EngineeringUK

Engineering UK 2011

The state of engineering

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Engineering UK 2011 – report
Authors

The lead authors for Engineering UK 2011 were Dr Anil Kumar and Neil Randerson with support from other colleagues at EngineeringUK.

EngineeringUK would also like to thank the following partners for their valuable contributions:

Roger Salomone,
EEF Energy Adviser, EEF

Robin Lynn,
Policy Manager, Equality and Human Rights Commission

Bill Sutton,
Project Manager, Operations and Development, SEMTA

Nick Gooderson,
Head of Education, Training and Qualifications, ConstructionSkills

Nick Linford,
Head of the Pearson Centre for Policy and Learning, Pearson Education

Dr Esther Lockley,
Research and Information Manager, fdf

Charles Pickford,
Director of Employer Partnerships (Private Sector), fdf

Michael Peak,
Education Market Research and Intelligence Manager, British Council

Andrew Ramsay,
former CEO, Engineering Council

Bob Windmill,
UK Research Manager, SSC Alliance

Rob Moore,
Strategy Manager, Renewables, Energy & Utility Skills Ltd

Fruzsina Kemenes,
Skills & Education Policy Officer, RenewableUK

Lee Bryer,
Research & Development Operations Manager, ConstructionSkills

Foreword

The Rt. Hon Vince Cable MP

Our country has produced some of the world's greatest technological triumphs. From early manufacturing techniques developed during the industrial revolution to the first tentative clicks of the World-Wide-Web, Britain has led the way in research, in science and in engineering.

In these difficult economic times, we have a responsibility and an opportunity to forge a new role for engineering and science disciplines so that we can, once again, lead the world in the delivery of products and engineering expertise. Working together, industry, the education sector and the government have the ability to turn our rich native talent for innovation into a driver for sustainable economic growth. Indeed, the recent Spending Review settlement, which was positive for the science community, means that we have a strong base from which to build.

There are twin cogs in the engine of growth that must be correctly aligned to drive the engineering sector forwards.

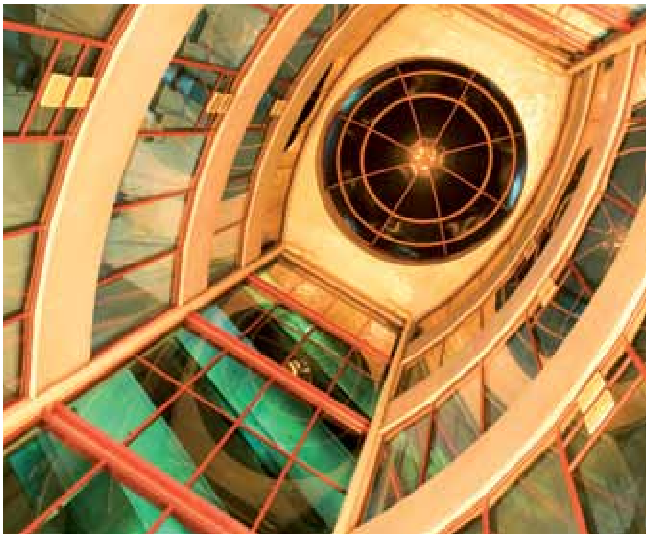
Firstly, we must ensure that we are training and equipping a steady stream of world class engineers in our education system. A growing economy will see a corresponding growth in demand for sufficient engineers technically qualified to service a whole range of UK industries – from nanotechnology to green energy production. This sets us a series of challenges in education and in the skills sector to ensure that we encourage more young people to take up a career in engineering.

The second cog is the creation of demand. As viable new industries emerge as part of our global supply chain, we must ensure a well resourced sector is buoyed up by an engaged and highly skilled workforce. We are focusing on getting skills provision right, backing a properly resourced apprenticeship route into the sector, and we are working closely with engineering SMEs.

My department is working hard on both challenges, so that we can deliver a more streamlined, more responsive answer for the engineering sector. This is why we welcome the work being undertaken by organisations like EngineeringUK and other partners in the Engineering the Future alliance.

This annual report is an excellent tool to assist industry and the government in assessing the extent, and countrywide provision, of engineering skills. It shows us the gaps that need to be filled but, importantly, also highlights areas of the country with particular expertise. Taken together with the excellent Big Bang Fair initiative, which seeks to excite young people about a career in engineering or science, it supports the push and pull approach that we need for the sector to thrive and flourish.

EngineeringUK
About Us



The engineering sector is crucial to the health of the UK economy, generating 20% of the country's Gross Domestic Product: three times that of the finance sector. Engineering is now driving forward the UK's burgeoning energy markets: clear evidence of the UK's economic and environmental reliance on the sector. The current economic climate creates an opportunity to raise the profile of engineering in an unprecedented way, and EngineeringUK is set up to do just that.

EngineeringUK is an independent, not-for-profit organisation whose purpose is to promote the vital contribution that engineers, engineering and technology make to our society, and inspire people at all levels to pursue careers in engineering and technology. We work in partnership with business and industry, government, education and skills providers, the professional engineering institutions, the Engineering Council, the Royal Academy of Engineering and the wider science, technology, engineering and mathematics community. Together, we pursue two strategic goals:

- To improve the perception of engineers, engineering and technology
- To improve the supply of engineers

Programme of work

We focus our activity on two core programmes:

The Big Bang: UK Young Scientists and Engineers Fair

In 2010 – only its second year – The Big Bang attracted over 23,500 people: more than three times as many visitors as in its first year. The Big Bang is steadily increasing its profile, and this year, for the first time, was open to the general public for one of its three days. It achieved widespread media coverage, including the Today Programme, BBC Radio One Drivetime, The Times and First News, as well as gaining almost 400 mentions in the regional media and coverage on the BBC's Bang goes the Theory and BBC News channel.

Work is already well underway for The Big Bang 2011, to be held at ICC London ExCeL on 10-12 March. Using social media and the print and broadcast media is enabling us to reach a considerable audience. Activities, including The Big Bang Lesson with Professor Brian Cox, have secured a Facebook following of over 5,000, as well as traditional media coverage from The Sun to the Times Educational Supplement.

Tomorrow's Engineers

This programme is led by EngineeringUK and The Royal Academy of Engineering, and has been developed to create sustainable, long-term involvement with previously unengaged schools and colleges to increase the uptake of engineering as a career. In the academic year 2009/10, five delivery partners worked together under the Tomorrow's Engineers umbrella to provide targeted enrichment and enhancement activities to an extra 30,000 young people across the UK.

How we work

Our activity is informed by four advisory panels: the Business and Industry Panel; the Education and Skills Panel; the Professional Panel; and the Careers Advisory Panel. Panel members are drawn from diverse backgrounds across business, industry, the professional engineering institutions and the education sector. However, they all share one thing: their passion for promoting engineering and engineers.

Communication, research and evaluation underpin everything we do. *Engineering UK,* our annual review of the state of UK engineering, is our flagship publication and provides the engineering sector, policy makers and the media with a definitive source of information and analysis.

This focus on activity, supported by a robust evidence base and coupled with our independent status, helps position EngineeringUK as an authoritative and unified voice for the engineering community.

Moving forward

EngineeringUK will continue to work in collaboration with partners across the community to improve the understanding and perception of engineering and engineers.

The Big Bang: UK Young Scientists and Engineers Fair

The next Big Bang event will take place at ICC London ExCeL from 10-12 March 2011.

With support from government, The Lloyd's Register Educational Trust, the Wellcome Trust, Rolls Royce, BAE Systems, Shell and Siemens, amongst others, The Big Bang will be a three-day educational experience for seven- to nineteen-year olds. As a showcase for innovation and creativity in all its forms, the event will also reward science and engineering engagement and achievement by once again hosting the finals of the high-profile National Science & Engineering Competition.

In 2011, we hope to attract 25,000 visitors to The Big Bang, with an even split between boys and girls. In particular, we hope to attract more over-16s through careers information and activities tailored to meet their needs.

More than simply a great day out, however, The Big Bang aims to deliver ongoing engagement with young people – a "year round conversation" The regional fairs that take place in the English regions, as well as in Northern Ireland, Scotland and Wales, provide an opportunity for young people across the country to experience close to home the excitement and opportunities available through science, technology, engineering and mathematics. In addition, our communications strategy ensures that not only those who attend the fair, but the wider population as a whole, understand that studying science, technology, engineering and mathematics subjects at school, college and university can open up a whole range of exciting and rewarding careers opportunities.

In five years' time, our aim is that 100,000 children and young people each year will experience The Big Bang for themselves at either the national or regional events. Our ultimate vision for The Big Bang is that every child in the UK should know someone involved with it.

Tomorrow's Engineers

In a science, technology, engineering and mathematics (STEM) Curriculum with a largely silent 'E', Tomorrow's Engineers lets young people apply their classroom learning to understanding what engineering is all about and to consider the career opportunities it offers. Tomorrow's Engineers identifies and funds a range of engineering activities provided by approved organisations to specific schools. Careful targeting of these schools means the programme achieves maximum impact. It reaches pupils at schools performing well in subjects that may lead to a career in engineering and where participation in such enhancement and enrichment programmes has traditionally been low. Thorough evaluation makes sure that Tomorrow's Engineers achieves its aims of inspiring young people to learn more about, and indeed aspire to a career in engineering.

In 2011, we will be expanding the number of delivery partners and working with more sponsors to develop locally-tailored activities. The engineering activities provided by Tomorrow's Engineers are underpinned by careers resources that will help young people, their parents and teachers understand the connection between a hands-on engineering activity and a future career opportunity.

We aim to reach 35,000 extra students via Tomorrow's Engineers in 2011, with an extra 100,000 reached annually within five years.

Careers information

EngineeringUK provides a range of on and offline careers resources for young people and those who influence them. In 2011, we will develop our existing offering to further complement, support and build on The Big Bang and Tomorrow's Engineers. In particular, we will:

- Use feedback from our Business and Industry, Professional and Careers Advisory panels to promote continued rationalisation of careers resources for under-16s and their influencers
- Draw on relationships across the engineering community to generate community-wide endorsement and adoption of clear and common careers messages
- Improve links between the Careers Advisory Panel and the Education and Skills Panel, and join up the various activities of the STEM programmes
- Ensure greater integration of careers messages and materials by contributing careers resources, expertise and support from the Careers Advisory Panel to activities such as The Big Bang and Tomorrow's Engineers

Strength in unity

Engineering has a great story to tell and we are working with people across the engineering community to tell it. For instance, we are collaborating with groups such as Engineering the Future and Education for Engineering, as well as reaching multiple stakeholders through our two key programmes: in 2010, The Big Bang involved over 110 organisations from across the science, technology, engineering and mathematics community. We are also able to take full advantage of wider opportunities and increasingly responsive relationships by acting as a unified voice for engineering. For example, we have collaborated on events designed to highlight the role of engineering in the UK economy at the major political party conferences, issued joint responses to consultations and policy announcements, and taken part in the development of a joint Vision for Engineering.

Underpinning activities

All of EngineeringUK's activities are underpinned by thorough research and evaluation. This has helped to establish the organisation with influencers, policy makers and the media as a trusted, authoritative voice for the engineering community. Our communications strategy, which puts the learner and those who influence the learner at its heart, makes sure that we use every appropriate communication channel to reach our audiences.

Research

The culmination of our research programme is *Engineering UK*; an annual report on the state of engineering and the cornerstone of our wider policy output. *Engineering UK* provides a contextual base for our press and public affairs work, looking at supply and demand issues, skills gaps, emerging technologies, diversity, sector-specific trends, and developments in training and education. It is increasingly used by our stakeholders to inform policy decisions and is widely used, quoted and referenced by the media and professional journals.

In addition to the *Engineering UK* report and related briefing papers, we also conduct annual research and analysis into perceptions of engineers and engineering, and carry out detailed evaluation for our core programmes.

Communication

EngineeringUK is all about communication. Our focus is on learners, since we believe that influencing them is the key to influencing the supply of engineers and the future public perception of engineering. We also aim to 'influence the influencers' by addressing those audiences who advise and support young people in their choices, including family members, teachers, careers advisors and policy makers.

In an increasingly complex media landscape, we will combine traditional and new media to reach all of our audiences, with messages tailored to each. For instance, in 2010 we began to exploit digital media to reach a highly digitally-literate audience of young people. In 2011 we will continue our strategy of "fishing where the fish are swimming" for example, by using those online social networks already widely used by young people, to get our messages to them.

Engineering – getting us back on track

At EngineeringUK we believe engineers and engineering are pivotal to the UK economy, and we are encouraged to find that the public thinks so too. Our recent perceptions research showed that 55% of the UK public trust engineers to get the economy back on track. We also believe that working in partnership is the only way to disseminate the engineering agenda as widely as possible. If you feel the same way, please visit www.engineeringuk.com for more information.

Paul Jackson,
Chief Executive
EngineeringUK

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Executive summary

Over the last year, it has become clear just how important a role engineering plays in attempts to rebalance the UK economy.

This report centres on the low carbon economy: the immense economic, social and technological challenges we face in achieving it, and the huge opportunities such an achievement would afford the UK, providing we are able to meet the demands for skilled workers.

Financially, the case for this focus is strong. The global market for low carbon goods and services was worth £3 trillion in 2008 and is projected to reach £4.5 trillion by 2015. The UK low carbon market is already worth more than £100 billion per year and is forecast to grow at a massive 5% annually over the next few years. By 2015, it's expected to exceed £150 billion.

