	**Percentage**
Quantity surveyors	45,014	6,644	14.76%
Draughtspersons	38,418	6,623	17.24%
Sheet metal workers	14,890	2,409	16.18%
Metal plate workers, and riveters	5,224	228	4.36%
Welding trades	65,612	10,546	16.07%
Pipe fitters	8,922	2,508	28.11%
Metal machining setters and setter-operators	48,712	9,376	19.25%
Metal working production and maintenance fitters	192,690	41,864	21.73%
Air-conditioning and refrigeration engineers	17,014	1,987	11.68%
Electricians and electrical fitters	257,830	51,269	19.88%
Electrical and electronic trades n.e.c	78,476	18,518	23.60%
Steel erectors	9,814	1,558	15.88%
Construction and building trades n.e.c	249,656	52,895	21.19%
Rubber process operatives	3,120	1,009	32.34%
Plastics process operatives	26,587	3,665	13.78%
Metal making and treating process operatives	8,423	1,646	19.54%
Electroplaters	3,515		
Process operatives n.e.c	14,976	3,540	23.64%
Energy plant operatives	6,282	919	14.63%
Metal working machine operatives	61,330	9,239	15.06%
Scaffolders, stagers and riggers	22,565	1,235	5.47%
Industrial cleaning process occupations	31,878	5,825	18.27%
Total	**1,210,948**	**233,503**	**19.28%**

* Fields left blank are due to sample size being too small for ONS to project how many workers there are employed in that profession and what their earnings are.

Managerial and Other Related Professions			
Profession	**Workforce**	**Estimated Retirees by 2026**	**Percentage**
Production managers and directors in manufacturing	301,244	95,118	31.58%
Production managers and directors in construction	181,776	47,379	26.06%
Production managers and directors in mining and energy	13,400	2,284	17.04%
Construction project managers and related professionals	61,915	10,659	17.22%
Quality control and planning engineers	32,540	4,812	14.79%
Estimators, valuers and assessors	63,071	16,381	25.97%
Total	**653,946**	**176,633**	**27.01%**

Appendix C

Retirements

Gender Breakdown of Skilled trades and other Related Professions			
Profession	**Male**	**Female**	**Percentage Difference**
Production mngrs and directors in manufacturing	266,174	35,268	13.25%
Production mngrs and directors in construction	166,205	15,571	9.37%
Production mngrs and directors in mining and energy	13,276	1,562	11.77%
Quantity surveyors	41,507	3,794	9.14%
Construction project mngrs and related professionals	56,639	5,561	9.82%
Quality control and planning engineers	22,900	9,793	42.76%
Draughtspersons	30,357	8,597	28.32%
Estimators, valuers and assessors	46,112	17,438	37.82%
Sheet metal workers	15,653		
Metal plate workers, and riveters	6,624		
Welding trades	65,199		
Pipe fitters	9,164		
Metal machining setters and setter-operators	46,215	2,497	5.40%
Metal working production and maintenance fitters	187,733	4,957	2.64%
Air-conditioning and refrigeration engineers	17,964		
Electricians and electrical fitters	253,608	4,222	1.66%
Electrical and electronic trades n.e.c	76,541	1,935	2.53%
Steel erectors	10,100		
Construction and building trades n.e.c	242,974	6,682	2.75%
Rubber process operatives	4,010	606	15.11%
Plastics process operatives	23,559	3,346	14.20%
Metal making and treating process operatives	8,473	610	7.20%
Electroplaters	3,961		
Process operatives n.e.c	11,381	3,639	31.97%
Energy plant operatives	7,807		
Metal working machine operatives	55,379	5,994	10.82%
Scaffolders, stagers and riggers	23,403		
Industrial cleaning process occupations	23,770	8,268	34.78%
Total	**1,736,688**	**140,340**	**8.08%**

* Fields left blank are due to sample size being too small for ONS to project how many workers there are employed in that profession.