However, the scale of the investment needed to meet UK climate change and renewable energy targets is unprecedented. To replace, upgrade and decarbonise Britain's infrastructure, we'd need £800 billion to £1 trillion of investment by 2030. That's £40 to £50 billion annually. These staggering amounts easily exceed historical averages and are on a scale not seen since reconstruction after the Second World War.

Tackling climate change is still a major challenge and we will only conquer it if we can break the inter-dependency between economic growth and environmental emissions. New technologies look most likely to provide the answer. Advances in the science, engineering and technology sectors will be critical if the UK is to achieve the target set by the 2008 Climate Change Act: that is, an 80% reduction in CO_2 emissions by 2050.

There is a substantial degree of overlap between the engineering and manufacturing sectors – both critical to the UK economy. The engineering sector is proving vital to the UK's economic revival. Accounting for almost one fifth (19.6%) of GDP in March 2009, it was almost three times the size of the financial services sector. Total turnover stood at £848.6 billion and the sector provided jobs for over 4.5 million people across 482,880 different enterprises.

The underlying challenge, however, will be the UK's ability to produce, in particular, its skilled STEM technicians of the future. It is therefore of great concern to see that participation in Further Education for engineering and manufacturing technologies, construction, planning and the built environment and information and communication technologies have all shown a decline over the last five years. This decline has been strongest amongst those aged 19+ (down 43.2%, 41.5% and 69.5% respecitively). The STEM FE data project has also shown that just over 85,000

students studying engineering courses withdrew or transferredin 2008/09. In parallel to the issue of supply, there is an urgent need to up-skill the existing workforce; we have identified that at least 10% of working SET technicians only have a qualification below level 2 where they actually require level 3 or above. However, as funding for a first level 3 qualification currently stops if the potential student is aged 25+ when the course is due to start, this could potentially hinder both the supply of new technicians and the up-skilling of existing workers.

The UK's manufacturing sector is projected to perform better than the overall economy in 2010. EEF, the industry trade body, forecasts growth of 3.8% this year. This compares with forecast growth of 1.1% for the economy as a whole. Manufacturing turned over £502.7 billion in 2008. However, research by the Institute for Employment Research reveals the true challenge. It shows that, between 2007 and 2017, manufacturing will need to recruit 587,000 new workers – approximately one fifth of the 2008 workforce – to replace those who retire or leave for other reasons.

If the UK is to achieve a low carbon economy and maintain an economically vibrant engineering sector, we will need to make sure that enough people with appropriate skills are available and willing to work in it. This will be no small task: by 2018, there will be 12.9% fewer 15- to 19-year-olds than there were in 2008. Consequently, we will need to cast our recruitment net wider to include those young people who currently fail to get a job. In March 2010, over 927,000 16- to 24-year-olds were unemployed, with youth unemployment predicted to break the one million barrier. Additionally, one in ten (10.3%) 16- to 18-year-olds struggle to make the transition from school to further education or employment.

Indeed, OECD data suggests that youth unemployment in the UK tends to be higher than in other comparable countries.

The sector also needs to take further steps to encourage women into engineering careers. The UK has the lowest proportion of female engineering professionals in the EU, at only 8.7%. Between 2005 and 2007, McKinsey studied listed companies across Europe. They found that the companies with the highest level of gender diversity in top management positions outperformed their peers in return on equity (11.4% compared with 10.3%), operating profit (EBIT 11.1% compared with 5.8%) and stock growth (64% compared with 47%).

How important is engineering in the UK?

- The engineering sector makes up nearly a fifth of the UK economy (19.6% of GDP) and employs over 4.5 million people.
- All of our lives and livelihoods depend on energy, so energy security is vital. Britain must be able to count on reliable supplies of energy for electricity, heating and transport, now and in the future. The security, sustainability and affordability of energy can only be delivered via a strong engineering sector.
- The engineering research base, which will help drive technological change, remains healthy within our Higher Education Institutions. In 2009/10, 59% to 71% of research assessed for engineering subject area sub-disciplines was classed as being internationally excellent.

The future of UK engineering within a low carbon economy

- The urgent need to decarbonise the UK's economy, for both climate change and energy security reasons, has given us a once-in-a-generation opportunity. Right across the engineering and manufacturing spectrum, from cars to trains, IT to nanotechnology, building materials to energy infrastructure, the need to cut carbon emissions is driving the development of new technologies and opening up new markets.
- The global market for low carbon goods and services was worth £3 trillion in 2008 and is projected to grow by 50% to just under £4.5 trillion by 2015.
- The UK government is committed to generating 15% of all energy from renewables by 2020. We will need to drastically restructure our national energy portfolio to achieve this transition.
- The Department for Energy and Climate Change estimates that the renewable energy sector alone could create 500,000 new jobs by 2020.
- The UK wind industry alone has the potential to create 60,000 new jobs over the course of the next ten years. This would effectively expand the workforce to well over ten times its current size.

What skills will be needed?

- According to evidence from Sector Skills Councils, for every one new job opportunity (green or otherwise) that comes from economic growth over the next ten years, ten will come from replacement demand. It follows then that the drive to up-skill people for the low carbon economy must focus on in-work training and development.
- The skills demanded by the industry to fulfil the needs of low carbon development are not fundamentally different from the existing skills base. It is the application of those skills that will differ. Indeed, there will be few purely 'renewables' jobs. Rather, engineers will be required to expand their current skills base, which will remain valid and transferable within the green economy. If we don't incorporate these 'renewables' requirements into the UK workforce, these jobs could go to workers from outside the UK.
- Recent work undertaken by ConstructionSkills indicates that, if low carbon measures were adopted rapidly (particularly in the non-domestic sectors), up to 60% of the workforce would have to adapt their skills.
- Working Futures III, a comprehensive set of UK employment projections for the period 2007-2017, predicts that the manufacturing sector will need to recruit an additional 587,000 workers to meet replacement demand as workers retire or leave for other reasons.
- The greatest demand will be for managers and senior officials (165,000), machine and transport workers (109,000), associate professionals and staff in technical occupations (108,000) and for staff in skilled trade occupations (91,000).

Is the UK on course to supply these needs?

- Current projections indicate that we won't meet forecast demand unless we actively develop new recruitment strategies.
- The UK Commission for Employment and Skills (UKCES) identified in its report *World Class Skills and Jobs for the UK* that there are currently 4.6 million people in the UK with no qualifications. This represents one in eight adults of working age.
- At least 10% of those working in specified SET technician careers are qualified to below level 2 or have no formal qualifications, even though their jobs require level 3 or 4 skills.
- When compared with all professional and skilled trades, the engineering sector has a disproportionately large percentage of hard to fill or skills shortage vacancies. In each case, the proportion of vacancies is double the average for all establishments.
- Over the last five years, participation in Further Education for all levels of engineering and manufacturing technologies has fallen by a quarter (25.8%). Within this, the number of over-19s has fallen by a staggering 43.2%, while the number of under-19s has risen by 10.6%.
- There has been a 6.9% increase in the number of students in Higher Education qualifying in engineering and technology over a seven-year period.
- Shortages of skilled and experienced candidates needed for critical roles are hindering the expansion of UK renewables businesses. Skills gaps are considered to be one of the most severe obstacles to growth for individual businesses, alongside connecting to the national grid and gaining planning permission.
- At the time of writing the BIS Skills for Growtrh Strategy was launched which sets out an encouraging vision for reform of the Further Education and skills system.

What are the challenges ahead for UK engineering?

- Replacing, upgrading and decarbonising our infrastructure to meet renewable energy targets is going to need staggering levels of investment. With estimates running at between £800 billion and £1 trillion, funding on this scale has not been seen since reconstruction after World War II.
- Making sure we meet projected demand for new engineers, despite the falling number of young people entering the workforce, is a challenge. It's vital that we provide accessible education pathways into engineering for young people – particularly those in danger of falling into the NEET (not in education, employment or training) category.
- Of all the STEM subjects, engineering and technology has the most unrepresentative gender balance. For the last eight years, the proportion of female applicants has remained at 12%, even though the number of applicants has increased over this time. This imbalance needs to be addressed.
- The gender imbalance in the workplace also needs to be addressed. In 2009, fewer than 13% of new Chartered Engineers were female, and the UK has the lowest percentage of female professional engineers in Europe. This is despite research by McKinsey showing that companies with the highest gender diversity in top management positions outperform their peers in return on equity, operating profit and stock growth.

Perceptions of engineering

- Public perceptions of engineering and engineering's role in tackling climate change are cause for concern. When surveyed, 92% of men and 84% of women said they think engineering plays an important role in tackling climate change. However, when asked what engineering developments of the last 50 years had had a significant impact on their lives, 52% of men and 71% of women couldn't name one.
- People see the challenging nature of engineering as a desirable quality. However, other aspects such as pay, level of interest and enjoyment are likely to be more attractive to those considering it as a career. In fact, pay comes out as the top factor for both men and women.
- In general, people aren't aware of the attractive salaries that can be earned in the engineering sector, and this could be a barrier to recruiting more people into the industry. Specifically, we need to raise awareness of the following facts:
    - Research suggests that as a graduate you could earn around £160,000 more during your working life than someone who went into work after A levels. However, engineering graduates can expect to earn significantly more: estimates suggest £243,730 more over their working life.
    - Analysis of the Annual Survey of Hours and Earnings (ASHE) shows that pay for professional engineers and technicians/craft level engineers is comparable to many other STEM professions. The highest paid in the STEM sector are health professionals, with a mean annual salary of £71,422. Managers in mining and energy come second, with a mean annual salary of £67,153.
    - At £26,291 the mean annual salary for engineering technicians and craftsmen compares favourably with the approximate mean salary for all non-engineering occupations (£22,320) and is higher that the national median salary of £25,800. (This figure was arrived at by analysing the most relevant technician occupational groups from the ASHE data – associate professional and technical occupations, skilled trades occupations and process, plant and machine operatives.)
- Most people feel that they have certain key skills, such as creativity and an ability to communicate well. But they didn't see these as skills needed by engineers – even though they clearly are.
- To make engineering more accessible and attractive to women, we need to better communicate the creative and people-centred aspects of engineering. There also needs to be better access to female role models.

Engineering UK 2011
Conclusions

The Engineering and Manufacturing sectors find themselves in a precarious position. On the one hand they are seen as potential saviours of the drive to a Low Carbon Economy and on the other will undoubtedly come under increasing fiscal pressure as the government strives to rebalance our fragile economy.

The Climate Change Act of 2008 has set the challenging target of reducing UK CO_2 emissions by 80% (against 1990 levels) by 2050. The scale of the investment required to meet UK climate change and renewable energy targets is unprecedented with £800 billion to £1 trillion required by 2030 to replace, upgrade and decarbonise Britain's infrastructure. However the economic rewards for decarbonising the economy are considerable. The global market for low carbon goods and services was worth £3 trillion in 2008 and is projected to reach £4.5 trillion by 2015. The UK low carbon market is already worth more than £100 billion per year and is forecast to grow at a massive 5% per year over the next few years.

There is a clear need to improve the supply of technicians and engineering professional and having identified that at least 10% of working SET technicians only have a qualification below level 2 for the upskilling of the existing workforce to at least level 3. Over the period 2007-2017, it is predicted that the manufacturing sector will need to recruit an additional 587,000 workers in order to meet replacement demand and, with only 67% of the c 20,000 engineering graduates leaving university entering engineering related jobs, we undoubtedly face an uphill struggle. Indeed, the burgeoning renewable energy sector already faces recruitment issues where skills shortages are already slowing growth in the wind industry.

The projected future demand for new workers in the manufacturing sector, coupled with a declining cohort of young people entering the workforce and an ageing population, makes it imperative that we cast our net widely and ensure that all young people, including those in danger of becoming NEET (not in education, employment or training), have the opportunities and accessible pathways to follow engineering learning paths. In March 2010 over 927,000 16–24 year olds were unemployed, with youth unemployment expected to exceed 1,000,000 in 2010. In this regard, we have seen through our own Engineers and Engineering Brand monitor the key importance and value of providing robust careers information to young people and their influencers, and that targeted enrichment and enhancement activities can improve their perceptions as well as their desire to work in Engineering.

We also need to remain cognisant of the fact that female engineers are still underrepresented in the sector with only 12% of newly registered chartered engineers, in 2009, being female. Furthermore the UK has the lowest proportion of female 'engineering professionals' (at 8.7%) in the EU. This situation is clearly at odds with McKinsey study of European listed companies, which revealed clear economic rewards: those with the highest level of gender diversity in top management positions outperforming their peers in terms of return on equity (11.4 per cent compared to 10.3 per cent), operating profit (EBIT 11.1 per cent compared to 5.8 per cent) and stock price growth (64 per cent compared to 47 per cent between 2005 and 2007).

Part 1 Engineering in Context

1.0 Engineering: the Saviour

Since the last edition of Engineering UK was published in December 2009, we are seeing the green shoots of recovery. The UK's manufacturing sector performed better than expected in the first half of the year. Industry trade body, the EEF, predicts that manufacturing will outstrip the rest of the economy in 2010, in terms of growth: it forecasts 3.8% growth in manufacturing[1] compared with 1.1% for the economy as a whole.

The new government has sprinted off the line, holding aloft the 'Big Society' banner. This drive for empowering communities, redistributing power and fostering a culture of volunteerism has set the political context for all future economic and social decisions.

We also face, following the deep financial recession, a new government set on fervently cutting public spending and reforming public services to reduce the national debt. As a result, numerous quangos are likely to be slashed.