Appendix D

Breakdown of Earnings

Breakdown of earnings (2016)				
Profession	**Mean Earnings**	**Male Mean Salary**	**Mean Female Earnings**	**Percentage Difference (Male/Female)**
All Engineering (non-technician) professionals	£42,073	£42,640	£37,277	14.39%
Civil engineers	£40,985	£41,281	£37,688	9.53%
Mechanical engineers	£44,720	£45,229	£40,200	12.51%
Electrical engineers	£46,571	£46,550	£46,907	-0.76%
Electronics engineers	£48,533	£50,072	£33,797	48.16%
Design and development engineers	£41,358	£41,796	£35,388	18.11%
Production and process engineers	£39,865	£40,988	£31,854	28.67%
Engineering professionals n.e.c.	£41,939	£42,542	£38,111	11.63%
Electrical and electronics technicians	£30,837	£30,971		
Engineering technicians	£34,482	£35,899	£31,867	12.65%
Building and civil engineering technicians	£29,568	£31,440		
Science, engineering and production technicians n.e.c.	£26,691	£30,632	£21,813	40.43%

* Fields left blank are due to sample size being too small for ONS to project how many workers there are employed in that profession and what their earnings are.

Regional breakdown (2015)		
Role	**Mean Highest Salary**	**Mean Lowest Salary**
Civil Engineers	Scotland - £48,600	South West - £32,051
Mechanical Engineers	Wales - £61,758	North East - £28,644
Electrical Engineers	London - £54,586	Wales - £32,442
Electronics Engineers	South East - £52,352	London - £35,978
Design and Development Engineers	London - £61,164	North West - £35,354
Production and Process Engineers	London - £45,018	East of England - £34,067
Engineering Professionals	Scotland - £49,568	Yorkshire & The Humber - £34,816
Engineering Technicians	London - £38,359	West Midlands - £28,646
Building and Civil Engineering Technicians	Scotland - £41,259	South West - £24,065
Science, Engineering and Production Technicians	London - £31,624	North east - £24,484

Appendix D

Breakdown of Earnings

Mean Salaries for Related Professions (2016)				
Description	Mean	Men	Women	Difference (Men/Women)
Quantity surveyors	£40,124	£40,817	£35,133	16.18%
Construction project managers and related professionals	£37,782	£39,863		
Production managers and directors in manufacturing	£52,040	£54,361	£41,814	30.01%
Production managers and directors in construction	£52,488	£55,087	£42,246	30.40%
Production managers and directors in mining and energy	£49,440	£50,748	£36,395	39.44%
Quality control and planning engineers	£52,242	£53,466	£39,960	33.80%
Draughts-persons	£30,689	£31,681		
Estimators, valuers and assessors	£31,284	£36,579	£23,172	57.86%
Sheet metal workers	£26,591	£26,764		
Metal plate workers, and riveters	£28,978	£28,978		
Welding trades	£27,146	£27,317		
Pipe fitters	£37,725	£37,725		
Metal machining setters and setter-operators	£27,395	£27,688	£25,951	6.69%
Metal working production and maintenance fitters	£31,704	£31,823	£28,211	12.80%
Metal working machine operatives	£21,670	£22,566	£16,703	35.10%
Air-conditioning and refrigeration engineers	£33,119	£33,119		
Electricians and electrical fitters	£30,914	£30,956		
Food, drink and tobacco process operatives	£18,609	£20,045	£15,746	27.30%
Glass and ceramics process operatives	£22,174	£22,645		
Chemical and related process operatives	£28,025	£29,924	£18,286	63.64%
Rubber process operatives	£29,158	£29,743		
Plastics process operatives	£24,279	£25,367	£16,180	56.78%
Metal making and treating process operatives	£24,285	£24,838		
Electroplaters	£22,292	£22,556		
Process operatives n.e.c.	£26,230	£26,944	£15,055	78.97%
Energy plant operatives	£32,351	£33,839		
Electrical and electronic trades n.e.c.	£32,259	£32,300	£30,999	4.20%
Steel erectors	£27,986	£27,986		
Scaffolders, stagers and riggers	£31,834	£31,834		
Industrial cleaning process occupations	£16,756	£18,226	£13,574	34.27%

* Fields left blank are due to sample size being too small for ONS to project how many workers there are employed in that profession.

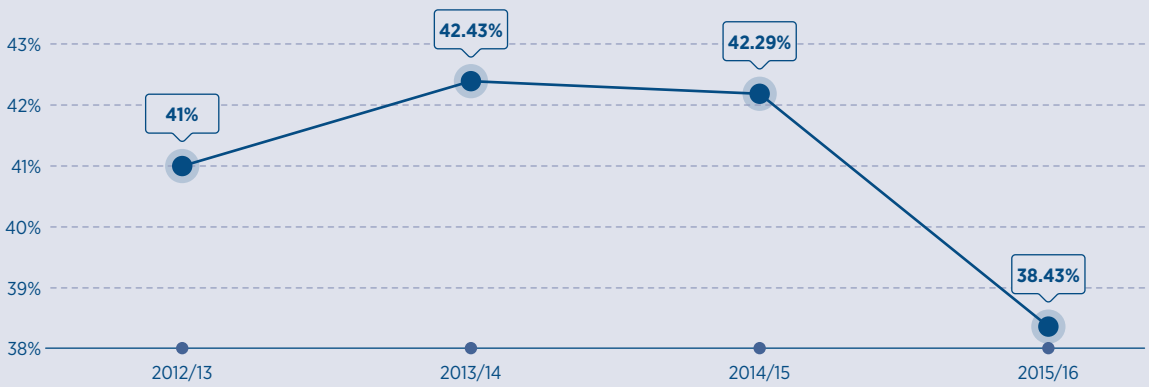
Appendix E

Engineering Professions

Engineering professions entered by graduates, by education level (2015/16)			
Education Level	**Profession**	**Graduates employed**	**Percentage**
Doctorate	Civil engineers	17	9.61%
	Mechanical engineers	24	13.59%
	Electrical engineers	15	8.36%
	Electronics engineers	8	4.46%
	Design and development engineers	51	28.38%
	Production and process engineers	19	10.31%
	Engineering professionals n.e.c.	45	25.30%
	Total	**179**	
Masters & Other Postgraduate	Civil engineers	180	25.81%
	Mechanical engineers	127	18.17%
	Electrical engineers	47	6.75%
	Electronics engineers	14	1.94%
	Design and development engineers	94	13.52%
	Production and process engineers	42	6.02%
	Engineering professionals n.e.c.	193	27.79%
	Total	**696**	
Undergraduate	Civil engineers	998	23.31%
	Mechanical engineers	937	21.87%
	Electrical engineers	281	6.57%
	Electronics engineers	157	3.67%
	Design and development engineers	774	18.08%
	Production and process engineers	415	9.69%
	Engineering professionals n.e.c.	720	16.81%
	Total	**4,282**	

Figure 24

Graduates Entering Engineering Professions, 2012—2016.



Appendix F

Geographic Breakdown of Professions Studied

Geographic Location of the Skilled Trades and Managerial Positions					
	Total UK	England %	NI %	Scotland %	Wales %
Production mngrs and directors in manufacturing	301,442	86.04%	1.86%	7.20%	4.90%
Production mngrs and directors in construction	181,776	86.60%	1.73%	7.70%	3.97%
Production mngrs and directors in mining and energy	14,512	69.53%		27.54%	2.93%
Quantity surveyors	45,301	82.88%	5.07%	7.32%	4.73%
Construction project mngrs and related professionals	62,200	84.00%	4.40%	8.07%	3.53%
Quality control and planning engineers	32,693	84.88%		11.11%	4.01%
Draughtspersons	38,954	83.93%	3.20%	9.73%	3.13%
Estimators, valuers and assessors	62,877	90.11%		5.64%	4.25%
Sheet metal workers	15,278	89.27%		8.67%	2.06%
Metal plate workers, and riveters	6,440	65.23%		34.77%	
Welding trades	65,612	80.54%	6.31%	7.12%	6.02%
Pipe fitters	8,833	64.28%		23.87%	11.85%
Metal machining setters and setter-operators	48,712	87.18%	1.94%	6.16%	4.71%
Metal working production and maintenance fitters	192,690	81.46%	2.53%	9.59%	6.41%
Air-conditioning and refrigeration engineers	17,964	94.24%		2.19%	3.57%
Electricians and electrical fitters	257,830	83.17%	2.78%	9.08%	4.96%
Electrical and electronic trades n.e.c	78,476	83.44%	2.25%	8.39%	5.91%
Steel erectors	10,100	86.72%		7.58%	5.69%
Construction and building trades n.e.c	249,656	87.57%	2.15%	5.24%	5.05%
Rubber process operatives	4,350	76.90%		17.95%	5.15%
Plastics process operatives	26,905	85.65%	3.73%	2.36%	8.26%
Metal making and treating process operatives	8,651	79.09%		7.44%	13.47%
Electroplaters	3,066	100.00%			
Process operatives n.e.c	15,020	78.02%	9.54%	7.22%	5.22%
Energy plant operatives	7,883	89.18%		10.82%	
Metal working machine operatives	61,373	82.26%	2.76%	8.34%	6.65%
Scaffolders, stagers and riggers	23,403	86.90%		6.23%	6.86%
Industrial cleaning process occupations	32,038	84.70%	3.01%	9.51%	2.79%
Total	**1,874,035**	**84.67%**	**2.37%**	**7.93%**	**5.02%**