Thankfully, there remains a firm recognition of and commitment to the science, technology, engineering and mathematics (STEM) community. Familiar themes are emerging (albeit under new names) which reflect the importance of rebalancing the economy and mirror the central tenets of the previous government's 'New Industry New Jobs' initiative and its industrial activism agenda.

The goal of rebalancing the economy (through investment in STEM skills, R&D and advanced manufacturing) is unlikely to sit easily with the drive to reduce public debt. And both these ambitions pale in comparison to the real global challenge: the need to tackle climate change. The UK is already committed to the challenging target of reducing CO_2 emissions by 80% (against 1990 levels) by 2050.

We believe that the targets set out in The Climate Change Act (2008) will only be achieved thanks to the activities and advances of the science, engineering and technology (SET) sector. This must be underpinned by a strong UK science and engineering base and the supply of talented individuals ready to take these 'grand challenges' and help to make the world a better place.

The economic rewards are also there. The global market[2] for low carbon goods and services was worth £3 trillion in 2008 and is projected to reach £4.5 trillion by 2015. The UK low carbon market is already worth more than £100 billion per year and is forecast to grow at a massive 5% per year over the next few years to exceed £150 billion by 2015.

1 http://www.bbc.co.uk/news/business-10834901

2 *Under the Microscope – Is UK plc ready for Low Carbon?* EEF, November 2009

On its 350th anniversary, The Royal Society prophetically stated: "This will not only be a century of biology. It will be a century of mathematics, chemistry, physics and engineering too"[3] It will be a century in which advances at the frontiers of multiple disciplines will transform the way we live, create new industries and jobs, and enable us to tackle seemingly intractable social and environmental problems. But this vision comes with a warning. To achieve it, we need to place science and innovation at the heart of the UK's long-term strategy for economic growth. And we need to be aware of the fierce competitive challenge we face from countries which are investing at a scale and speed that we may struggle to match.

This clear and present danger is evidenced by the Council for Science and Technology's report, *A Vision for UK Research*,[4] which neatly depicts the sheer size of India and China's current investment in R&D. They also point out that, whilst India and China are experiencing very high growth in research capability, this has not yet achieved the scale of the G8 competitors; currently, the competition from them comes more in engineering than science.

If that wasn't enough cause for action, then consider that South Korea spends $30 billion on low carbon. This is over 80% of the three-year $38 billion economic stimulus package it deployed in response to the global downturn.[5]

The low carbon agenda (and specifically the emerging technologies it encompasses) provides perhaps the only real way to effectively decouple economic growth and environmental emissions; two factors that have been inextricably linked since the Industrial Revolution.

However, it's not just the economic imperative driving the low carbon/climate change agenda. The Organisation for Economic Co-operation and Development (OECD) reported in 2008[6] that water shortages and lack of sanitation adversely affect an important part of the world's population. Out of approximately 6.5 billion people on earth, 1.1 billion do not have access to potable water and 2.6 billion people do not have access to improved sanitation. By 2030, the number of people living under severe water stress is expected to increase by more than 1 billion to 3.9 billion – nearly half the projected world population.

Finally, the size of this challenge has to be set against the future competition for skills. Working Futures III (WFIII) is a comprehensive set of UK employment projections for the period 2007-2017. Over this 10-year period, it is predicted that the manufacturing sector will need to recruit an additional 587,000 workers to replace workers who retire or leave the industry for other reasons. Detailed analysis shows that the greatest demand for new workers will be for managers and senior officials (165,000), machine and transport workers (109,000), associate professionals and technical occupations (108,000) and those in skilled trade occupations (91,000).

> "Consumer purchasing decisions are the ultimate driver of carbon emissions in an economy. All carbon emissions can be attributed to the delivery of products and services to meet the needs of the consumer."
>
> The carbon emissions generated in all that we consume, Carbon Trust, January 2006

3 The Scientific Century: securing our future prosperity, RS Policy document 02/10, Issued: March 2010

4 *A Vision for UK Research*, CST, p15-18, March 2010

5 *Building a Green Recovery*, HSBC, May 2009

6 OECD, 2009, OECD, 2008a

Part 1 Engineering in Context
2.0 Engineering the low carbon economy

2.1 Climate change UK commitments

The seminal Stern Review[7] on the economics of climate change concluded, "the scientific evidence is now overwhelming: climate change exists and presents very serious global risks which demand an urgent global response."

The Copenhagen Accord[8] provided a commitment to limit the increase in global average temperature to no more than 2°C. More than 70 countries, accounting for over 80% of global emissions, have submitted emissions reduction targets and actions.

Reducing UK emissions by at least 80%, together with appropriate efforts by other countries, will put the world on a long-term path aimed at limiting global temperatures to around 2°C above pre-industrial levels.

The Climate Change Act 2008[9] has committed the UK to reducing emissions of greenhouse gases by at least 80% by 2050, as a fair contribution to a global action on climate change. The UK should reduce emissions of greenhouse gases by 34% by 2020. Once a global deal is reached, the target should increase to 42% by 2020. Furthermore, the UK government's target is to produce 15% of the UK's energy from renewables by 2020, which is an almost ten-fold increase from 2008.

7 *The Stern Review on the Economics of Climate Change*, published October 2006

8 Copenhagen UN Climate Change Conference 2009

9 http://www.theccc.org.uk/carbon-budgets/

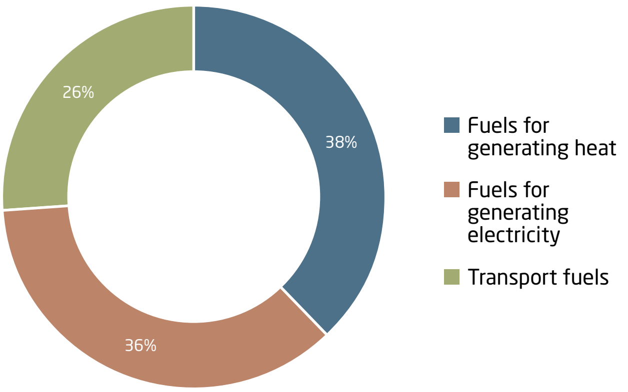
2.2 Energy security for a low carbon economy

All of our lives and livelihoods depend on energy.[10] Britain must be able to count on reliable supplies of energy for electricity, heating and transport, now and in the future. In short, the security, sustainability and affordability of energy is paramount.

In 2008, Britain's total demand for energy was equivalent to one and a half billion barrels of oil.[11] As Figure 2.0 shows, 36% of this total was used to produce electricity. Another 38% was used to produce heat: for heating homes and other buildings, for hot water and cooking and for various industrial processes.[12] The remaining 26% was used in the form of transport fuels.[13]

Governments across the globe, including the UK, now recognise the importance of improving the security of future sources of energy. Key threats to energy security include: the political instability of several energy producing countries; the potential for manipulation of energy supplies; competition over energy sources; attacks on supply infrastructure; and accidents and natural disasters.

Fig. 2.0: What do we use energy for?



10 *Rebuilding Security – Conservative Energy Policy for an Uncertain World*, 19th March 2010. http://www.conservatives.com/News/News_stories/2010/03/Conservatives_propose_radical_overhaul_of_Britains_energy_policy.aspx11

11 Department of Energy and Climate Change, *Digest of United Kingdom energy statistics 2009*, p27, table 1.1

12 Not including electrical heating

13 Department of Energy and Climate Change, *Digest of United Kingdom energy statistics 2009*, p27, table 1.1

2.3 Renewables[14]

The urgent need to decarbonise the UK's economy for both climate change and energy security reasons has given the UK a once-in-a-generation opportunity. Right across the manufacturing spectrum, from cars to trains, IT to nanotechnology, building materials to energy infrastructure, the need to cut carbon emissions is driving the development of new technologies and opening up new markets.[15]

Britain has some of the best renewable energy resources in Europe, which could allow us to offset the depletion of our fossil fuel resources and diversify away from total dependency on gas-fired generation. But while countries like Germany have more than doubled the share of their energy that comes from renewables since the mid-nineties, the UK remains third from bottom of the table of EU renewable energy use – above only Luxembourg and Malta.[16] Britain is bound by an EU commitment to source 15% of its energy from renewable sources by 2020: currently, the total is just 2.5%.[17]

Nuclear power has long been Britain's most significant source of low carbon energy. In 1979, nuclear provided 12% of our electricity and by 1997 that proportion had more than doubled to 26%.[18] That, however, was the high point. From 1997 to the present day, the nuclear share of the generating mix halved to 13%[19] – and will continue to fall as all but one of our nuclear power stations retire by 2023.

The depletion of our North Sea Gas reserves means that this trend is set to continue. For instance, National Grid's base case prediction (Figure 2.1) is that imports will account for 70% of UK gas demand by 2018 – up from 1% in 2000, and 40% in 2008.[20]

14 More detail on renewable energy can be found in section 27.3

15 *Rebirth of UK Manufacturing – An Opportunity for a World Class Industry*, RenewableUK, March 2010

16 Mike O'Brien, Commons Hansard, 8 June 2009, column 727W; Department of Energy and Climate Change, Energy Trends, June 2009

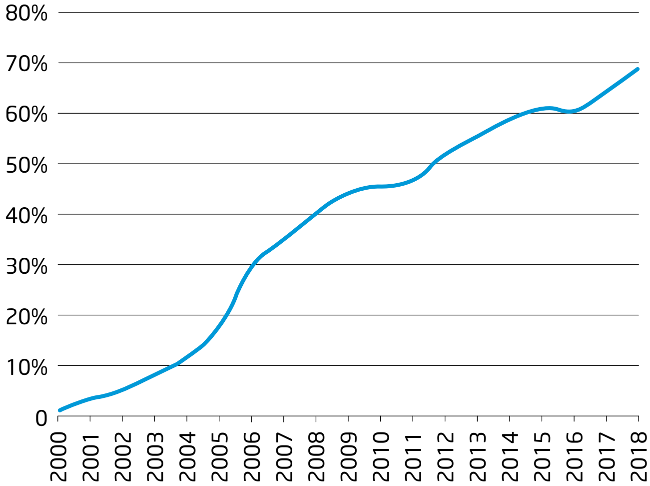
17 ibid

18 Department of Energy and Climate Change, *Digest of United Kingdom Energy Statistics 2009*: Long-term trends, table 5.1.3

19 ibid

20 National Grid, *Gas transportation: Ten year statement 2009*, December 2009, page 77, chart 4.8G

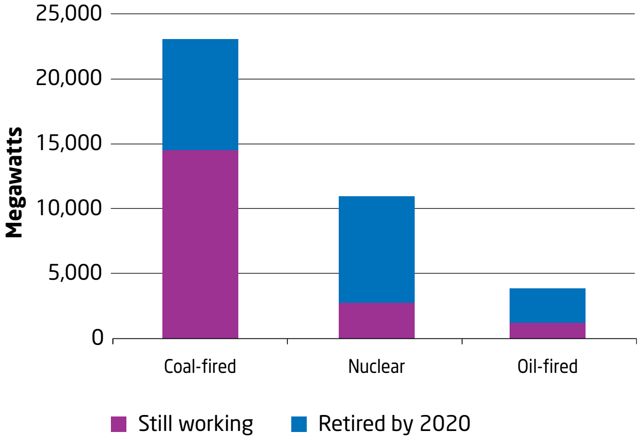
Fig. 2.1: Imported proportion of UK gas supplies



Source: National Grid gas transportation ten year statement 2009

Much of our fossil fuel and nuclear generating capacity is approaching the end of its working life. In the case of coal-fired and oil-fired power stations, the process of retirement has been hastened by the pollution control standards required by the EU Large Combustion Plant Directive. By 2020, at least a third of our coal-fired capacity and two-thirds of our oil-fired capacity – along with nearly three-quarters of our nuclear capacity – is due to have closed down.[21]

Fig. 2.2: 2008 generating capacity in 2020



Source: BERR, Energy white paper 2007

By 2025, there will be further coal plant closures and just one of our existing nuclear power stations will still be working.[22]

21 Department for Trade and Industry, *Meeting the energy challenge: A white paper on energy*, May 2007, page 129; Commons Hansard, 16 March 2009, column 942W

22 ibid

2.4 Renewable investment requirements

The scale of the investment required to meet UK climate change and renewable energy targets is unprecedented. The report[23] by the Green Investment Bank Commission highlighted estimates of investment required reaching £550 billion between now and 2020.[24]

£800 billion to £1 trillion of investment is needed by 2030 to replace, upgrade and decarbonise Britain's infrastructure.[25] This £40 to £50 billion annual requirement substantially exceeds the historical average and is on a scale not seen since reconstruction after the Second World War.[26]

This investment need is the consequence of decades of underinvestment (especially in energy, but also in energy security and technological change) and is driven by the imperative to create a low carbon economy. The transition must be achieved rapidly if the UK is to meet its legally binding target of reducing greenhouse gas emissions by 20% relative to 1990 levels by 2020 and by 80% by 2050.

Substantial increases in investment are required across most infrastructures, but some sectors will require more dramatic increases than others. In the energy sector, for example, the next five years requires investment at double the rate of the previous five years.[27] Meeting the UK's energy policy commitments alone will take over £200 billion between now and 2020.[28] In contrast, only £11 billion was invested in Britain's 'dash for gas' during the 1990s, which was considered transformational at the time. [29]

Whilst investment is crucial, as discussed in last year's report,[30] there are opportunities for innovative companies to make major savings on resources used in manufacturing. On average, over 90% of the materials used in production are not included in the final product. Companies spend up to 5% of their annual turnover on waste, including unused materials, defects, energy and water. Engineering solutions to these problems could potentially generate a share of £6.4 billion a year in savings by enabling organisations to use resources more efficiently.