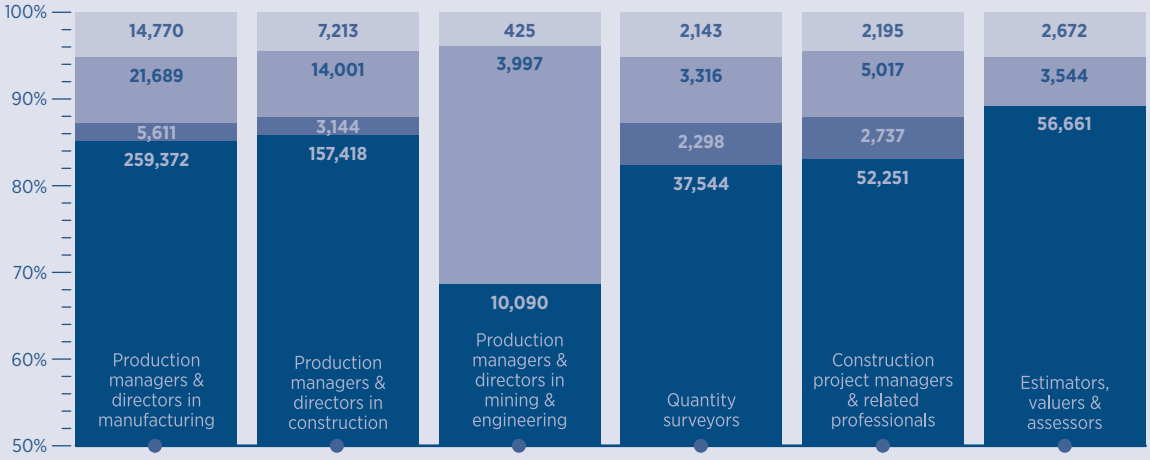


Figure 25

Geographic Location of Managerial & Other Related Workforce.

Appendix F

Geographic Breakdown of Professions Studied

Geographic Location of the Skilled Trades					
	Total UK	England %	NI %	Scotland %	Wales %
Quality control and planning engineers	32,693	84.88%		11.11%	4.01%
Draughts-persons	38,954	83.93%	3.20%	9.73%	3.13%
Sheet metal workers	15,278	89.27%		8.67%	2.06%
Metal plate workers, and riveters	6,440	65.23%		34.77%	
Welding trades	65,612	80.54%	6.31%	7.12%	6.02%
Pipe fitters	8,833	64.28%		23.87%	11.85%
Metal machining setters and setter-operators	48,712	87.18%	1.94%	6.16%	4.71%
Metal working production and maintenance fitters	192,690	81.46%	2.53%	9.59%	6.41%
Air-conditioning and refrigeration engineers	17,964	94.24%		2.19%	3.57%
Electricians and electrical fitters	257,830	83.17%	2.78%	9.08%	4.96%
Electrical and electronic trades n.e.c.	78,476	83.44%	2.25%	8.39%	5.91%
Steel erectors	10,100	86.72%		7.58%	5.69%
Construction and building trades n.e.c	249,656	87.57%	2.15%	5.24%	5.05%
Rubber process operatives	4,350	76.90%		17.95%	5.15%
Plastics process operatives	26,905	85.65%	3.73%	2.36%	8.26%
Metal making and treating process operatives	8,651	79.09%		7.44%	13.47%
Electroplaters	3,066	100.00%			
Process operatives n.e.c	15,020	78.02%	9.54%	7.22%	5.22%
Energy plant operatives	7,883	89.18%		10.82%	
Metal working machine operatives	61,373	82.26%	2.76%	8.34%	6.65%
Scaffolders, stagers and riggers	23,403	86.90%		6.23%	6.86%
Industrial cleaning process occupations	32,038	84.70%	3.01%	9.51%	2.79%
Total	**1,874,035**	**84.67%**	**2.37%**	**7.93%**	**5.02%**