23 *Unlocking investment to deliver Britain's low carbon future*, Report by the Green Investment Bank Commission, June 2010

24 Helm, D, Wardlaw, J & Caldecott, B, 2009, *Delivering a 21st Century Infrastructure for Britain*, Policy Exchange; Holmes, I & Mabey, N, 2010

25 Infrastructure UK, 2010, *Strategy for National Infrastructure*

26 Ibid

27 Ibid

28 Helm, D, Wardlaw, J & Caldecott, B, 2009, *Delivering a 21st Century Infrastructure for Britain*, Policy Exchange (£264 billion by 2025); E3G (excluding energy efficiency, transport investments)

29 Climate Change Capital analysis

30 EngineeringUK 2009/10 p23

2.5 Fervent agreement: concerted action

Words are cheap, as the old adage goes and numerous reports demonstrate. However, there are many challenges on the path to a low carbon economy – not least, the necessary technological advances. Fortunately, a great many experts and bodies are in fervent agreement as to the challenges the UK science, engineering and technology sectors face.

The Climate Change Committee (CCC) recommended[31] that the UK should focus on the development and deployment of at least six technologies:

1. Offshore wind – Likely to be the least costly route to decarbonising the power sector and meeting the UK's 2020 15% renewable energy target. The UK needs 13GW of offshore wind capacity to be developed, at a cost of up to £50 million per annum in funding for Research, Development & Demonstration (RD&D).

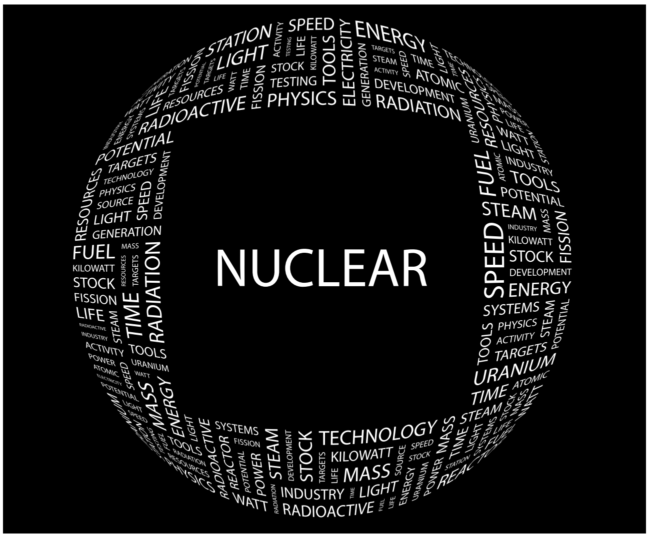
2. Marine (wave and tidal) – The UK has the potential to be a world leader in this area and has significant natural resources, with an estimated potential of 65GW per year. UK-based companies have world-leading expertise in marine engineering and design.

3. Carbon capture and storage (CCS) – Technology to remove carbon from coal and gas powered generation will be crucial in meeting the target. The UK is strong on sub-surface evaluation and geotechnical engineering because of the North Sea oil and gas developments.

4. Smart grids and meters – The UK has research expertise and industrial capabilities in key smart grid technologies, including electrical machinery, power electronics and communications.

5. Electric vehicles – The UK has the expertise to design and build electric cars. Funding needs to be protected for the purchase of electric cars (£230m) and to support the development of a national battery charging network (£30m). Investment of up to £800 million will be needed to meet the CCC's target of 1.7 million electric cars on the road by 2020.

6. Aviation – UK-based companies are globally competitive in design and manufacture of advanced wings and aeroengines. Public support for radical technologies (eg blended wing) will be necessary to achieve UK targets.



The CCC also proposed that the UK should deploy nuclear power, advanced insulation technologies, carbon capture and storage (CCS) for industry, and heat pumps. The UK should invest in research and development of hydrogen fuel-cell vehicles, technologies in agriculture and industry, 3rd generation solar photo-voltaic (PV) technologies, electricity storage and advanced bio-fuels.

The 2009 government report, *The UK Low Carbon Industrial Strategy,*[32] identified 11 national priority areas where evidence pointed to the greatest economic opportunity for the UK. These were:

- Offshore wind power
- Wave and tidal power
- Civil nuclear power
- Carbon capture and storage
- Ultra-low carbon vehicles
- Low carbon buildings and construction
- Low carbon aerospace
- Chemicals and industrial biotechnology
- Low carbon electronics, and information and communications technology
- Business and financial services
- Carbon markets

31 http://www.theccc.org.uk/reports/low-carbon-innovation

32 The UK Low Carbon Industrial Strategy, HM Government, 2009. http://www.berr.gov.uk/files/file52002.pdf

The Energy Technologies Institute[33] – which was created via an announcement in the March 2006 Budget – has identified similar energy challenges in its 2010 portfolio:[34]

- Wind: offshore-specific system design and engineering
- Marine: tidal stream and wave
- Distributed energy (DE) Combined heat and power (CHP), demand management, efficiency
- Buildings retrofit of new technologies and systems
- Energy storage and distribution infrastructure, heat and energy storage, fault management, smart networks
- CCS, storage modelling, capture technologies, network design
- Transport: electric vehicle infrastructure, heavy duty vehicle efficiency
- BioEnergy
- Soil chemistry and agronomy, value chains, energy conversion
- Energy systems modelling (ESM)

Funded via several government departments, the Carbon Trust,[35] a not-for-profit company, was established in 2001 in order to provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. Latterly, it helps address the challenges that exist as a result of the 2008 Climate Change Act.

Other bodies that are in fervent agreement include the Committee for Science and Technology,[36] who identified six key technology areas: carbon capture and storage; disaster mitigation technologies; low carbon distribution networks for electricity generation; medical devices; e-health; and plastic electronics. Also in agreement is the Technology Strategy Board,[37] with its 2008-2011 budget of £711 million, plus aligned funding from the Regional Development Agencies of £180 million and at least £120 million from the Research Councils. It has also identified six key technology areas: high value manufacturing; advanced materials; nanotechnology; bioscience; electronics, photonics and electrical systems; and information and communication technology.

What is needed now is speedy and concerted action by all parties, underpinned by pragmatic UK government support. However, in the current climate, the need to invest for the future sits uneasily with the need to reduce the UK deficit.

33 http://www.energytechnologies.co.uk/Home.aspx

34 http://www.energytechnologies.co.uk/Uploads/RelatedDocsThumbnails/eti-brief-july-2010.pdf

35 http://www.carbontrust.co.uk

36 http://www.cst.gov.uk/reports/files/vision-report.pdf

37 http://www.innovateuk.org/ourstrategy.ashx

2.6 Low carbon skills and jobs

The low carbon economy will spawn opportunities for wealth creation around the world. For example, the drive to a sustainable, low carbon economy in China could generate 40 million new jobs, against 10 million lost jobs in energy-intensive activities.[38] Closer to home, the Department for Energy and Climate Change (DECC) estimates that 500,000 new jobs could be created by 2020 in the UK by the renewable energy sector alone.[39]

But these opportunities can only be capitalised on if an appropriately skilled workforce is available to support them. The coalition government is certainly focused on education. Its manifesto[40] highlights the critical role of schools, colleges (section 26 of its report) and universities (section 31 of its report). One of its first acts was to pass The Academies Bill. This allows schools in England to opt out of local authority control, encourages parents to set up their own free schools and enables the establishment of University Technical Colleges (UTCs)[41] in key city areas, to boost technical and vocational education. There is continued support for apprenticeships and more broadly vocational pathways, coupled with a drive for localism. The government has also delayed the research excellence framework (REF) in Higher Education until its impact can be thoroughly reviewed.

However, it should be clearly noted that the skills currently needed to support the low carbon economy are not fundamentally different from those currently needed within the engineering and advanced manufacturing sectors. Rather, existing core skills will need to be applied to new situations and new products and services; in the main, there will not be new green jobs but a greening and up-skilling of existing jobs and industrial sectors. This is just as well when one considers that 70% of the UK's 2020 workforce is already in employment.[42] The abolition of the fixed retirement date from October 2011 appears to be primarily a cost saving move. Nevertheless, it could provide (as yet undetermined) positive benefits, by reducing the need for employers to meet replacement demand.

Clearly, the UK will have to foster a skilled workforce for its own needs, as well as providing wider expertise on the educational, skills, employment and technological challenges that will be met in achieving a low carbon economy. Part 2 of this report, *Engineering in Education and Training*, and Part 3, *Engineering in Employment*, provide detailed analyses of how the UK is currently set up to meet these needs.

2.7 Public perceptions of climate change

Our own primary research[43] into perceptions of climate change published in July 2010 highlighted some areas for concern. Nearly two thirds (65%) of female respondents believe climate change to be a major problem, compared with just over half (59%) of men. There was also a clear pattern when looking at perceptions of climate change by age, with older respondents being less likely than their younger counterparts to see climate change as a major problem (Table 2.0).

Separately, in support of informed debate, the Government Office for Science[44] (Go-Science) has set-up a web site that compiles key findings on climate change from current literature.

38 *Low-carbon Jobs in an Interconnected World: Interim Findings*, Global Climate Network, 2009

39 The UK Renewable Energy Strategy, Department for Energy and Climate Change, 2009

40 http://www.cabinetoffice.gov.uk/media/409088/pfg_coalition.pdf

41 http://www.utcolleges.org/

42 *Prosperity for all in the Global Economy – World Class Skills*, Leitch review of Skills, HM Treasury, 2006

43 Summary and Full data tables available at: http://www.engineeringuk.com/what_we_do/research/briefing_papers.cfm

44 http://www.bis.gov.uk/go-science/climatescience

Table 2.0: Do you believe that climate change is a major problem?

	Gender %			Age %						
	Total	**Male**	**Female**	**16-17**	**18-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65+**
Yes	62	59	65	79	69	69	64	61	58	53
No	38	41	35	21	31	31	36	39	42	47

Base: All respondents (2099)

Amongst those who thought climate change was a problem, there was a high level of belief (88%) that engineers had a role in tackling it, as shown in Table 2.1. Men (92%) were more likely to say that engineers had a role to play than women (84%). Those aged 35-44 were the most likely to say that engineers had an important role to play.

This recognition of the role of engineers in tackling climate change is very welcome news. However, when asked which engineering developments of the last 50 years have had the greatest impact on them (Table 2.2), 62% of respondents either didn't know or couldn't name an engineering development. Women were more likely than men to be unable to name an engineering development which has had an impact on their lives, at 71% compared with 52%.

Table 2.1: Do you believe that engineers have a role to play in tackling climate change?

	Gender %			Age %						
	Total	**Male**	**Female**	**16-17**	**18-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65+**
Yes	88	92	84	81	84	87	92	88	88	88
No	12	8	16	19	16	13	8	12	12	12

Base: Believe climate change to be a major problem (1307)

Table 2.2: What engineering development of the last 50 years has had the greatest impact on you?

	Gender %			Age %						
	Total	**Male**	**Female**	**16-17**	**18-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65+**
None have had any impact on me	19	18	19	16	23	20	17	16	22	16
Don't know	43	34	52	52	50	49	49	48	35	30

Base: All respondents (2099)

Since the role of the individual is likely to be an important factor in tackling climate change (as highlighted in the CBI,[45 46] Climate Change Board's report *Everyone's business*), this apparent disconnect between the perceived importance of engineering but the inability to identify any engineering achievements could be very significant.

The importance of our homes in tackling climate change was acknowledged in the government's *Building A Greener Future: Policy Statement*[47] (July 2007), which stated that all new homes should be zero carbon from 2016. This commitment was taken further in the 2008 Budget, with the announcement that all new non-domestic buildings should be zero carbon[48] from 2019 (with earlier targets for schools and other public buildings).

45 http://climatechange.cbi.org.uk/

46 CBI Climate Change Board. *Climate Change is Everyone's Business*, February 2010

47 http://www.communities.gov.uk/planningandbuilding/theenvironment/zerocarbonhomes/

48 http://www.communities.gov.uk/planningandbuilding/theenvironment/zerocarbonhomes/

Encouraging consumers to reduce their domestic carbon footprint is a positive strategy. However, we need to be aware that if people save money by insulating their homes and so on, they might spend the money they've saved on more goods and services – and actually increase their carbon footprint. Therefore, it's critical that we harness technological innovation to strive to decouple carbon production from the production of goods and services.

A final indicator of the scale of the challenge to win hearts and minds comes from the Ipsos Mori Issues Index, 2009.[49] This shows that the environment is not a top-of-mind issue for most people. Just 5% mentioned it spontaneously as one of the most important issues facing Britain, down from a peak of 19% in January 2007, before the recession.

49 *Public Attitudes to Science 2011: A Review of Existing Literature and Evidence*, p12, Ipsos MORI, August 2010

Part 1 Engineering in Context
3.0 Making low carbon pay

This section was authored by Roger Salomone, EEF Energy Adviser, EEF

The opportunity

The market for low carbon goods and services is a major opportunity for UK industry. Manufacturing accounts for a significant share of a sector which is growing rapidly, both domestically and internationally.

The UK market is already worth more than £100 billion and is forecast to grow at 5% a year – much faster than the rest of the economy. Manufacturing accounts for a disproportionate share of this sector: 30% compared with less than 15% in the wider economy. Amongst some of the fastest growing areas the share is higher still – 40% in renewable energy, for example.

Exports provide the greatest opportunity of all. The global market for low carbon goods and services was worth in excess of £3 trillion in 2008 and is projected to grow 50% to just under £4.5 trillion by 2015.

Government has a crucial role to play in facilitating the development of the sector. We are not alone in our aspiration to profit from the transition to a low carbon economy and the fast-growing industries it is generating. Countries around the world are devoting significant resources to establishing home-grown industries and actively courting inward investment.

Most important is creating the right framework of financial incentives. Leadership is needed in two areas – stimulating demand and encouraging investment. The tax system needs to be used to encourage the types of investments on which low carbon industries depend.

Stimulating demand

Financial incentives to encourage the consumption of more climate-friendly products helps create early markets that companies can exploit and use to grow their businesses. A range of domestic and European policies – from energy taxation and emissions trading to grants for low carbon cars and subsidies for renewable energy – have been developed to this end.

However, there remains considerable scope for improvement in the consistency, stability and predictability of the price signals these policies create. In particular, energy taxation needs to be based on a clear and consistent carbon price. At present, the UK's Climate Change Levy taxes fuels at different and inconsistent rates unrelated to the emissions they produce.

Stimulating demand is necessary but not sufficient to encourage the development of low carbon industries in the UK. Any government interested in promoting the production, as well as consumption, of low carbon technologies must also create an attractive business environment for companies developing those technologies.

Products can quite easily be developed and manufactured in one country and supplied to another. The wind energy industry provides an unfortunate example. Despite having some of the most generous wind energy subsidies, the wind turbines now being deployed at an increasingly rapid rate in the UK are mainly manufactured in Germany and Denmark.

Encouraging investment

Alongside a strong supply of core skills, getting business tax right is vital to encouraging low carbon industries. Modern manufacturing, especially in emerging industries like the low carbon sector, depends on activities sensitive to taxation – capital investment and innovation. Companies add value, create wealth and stay competitive by regularly investing in state-of-the-art machinery, product design and R&D.

Unfortunately, the UK corporate tax system fails to recognise the nature and importance of capital investment in modern manufacturing and has been moving in the wrong direction. Capital allowances for investment in machinery and equipment were cut from 25% to 20% by the previous government and the new government has announced that they fall again to 18% from 2012. At the same time, the Industrial Buildings Allowance, a tax allowance for the cost of building new industrial facilities, will be phased-out in 2011.

This means the cost of investing in new equipment and constructing industrial facilities in the UK is rising at a time when the quickening pace of technological change renders existing machinery, equipment and plant obsolete faster. Manufacturers typically replace their machinery and equipment every seven to eight years. Yet the effective rate of depreciation attributed to capital investments by the tax system means that companies are only able to recoup their costs after thirty years or more.

For early-stage companies developing low carbon technologies, the issue is a different one. Traditional measures of tax competitiveness, such as the level of corporation tax and allowances for business critical activities, are often less relevant. Pre-revenue companies who have yet to commercialise their technologies, let alone generate a profit, are not eligible for corporation tax and hence allowances which can be offset against it are less significant.

Creative policies are needed to overcome this issue. For example, under the current system, loss-making companies can build up an allowance equivalent to their accumulated losses to offset against future corporation tax liabilities when they become profitable. Allowing these companies to monetise the value of the future allowance generated by their losses, by selling bonds to investors, would provide them with a source of finance when they most need it.

Joined-up policy needed

Despite encouraging progress and strong foundations to build on, the UK remains a long way from being the best country in the world for manufacturers of low-carbon technology. However, through a combination of more strategic and better joined-up thinking from government and active engagement from industry, the UK could yet position itself as the premier location for the low carbon industrial revolution.

Part 1 Engineering in Context
4.0 UK engineering research and innovation

"The Department's central task, and my central task, is making sure that Britain is a place where enterprise and innovation are made easier and can succeed. Where ideas are generated and turned into jobs. Where people have the skills we need."

Vince Cable, Secretary of State for Business, Innovation and Skills, 3rd June 2010, Cass Business School Speech.

4.1 A proud history

"Companies need other reasons to locate in the UK, whether it is the strength of our science base, the quality of our people, our approach to innovation or government support." Sir John Rose, Speech at RSA, 2009

The UK has a long history of research excellence – UK researchers and institutions have won over 70 Nobel Prizes for their achievements. Each year, the UK produces over 15,000 PhD graduates, over 100,000 Masters, and over 300,000 first degree graduates.

However, as share speculators will know all too well, past performance is no indicator of future performance.

As a consequence, the UK must view R&D as an investment – but one that is driven by people and which will help drive economic and social prosperity for UK and address the grand challenges of climate change, clean water and ageing populations. We only need to lift our eyes above the horizon to see that global competition is a real and current threat.

4.2 Engineering research on the world stage

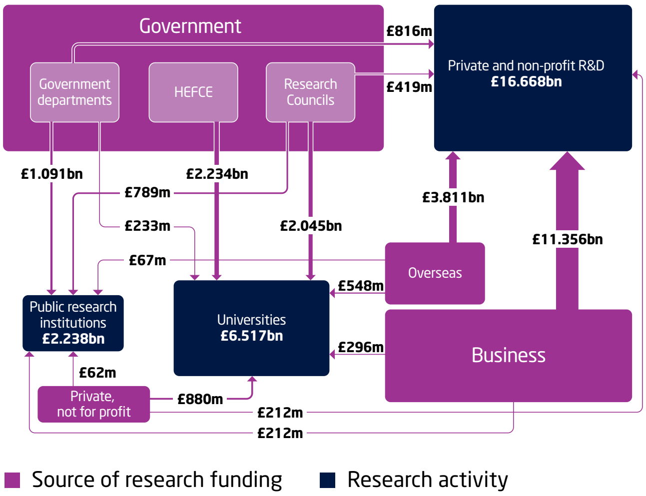
4.2.1 Research Assessment Exercise (RAE)

In Engineering UK 2009/10, our analysis[50] of the state of engineering R&D within UK HE institutions, as assessed by the 2008 Research Assessment Exercise (RAE), found it to be in excellent shape. The engineering research base, which will help drive technological change, was seen to be thriving within our Higher Education institutions. Within the engineering subject area, 59% to 71% of research assessed for the sub-disciplines was classed as being internationally excellent.

In the intervening period, proposals have been put into place to replace the RAE with the Research Excellence Framework (REF), which, it is proposed, will add impact metrics with a weighting of 25%. This has caused so much debate within the STEM community that, in July 2010, David Willetts announced a one-year delay to the REF for further Higher Education Funding Council for England (HEFCE) pilot evaluations to be undertaken. We will watch this space with interest.

The RAE, whilst fundamentally important, is not the only source of R&D funding. Figure 4.0, reproduced from the Royal Society report *The Scientific Century: securing our future prosperity*[51] adeptly helps to put the various UK science funding streams into context.

Fig. 4.0: Flows of funding in UK science[52]



Source: BIS science, engineering and technology statistics Nov 2009

4.2.2 Engineering's share of world citations

The ability to judge a nation's scientific standing is vital for the UK government and businesses if it is to be able to determine scientific priorities and funding. May[53] established the ground breaking citation analysis of published research papers and their reviews in order to draw international comparisons of countries' scientific impact and strengths.

Accordingly, this section draws on evidence from the most recent substantial analyses in the international comparative study carried out in July 2009[54] by the Department of Innovation, Universities and Skills (DIUS). This report allows the comparison of engineering research at an international level[55] and thereby provides comment on the state of the UK engineering research base in a few key areas.

By studying the share of world citations to engineering papers (Figure 4.1) and the total citations to engineering papers (Table 4.0), we can see that within the G8, the UK has sustained its position: it remains second in volume of engineering papers (behind the USA, which is not shown on the figure), with a 7.7% share. The past decade has seen a sustained growth for China, which has moved ahead of all the G8 countries apart from the USA and is also in the top three for mathematics and physical sciences.

50 *EngineeringUK 2009/10*, p31-31

51 The Scientific Century: securing our future prosperity, RS Policy document 02/10, March 2010, DES1768

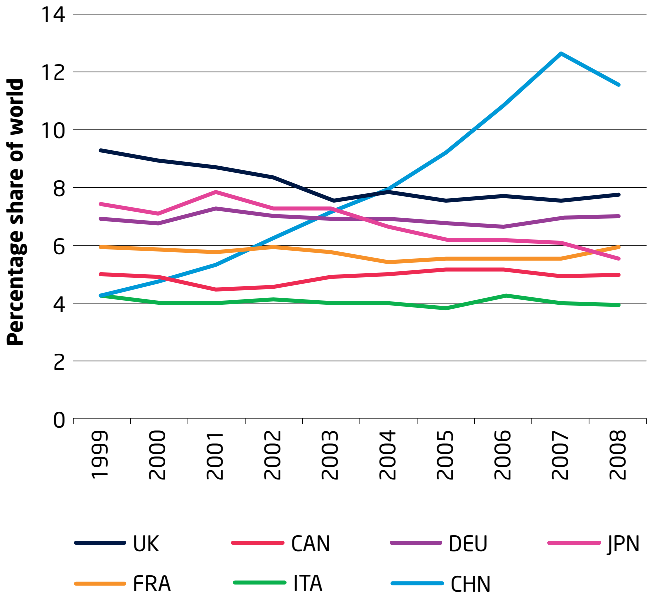
52 This diagram disaggregates familiar statistics on science budgets in order to represent different funding streams in public, private and charity science. Source: Department for Business, Innovation and Skills series, Science, Engineering and Technology statistics, release date November 2009. All figures are for 2007, and are estimates derived from National Statistics surveys of government and business R&D expenditure, adjusted with reference to National Statistics First Release Gross Domestic Expenditure on Research and Development 2007 (March 2008). Gross expenditure on R&D is classified using OECD definitions, so estimates may differ from other accounts. Figures shown exclude expenditure on overseas R&D (£1.95bn) and universities' own expenditure on research (£308m). 'Public research institutions' includes government research laboratories and Research Council laboratories.

53 May, R.M. Science 275, 793–796 (1997)

54 DIUS, *International Comparative Performance of the UK Research Base*, September 2009

55 King, D.A. *Nature 430*, 311 – 316 (2004) – highlighted that citation analyses must not be used to compare different disciplines. However, comparing one discipline across different countries is easier than comparing two different disciplines within one country.

Fig. 4.1: Total citations to engineering papers



Data: Thomson Reuters. Analysis: Evidence

Table 4.0: Share of world citations to engineering papers

	Recent average (2003-2007)	Current value (2008)	Current relative to Recent
Citations to UK papers	52,550	3,941	-
Group average citations	30,039	2,256	-
UK / Group average	1.75	1.75	-0%
UK rank within Group	3	3	↔
UK rank within G8	2	2	↔
UK share of world	7.6	7.7	+1%

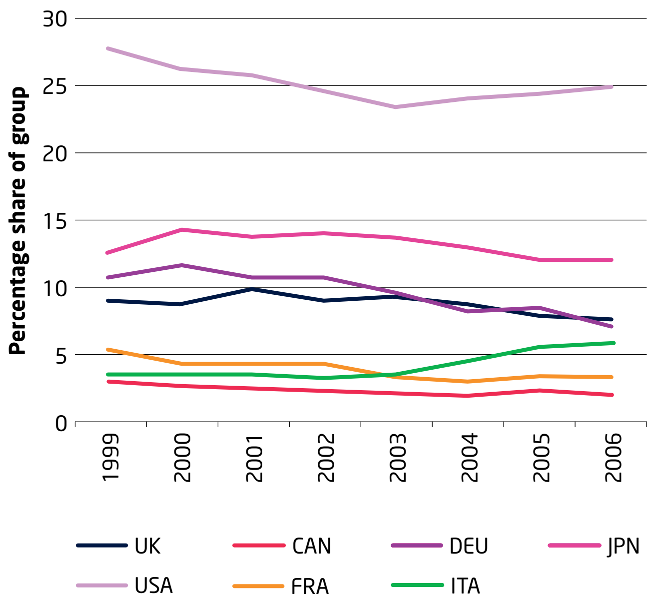
Data: Thomson Reuters. Analysis: Evidence

4.2.3 Engineering's share of OECD PhD awards

As indicated earlier, the 2008 RAE exercise found engineering in the UK to be in excellent shape. But, as the report *One Step Beyond: Making the most of postgraduate education*[56] points out, cutting-edge research conducted by postgraduates in our world-leading research centres contributes significantly to the health of the UK research base. The UK delivers 8% of world research output, is second only to the US in a number of research disciplines and first amongst the G8 for research productivity. The talent developed in our postgraduate education system is critical to maintaining this success.

Figure 4.2 and Table 4.1, taken from the DIUS's international comparative study in 2009,[57] shows that the UK has a slightly rising output of PhDs in engineering and technology: up to 2,400 in 2006 compared with fewer than 2,000 per year before 2001. Its ranking within the G8 has also gone up to third from fourth, primarily because Germany's PhD output has declined slightly to less than 2,200 per year. It should be noted that all relative shares have been affected by the rapid expansion in the number of PhDs in the USA, which is up from around 5,500 a year five years ago to over 7,500 in 2006, making up 25% of the world share.