Technician Workforce 2016					
	Total UK	England %	NI %	Scotland %	Wales %
Electrical and electronics technicians	25,559	88,54%		7.83%	3.63%
Engineering technicians	80,309	81.66%	3.94%	9.67%	4.73%
Building and civil engineering technicians	23,811	83.03%		9.03%	4.33%
Science, engineering and production technicians n.e.c	31,781	78.68%		17.40%	3.92%
Total	**161,460**	**82.37%**	**2.49%**	**10.80%**	**4.34%**

Appendix G

Ethnicity Breakdown

Engineering Professions by Ethnicity 2016						
	Total	**White** (white British, Irish, Other white)	**Mixed / Multiple ethnic groups**	**Other ethnic group**	**Asian** (Indian, Pakistani, Bangladeshi, Chinese, other)	**Black, African, Caribbean, Black British**
Civil engineers	83,202	73,558	583	1,849	6,083	1,129
Mechanical engineers	79,311	73,422		1,311	2,774	1,804
Electrical engineers	37,911	36,440			891	580
Electronics engineers	29,488	25,566			2,578	1,344
Design and development engineers	69,140	60,388		1,015	7,737	
Production and process engineers	43.061	41,359		505	1,197	
Engineering professionals n.e.c.	102,621	95,874		896	3,519	2,332
Total	**444,734**	**406,607**	**583**	**5,576**	**24,779**	**7,189**

Technician Workforce by Ethnicity						
	Total	**White** (white British, Irish, Other white)	**Mixed / Multiple ethnic groups**	**Other ethnic group**	**Asian** (Indian, Pakistani, Bangladeshi, Chinese, other)	**Black, African, Caribbean, Black British**
Electrical and electronics technicians	25,260	25,260				
Engineering technicians	76,338	71,705	676	1,236	1,697	1,024
Building and civil engineering technicians	21,494	20.846				648
Science, engineering and production technicians n.e.c.	30,543	30,543				
Total	**153,635**	**148,354**	**676**	**1,236**	**1,697**	**1,672**

Appendix G

Ethnicity Breakdown

Ethnicity Breakdown of Skilled Trades and Other Related Professions						
	Total	**White** (white British, Irish, Other white)	**Mixed / Multiple ethnic groups**	**Other ethnic group**	**Asian** (Indian, Pakistani, Bangladeshi, Chinese, other)	**Black, African, Caribbean, Black British**
Production mngrs and directors in manufacturing	295,507	279,561	734	2,689	10,475	2,048
Production mngrs and directors in construction	177,053	168,698	1,111	1,901	3,903	1,440
Production mngrs and directors in mining and energy	13,892	13,892				
Quantity surveyors	41,755	39,558			1,147	1,050
Construction project mngrs and related professionals	56,162	54,062		2,100		
Quality control and planning engineers	30,470	29,917		553		
Draughtspersons	36,494	35,142			1,352	
Estimators, valuers and assessors	60,269	59,533				736
Sheet metal workers	14,891	14,891				
Metal plate workers, and riveters	6,256	6,256				
Welding trades	60,117	60,117				
Pipe fitters	8,260	8,260				
Metal machining setters and setter-operators	46,608	45,021			1,037	550
Metal working production and maintenance fitters	186,932	181,174	1,297	491	2,699	1,271
Air-conditioning and refrigeration engineers	17,726	17,726				
Electricians and electrical fitters	250,322	236,737	1,296	1,668	6,361	4,260
Electrical and electronic trades n.e.c	73,918	72,809			1,109	
Steel erectors	9,182	9,182				
Construction and building trades n.e.c	243,238	228,560		2,305	8,691	3,682
Rubber process operatives	3,119	3,119				
Plastics process operatives	24,939	24,939				
Metal making and treating process operatives	8,256	7,743			513	
Electroplaters	3,867	3,867				
Process operatives n.e.c	12,406	12,406				
Energy plant operatives	7,322	7,322				
Metal working machine operatives	57,827	52,268		711	4,848	
Scaffolders, stagers and riggers	22,915	22,915				
Industrial cleaning process occupations	30,475	27,736		1,087	512	1,140
Total	**1,800,178**	**1,723,411**	**4,438**	**13,505**	**42,647**	**16,177**

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