Fig. 4.2: Doctoral awards in engineering and technology as share of a group



Data: OECD. Analysis: Evidence

56 One Step Beyond: Making the most of postgraduate education, Professor Adrian Smith, Dr Tim Bradshaw, Professor Keith Burnett, Dr David Docherty, Professor Wendy Purcell, Professor Sarah Worthington, March 2010

57 DIUS, International Comparative Performance of the UK Research Base, September 2009

Table 4.1: Doctoral awards in engineering and technology

	Recent average (2001-2005)	Current value (2006)	Current relative to Recent
UK PhDs	2,184	2,397	+10%
Group average PhDs	1,458	1,755	+20%
UK / Group average	1.50	1.37	-9%
UK rank within Group	4	3	↑
UK rank within G8	4	3	↑
UK share of group	9.1	7.8	-14%

Data: OECD. Analysis: Evidence

This growth in postgraduate numbers has benefited universities enormously. Taught postgraduate provision alone brought in income of over £1.5 billion for universities in 2008/09. Attracting and retaining high-calibre, taught postgraduate students is a valuable way for universities to recruit postgraduate researchers, who are an integral part of HEIs' research capability.[58]

Two other benefits of a strong science and engineering R&D base pointed out by the *Impacts of Investment in Science & Engineering Research Base* policy report[59] by CASE (Campaign for Science and Engineering) are:

"Driving industry with the needs and findings of researchers. Around a quarter of innovative UK businesses recognise their use of information from higher education institutions (HEIs) and a quarter use information from government or public research institutes. Public research encourages firms to engage in more collaborative R&D, intensifying existing partnerships and initiating new ones."[60]

"Producing spin-out companies. In 2006/07, 327 spin-offs were formed from publicly funded research. From 2003 to 2007, 31 HEI spin-offs were floated on stock exchanges with an initial public offering of £1.5 billion and ten were acquired for a total of £1.9 billion."[61]

... and finally, we mustn't forget that alongside high-tech manufacturing in sectors such as pharmaceuticals, aerospace, software and industrial design, UK services[62] are increasingly knowledge-intensive, and now account for three quarters of gross value added (GVA) and over 80% of employment in the UK. This is despite not historically being viewed as a traditional home for R&D or innovation.

4.2.4 What's the pay off?

The UK's prosperity ultimately depends on two things: firstly, the number of people employed and, secondly the value of what those workers produce. The UK's relative international position in terms of employment rate and level of productivity is illustrated in Figure 4.4.[63] It shows the UK performing above the OECD average for employment (10th of 30) and productivity (11th).

58 *One Step Beyond: Making the most of postgraduate education*, Professor Adrian Smith, Dr Tim Bradshaw, Professor Keith Burnett, Dr David Docherty, Professor Wendy Purcell, Professor Sarah Worthington, March 2010

59 Impacts of Investment in the Science & Engineering Research Base, C*aSE Policy Report Number 10* September 2009

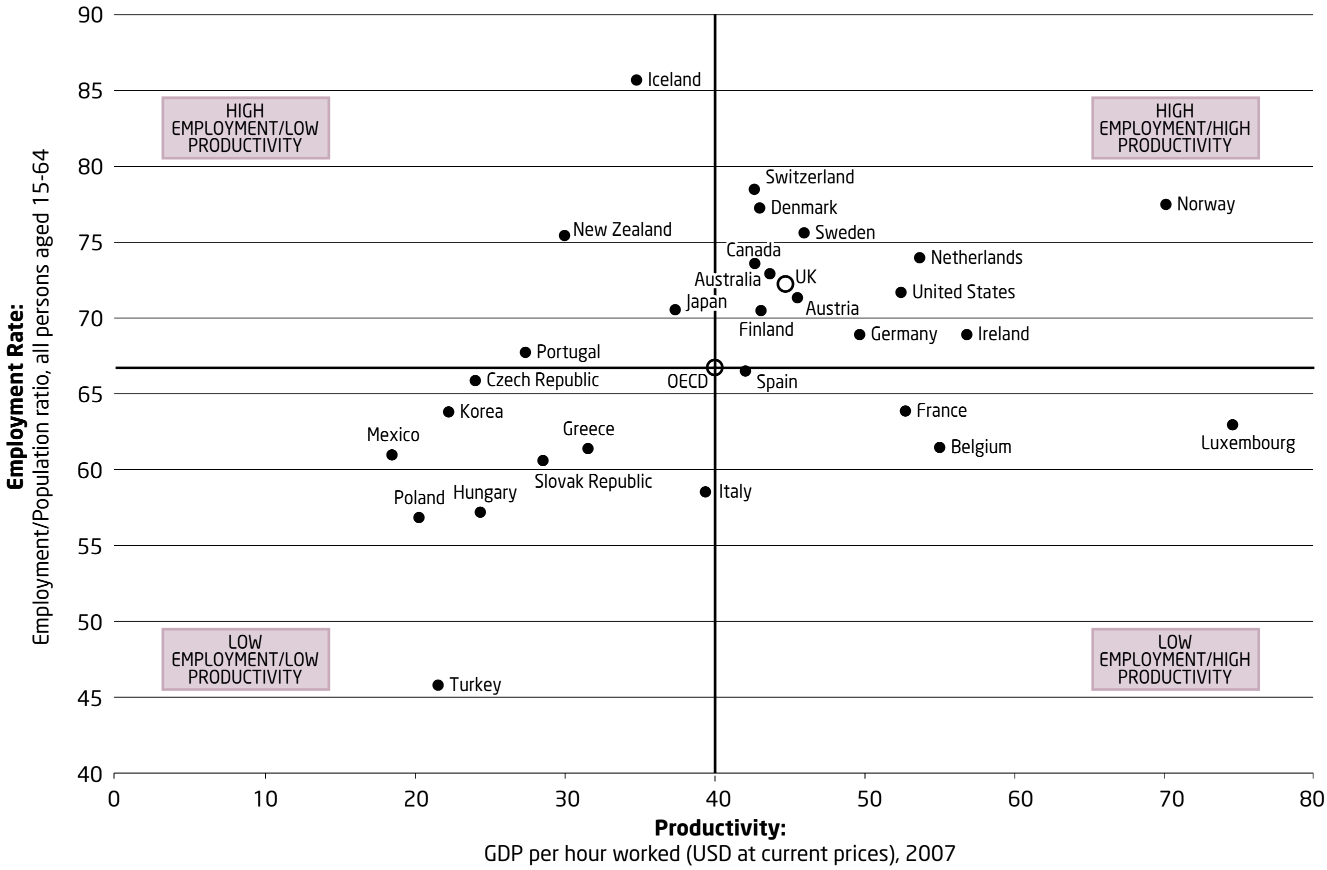
60 *Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality*, OECD, 2006

61 UNICO data

62 *Hidden Wealth: The Contribution of Science to Service Sector Innovation*, Royal Society, 2009

63 UKCES annual review report July 2010

Fig. 4.3: Productivity and employment in the OECD countries



Source: Spilsbury and Campbell (2009), Chart 1.1, page 22

The UK Commission for Employment and Skills (UKCES) annual report[64] goes further. It stresses that the potential links between skills and innovation are important – including the role of skilled workers in transfer of knowledge between firms, sectors and countries, whether through collaboration on R&D and technical problem-solving by firms involved in supply-chains,[65] or the mobility of highly-qualified engineers and scientists between firms.[66] What's more, if firms in each country are to identify and make effective use of knowledge, ideas and technologies generated elsewhere, 'absorptive capacity' is needed, through the development or acquisition of high levels of workforce skills.[67] So skills may help to stimulate productivity growth through their effect on innovation. But these effects may take some time to unfold.

At the time of writing, there is widespread concern within the STEM community that the government's planned cap on non-EU migrants may have a disproportionately negative effect on science and engineering, particularly in terms of appointments and investment. "A 'migrant cap'[68] on non-EU migrants could have devastating consequences for UK universities and industries which may, in turn, hinder or stall the economic recovery. In 2007/08, 10.5% of all UK academic staff were non-EU nationals: 11% in physical sciences and 10% in engineering (Higher Education Statistics Agency). Indeed, the OECD[69] showed that immigration barely affects home employment in highly-skilled sectors – the sectors that would be most badly affected by a cap on non-EU migrants.

64 ibid

65 Lundvall, B-A. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning.* Pinter Publishers, London

66 Mason, G., Beltramo, J-P. and Paul, J-J. (2004), External Knowledge Sourcing in Different National Settings: A Comparison of Electronics Establishments in Britain and France, *Research Policy*, Vol. 33, No. 1, pp. 53-72

67 Griffith, R., Redding, S. and Van Reenen, J. (2004), Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries, *Review of Economics and Statistics*, Vol. 86, No. 4, pp. 883 - 895

68 CASE Briefing on Proposed Cap on Non-EU Economic Migrants, 22nd June 2010

69 The Unemployment Impact of Immigration in OECD Countries, OECD, 2007

Part 1 Engineering in Context
5.0 Size of the engineering sector

The Annual Business Inquiry (ABI)[70] collects data from VAT and/or PAYE registered businesses in the UK, for about two thirds of the UK economy. This data is then classified using the Standard Industrial Classification (SIC) codes 2007.[71] This section of Engineering UK gives a snapshot of the engineering-related sector during the recession, in terms of the number of enterprises, total turnover, average number of workers employed during the year and the total employment cost[72] for those businesses which are related to engineering, based on SIC (2007).

Included in this analysis are five main SIC code groups:

- Section B – Mining and quarrying
- Section C – Manufacturing
- Section D – Electricity, gas, steam and air conditioning supply
- Section E – Water supply, sewerage, waste management, and remediation activities
- Section F – Construction

In addition, three SIC sub-categories have also been included, these are:

- 49 – Land transport and transport via pipelines
- 61 – Telecommunications
- 71 – Architectural and engineering activities; technical testing and analysis

70 http://www.statistics.gov.uk/abi/

71 Data collected prior to 2008 used SIC (2003)

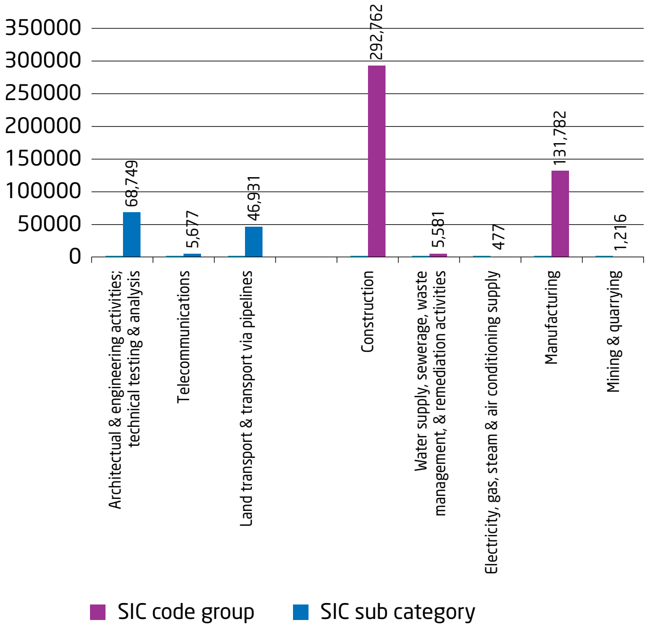
72 For trends prior to 2008 please refer to *Engineering UK 2009/10*

5.1 Number of enterprises

Officially, the UK entered recession at the end of December 2008 after two consecutive quarters of decline in Gross Domestic Product (GDP) and came out of recession in the last quarter of 2009. The ABI survey was conducted during the recession, although the actual date used for individual business returns does vary depending on business circumstances.

According to the ABI engineering footprint defined by EngineeringUK, there were 553,182 VAT or PAYE engineering businesses in the UK in 2008. Figure 5.0 shows over half (292,769) of the VAT and/or PAYE registered engineering companies are in the construction sector. They actually form 14.8% of all VAT and/or PAYE registered businesses included in the 2008 ABI survey. The next most important sector, in terms of the number of businesses, is manufacturing, with 131,782 businesses. The next three largest industries are all sub-categories of larger SIC code groups. Architectural & engineering activities and technical testing & analysis have 68,749 businesses, while land transport & transport via pipelines has 46,931, and telecommunications has a further 5,677.

Fig. 5.0: Number of enterprises by SIC code group (2008) – UK



Source: ONS/Annual Business Inquiry 2008

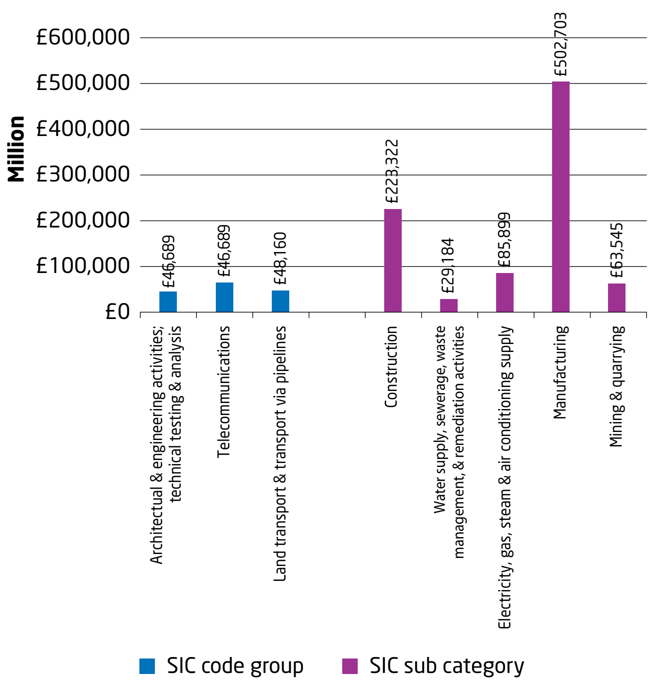
5.2 Turnover

All of the business areas selected generate a huge amount of turnover each year, with total turnover for the engineering footprint reaching £1,063 billion. Manufacturing, which generated £502 billion in 2008, accounted for nearly half of this turnover. This shows the importance of the manufacturing sector to the UK economy, especially when you consider that it only has 45% of the number of VAT and/or PAYE registered businesses that construction has. In fact, on average each manufacturing company generates five times the turnover of each construction business (Figure 5.1).

The construction sector has the second highest level of turnover, at £223 billion. This shows that construction is still vitally important to the UK economy, even though it doesn't generate the same level of turnover as manufacturing.

Of the selected industrial sectors, the third most important is electricity, gas, steam & air conditioning supply, which generates a total turnover of £85 billion. This sector of the economy is very small, at only 477 companies. However, the average turnover per company is an impressive £180 million.

Fig. 5.1: Total turnover by SIC code group (2008) - UK



Source: ONS/Annual Business Inquiry 2008

5.3 Employment

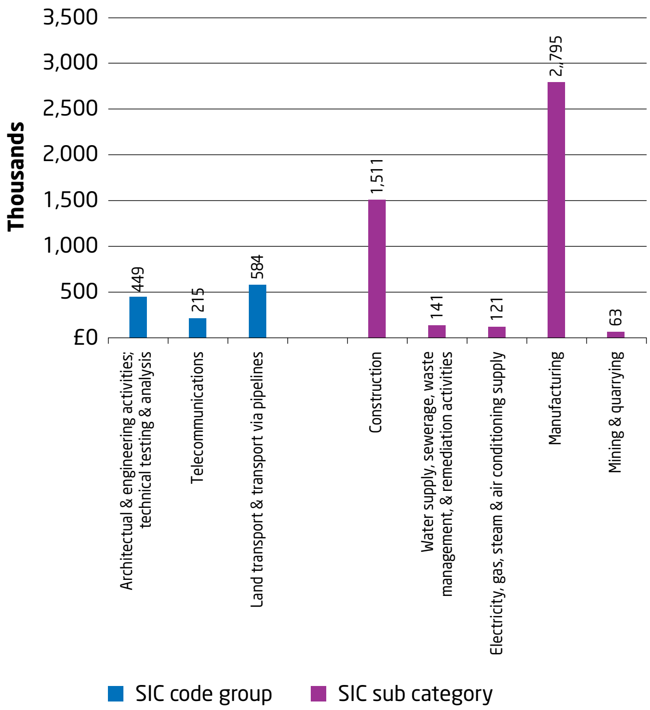
Figure 5.2 shows the average level of employment by SIC code group for the selected industries. Again, the importance of the manufacturing sector to the UK economy was highlighted. On average, the engineering footprint employs 5.9 million workers with 2.8 million workers being employed in the manufacturing sector. On average, each manufacturing company employs 21 workers.

The second most important sector of those selected was construction, which employed 1.5 million workers – an average of 5 workers per company.

Despite only being a sub-category of a larger SIC code group, land transport & transport via pipelines had the third highest level of average employment, 584,000, which equates to an average of 12 employees per company.

The highest level of average employment per company was in electricity, gas, steam & air conditioning supply, where 477 companies employed 121,000 workers on average – 254 workers per company.

Fig. 5.2: Total employment average during the year by SIC code group (2008) – UK



Source: ONS/Annual Business Inquiry 2008

Part 1 Engineering in Context
6.0 Engineering in the nations and regions

The analyses within this section are from the Inter-Departmental Business Register (IDBR) by home nations and English regions. They are based on the engineering footprint,[73] as defined by EngineeringUK in 2008 and consistently used in subsequent annual reports.

6.1 Number of engineering enterprises 2008 to 2009

In March 2009, there was a total of 482,880 engineering enterprises in the UK – an increase of 12,575 from the comparable data in March 2008.[74] The number of engineering enterprises increased in each region, except Northern Ireland which declined by 265 enterprises.

The largest area for growth was London (3,830) and the South East (2,155) and overall the number of engineering enterprises in England grew by an impressive 11,330. The number of engineering enterprises also grew in Scotland (1,395) and Wales (115).

73 In 2008, the Engineering and Technology Board's (now EngineeringUK) footprint for engineering was defined using SIC2003 (section 33.3). This data was then used to analyse ONS. Using this SIC2003 definition of engineering, this section analyses the Inter-Departmental Business Register (IDBR) by home nations and English regions. The IDBR collects data on VAT registered businesses in the UK.

74 The 2009 data was collected in March 2009, which was very early on in the recession. As a result the full impact of the recession may not have been captured in the IDBR data.

Table 6.0: Number of engineering enterprises (2008-2009) – UK regions

Home nation/ English region	Number of enterprises (March 2008)	Number of enterprises (March 2009)	Actual change 2009 to 2008	Percentage change
North East	13,225	13,740	515	3.9%
North West	46,075	47,575	1,500	3.3%
Yorkshire and The Humber	33,910	34,425	515	1.5%
East Midlands	34,290	34,685	395	1.2%
West Midlands	41,950	42,640	690	1.6%
East of England	54,880	55,875	995	1.8%
London	56,465	60,295	3,830	6.8%
South East	82,375	84,530	2,155	2.6%
South West	44,450	45,215	765	1.7%
England	*407,650*	*418,980*	*11,330*	*2.8%*
Wales	*18,610*	*18,725*	*115*	*0.6%*
Scotland	*29,800*	*31,195*	*1,395*	*4.7%*
Northern Ireland	*14,245*	*13,980*	*-265*	*-1.9%*
Total	470,305	482,880	12,575	2.7%

Source: ONS/IDBR

6.2 Number of engineering enterprises 2009

In March 2009, there was a total of 482,880 engineering enterprises in the UK, employing 4,566,316 staff (Table 6.1) and generating a combined turnover of £848.6 billion – 19.6% of total GDP.

Contrary to popular belief, the engineering sector is actually three times larger than the celebrated financial services sector. According to the Financial Services Skills Council (FSSC), the UK financial services industry employs over one million individuals. What's more, the Office for National Statistics (ONS) estimates that the sector accounts for only around 7% of UK GDP.[75]

Table 6.1: Engineering in the nations and regions (2009) – UK

Home nation/ English region	Number of enterprises	Employment	Turnover (thousands)
North East	13,740	162,164	34,486,353
North West	47,575	428,358	65,202,480
Yorkshire and The Humber	34,425	349,207	48,888,504
East Midlands	34,685	328,816	46,889,370
West Midlands	42,640	473,308	73,381,898
East of England	55,875	543,802	92,355,601
London	60,295	470,528	154,412,563
South East	84,530	818,713	174,717,580
South West	45,215	362,026	49,961,331
England	*418,980*	*3,936,922*	*740,295,680*
Wales	*18,725*	*190,689*	*31,520,397*
Scotland	*31,195*	*315,047*	*60,828,099*
Northern Ireland	*13,980*	*123,658*	*15,938,169*
Total	482,880	4,566,316	848,582,345

Source: ONS/IDBR

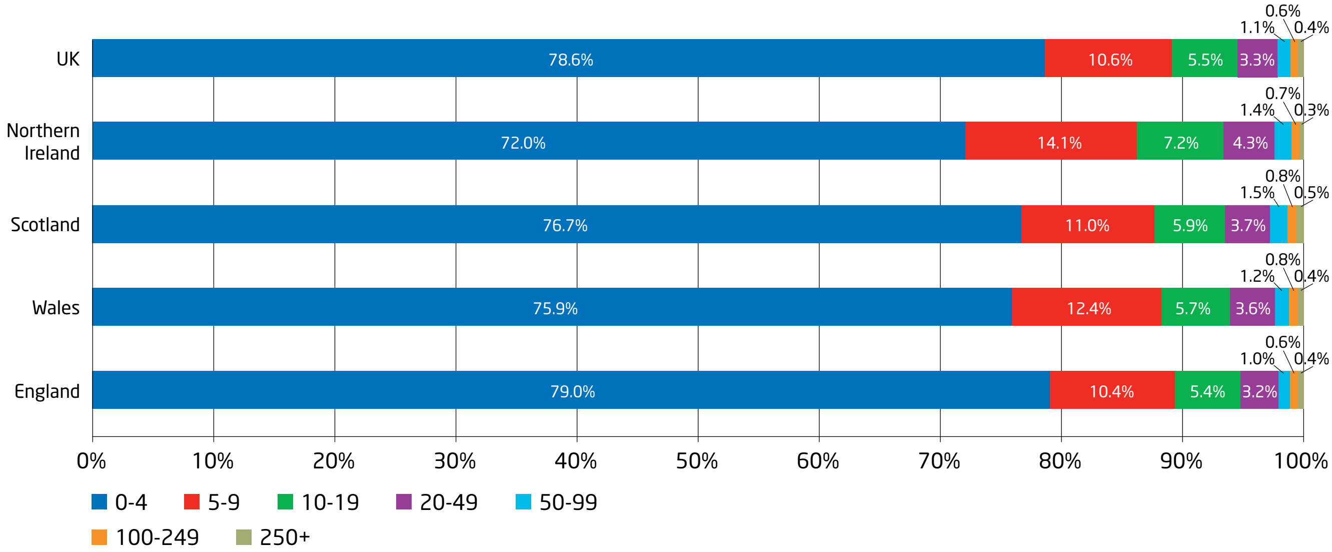
Figures 6.0 and 6.1 shows that most engineering businesses in the UK are small,[76] with approximately nine out of every ten being micro businesses. [77]

75 Financial Services Skills Council Response to the House of Commons Education and Skills Committee inquiry on Post-16 Skills Training, January 2007

76 Fewer than 10 -49 employees

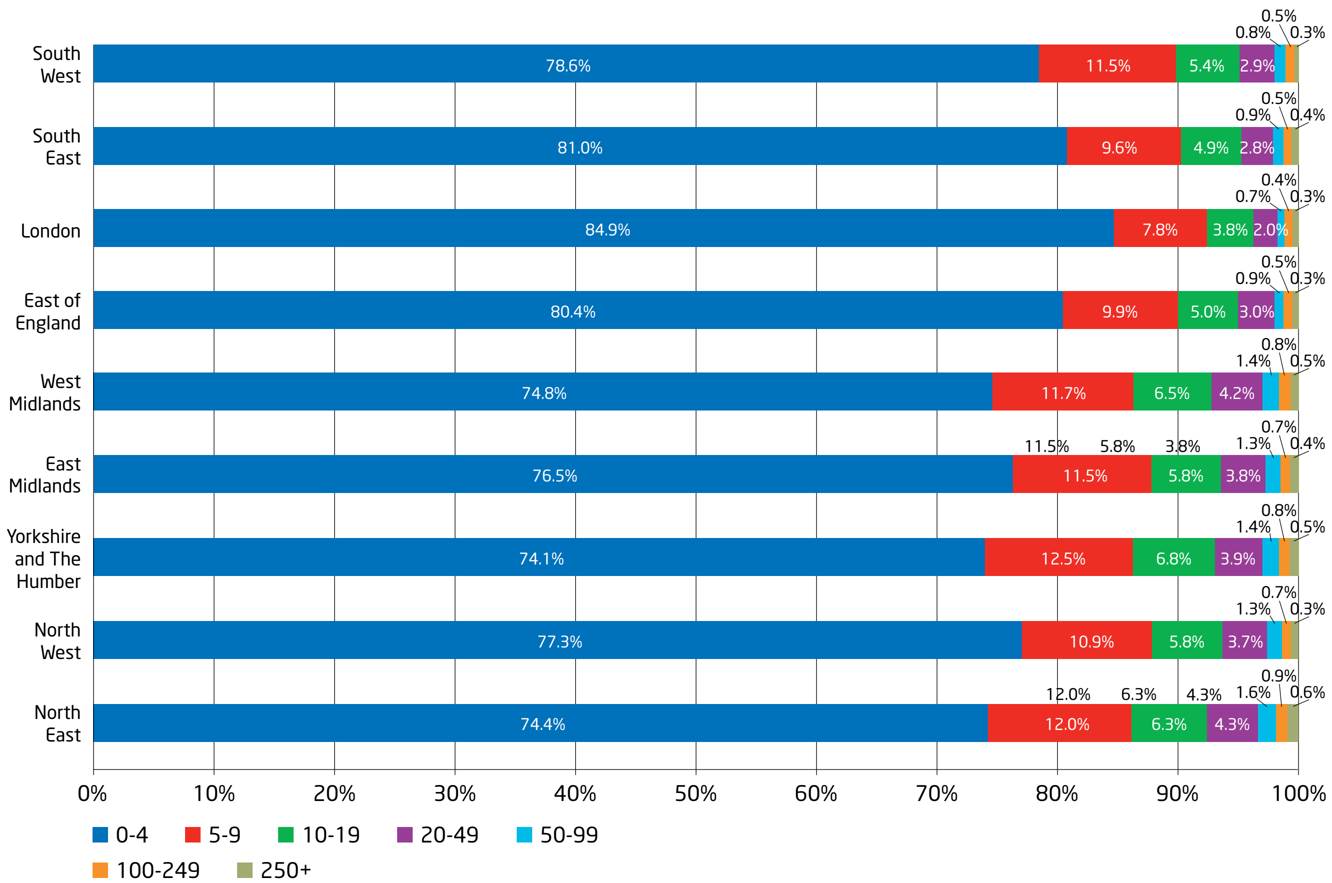
77 Fewer than 1-9 employees and turnover <£2 million

Fig. 6.0: Share of VAT-registered engineering enterprises by number of employees by home nation (2009)



Source: ONS/IDBR

Fig. 6.1: Share of VAT-registered engineering enterprises by number of employees by English region (2009)



Source: ONS/IDBR

78 More than 250 employees

6.3 Share of employment

Although large businesses[78] make up only 0.4% of all engineering businesses in the UK, they are responsible for 42.1% of all staff employed in engineering. The importance of large businesses to employment does vary by UK home nation. In Northern Ireland, large businesses account for only 26.8% of all employment, whilst micro businesses (fewer than 10 employees) account for 25.7%. Overall, micro businesses are very important for engineering employment as they are responsible for employing 21.5% of all people in the engineering sector.

Examination of the share of employment by size of business for the regions within England highlights some interesting patterns. There are only three regions where nearly half the staff employed by engineering firms are working for large firms (those with at least 250 employees). These three regions are:

- The East of England
- London
- The South East

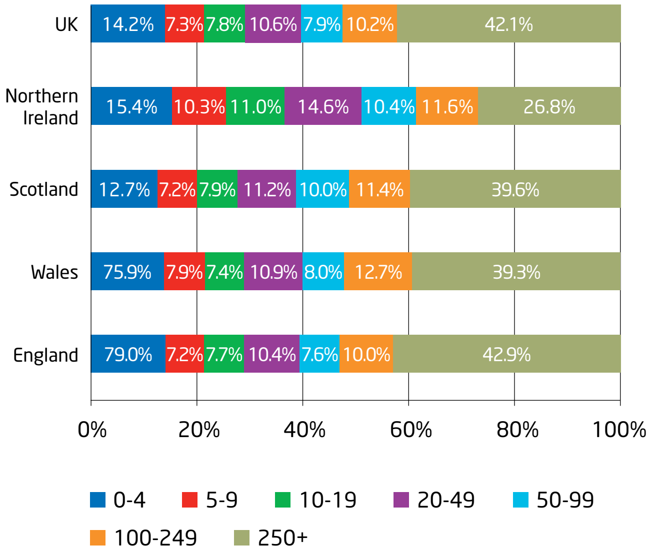
Conversely, there are four regions where companies of at least 250 employees make up less than 37% of all engineering employees. These regions are:

- The North West
- Yorkshire and the Humber
- The East Midlands
- The South West

The North West, Yorkshire and the Humber and the East Midlands are all considered to be areas of traditional manufacturing where you would expect there to be an abundance of large engineering companies.

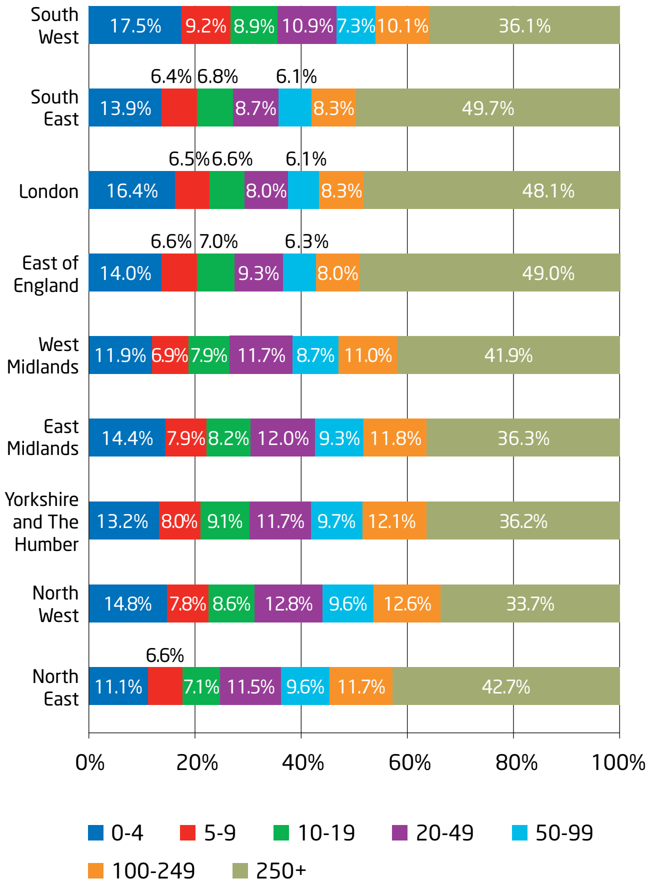
Analysing the different English regions by the total number of employees in engineering companies shows that 17.9% of all employees of engineering firms in England are working for companies in the South East. The second largest region, the East of England, employs 11.9%.

Fig. 6.2: Share of employment by enterprise size and home region (2009)



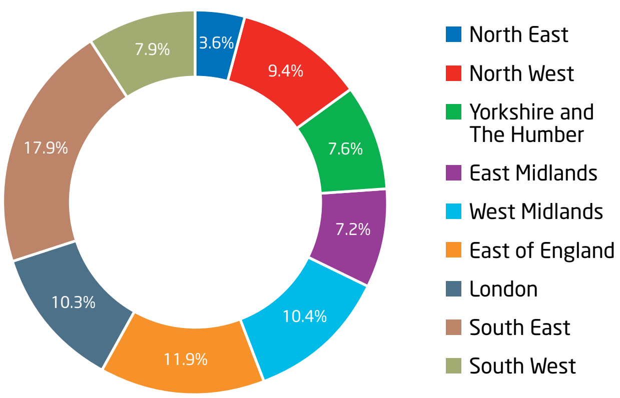
Source: ONS/IDBR

Fig. 6.3: Share of employment by enterprise size and English region (2009)



Source: ONS/IDBR

Fig. 6.4: Share of employment by English region (2009)



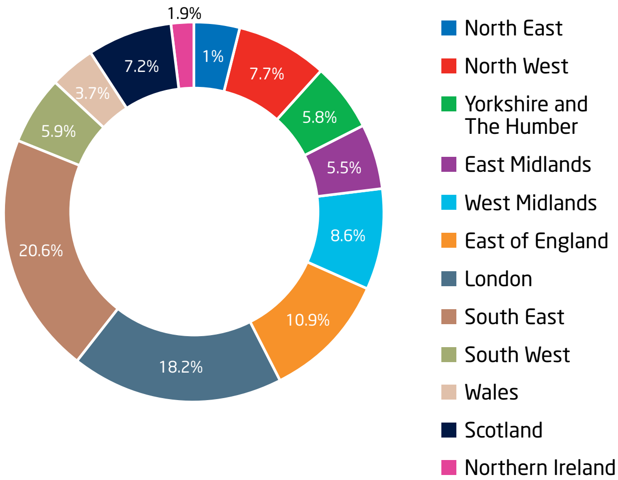
Source: ONS/IDBR

6.4 Share of turnover

In 2009, the turnover of all engineering businesses was £848.6 billion (19.6% of total GDP), an increase of 6.2% on the previous year. The South East of England had the largest number of employees in engineering companies as well as the largest share of turnover. The South East accounts for 20.6% of all turnover in the UK, while London accounts for a further 18.2%.

Although London and the South East account for nearly 40% of all turnover from engineering companies, policy makers should not overlook the importance of engineering in other nations and regions in the UK.

Fig. 6.5: Share of turnover of VAT registered engineering enterprises by home nation and English region (2009)



Source: ONS/IDBR

Part 1 Engineering in Context

7.0 Perceptions of engineers and engineering

The engineering and science sectors are very important to the success of the UK economy. Several key stakeholders in the STEM sector, in addition to EngineeringUK, have recognised the importance of these sectors and are conducting research into people's perception of them.

In 2009, the Wellcome Trust launched its monitor of perceptions of science. In this survey the Wellcome Trust identified that:

"A majority of young people aged 14 to 18 (81%) said they thought science was a good area of employment for young people to go into. This was even true for those (71%) who did not personally express interest in a career in science."[79]

The Department for Business, Innovation and Skills (BIS) is also conducting some research into public attitudes towards science. The BIS definition of science includes the physical sciences, such as physics and chemistry, as well as the application of science ie engineering. BIS has set up a steering group to oversee the development of this research project and EngineeringUK is actively contributing to this process.

Each year, EngineeringUK carries out research to measure the perceptions of engineers and engineering, in order to inform our own and partner programmes and gauge if progress is being made in this key area. Our research is conducted across five key audience groups:

- The general public 17-19 (nationally representative sample)
- The general public 20+ (nationally representative sample)
- Educators
- School children aged 7-11
- School children aged 12-16

79 Wellcome Trust *Monitor 1*, September 2009 - Sarah Butt, Elizabeth Clery, Varunie Abeywardana and Miranda Phillips

7.1 Engineers and Engineering Brand Monitor[80]

In March 2010, FreshMinds, an independent research consultancy, was appointed to conduct the latest wave of the Brand Monitor – a yearly study that first commenced with a pilot in 2008. The Brand Monitor measures perceptions held by children, those that influence them, the general public and education professionals, of engineering, engineers, and engineering careers. The 2010 Brand Monitor also looked at perceptions of manufacturing, science and technicians. The themes explored are detailed in Table 7.0.

Table 7.0 Themes explored in the 2010 Brand Monitor

Themes relating to engineering:
Awareness and understanding of engineering
General perceptions of engineering
Role of engineering within the UK economy
Perceptions of engineers
Perceptions of engineering as a career
Perceptions of the educational pathway to engineering
Consideration and recommendation of engineering as a career
Perceptions of how students see engineers (relevant to educator group)
Perceptions of student career values (relevant to educator group)
Themes relating to manufacturing:
General perceptions of manufacturing
Role of manufacturing within the UK economy
Perceptions of manufacturing as a career
Consideration and recommendation of manufacturing as a career
Perceptions of the educational pathway to manufacturing
Themes relating to science and technicians:
General perceptions of science
General perceptions of technicians
General perceptions of apprenticeships
Perceptions of science as a career
Consideration and recommendation of science as a career
Awareness and understanding of the role of a technician
Perceptions of the educational pathway toward becoming a technician
Consideration and recommendation of becoming a technician

The 2010 Brand Monitor was conducted online between April and July 2010. There was a total of 5,781 respondents across five different target groups.

80 http://www.engineeringuk.com/_db/_documents/2010_Engineering_UK_Brand_Monitor_FINAL_20100811040830.PDF

7.2 Key themes emerging from the research

Increased knowledge of engineering leads to improved perceptions of engineering across all groups.

The study demonstrates a relationship between perceived knowledge and understanding of engineering and positive sentiment towards it across the groups studied. For example, in the 20+ age group, those who feel they have better knowledge (8%) are also more likely to see engineering as desirable or enjoyable (28%). They are more likely to consider it as a career (57%) and more likely to recommend it as a career to others (21%). Those who count engineers amongst their friends (35%) or close family (42%) also tend to have greater knowledge of and more favourable attitudes towards the industry.

Awareness could be raised in many ways. However, there appear to be specific deficiencies in public knowledge of the range of engineering roles available: 20-40% of 20+ year-olds knew "nothing" about specific types of engineering, or of the day-to-day realities of what various roles involve (28% of 20+ year-olds agreed that "hardly anyone knows what engineers do"). Similarly, there is confusion around educational pathways into the profession. For example, 36% of 20+ year-olds think students need a first degree to become an engineer, 22% think A-levels or highers are required and 20% think higher level degrees are required. Respondents felt that better communication of possible career paths through the industry would be of benefit: 66% of 17- to 19-year-olds felt this was somewhat or very important.

For all ages, it seems the engineering discipline tends to be described either with reference to its outputs (structures, systems, etc), or by its processes (mechanical equations, technical drafting, etc). But it's less often described by its human element: what people who work as engineers do and how this interacts with, or influences, the people in the world around them. For instance, fewer than half of over 20s felt that engineers need to be good communicators (46%), and only a third (33%) said they need to be "good with people" in order to do their job well. Drawing and communicating clearer links between these elements would be likely to have a positive impact on knowledge and awareness and, by extension, on perceptions.

For all age groups, the challenging nature of engineering is seen as a desirable quality. However, other aspects such as pay, level of interest and enjoyment are likely to be more attractive to those considering it as a career.

Among the 17- to 19-year-old group, those who find engineering desirable tend to do so because they consider it challenging (72%). This descriptor was strongly associated with engineering, even when compared with accountancy (47%), law (24%), teaching (48%) and medicine (7%).

However, a sense of challenge is not the primary element people consider when making career choices. Of the 17- to 19-year-old sample, the majority are more likely to consider pay as a priority (77%), alongside level of interest (70%) and level of enjoyment (38%).

Pay is one area where engineering is perceived to be falling short of other industries. Respondents over 20 considered engineering to pay better than teaching (57%) but worse overall than accountancy (14%), law (4%) and medicine (11%). If engineering pay is in fact comparable with these professions, then the reality of this needs to be communicated clearly in promoting engineering as a career option. If engineering pay matches people's perception of it and is not on a par with these other professions, then alternative approaches could be taken.

One possible key aim would be to identify ways of enhancing interest in, and enjoyment of, engineering-related subjects and disciplines. Promoting the industry from this angle rather than from a 'challenge' angle, if effective, would be more likely to have a real influence on the career decisions that people make. Again, this is likely to come down to awareness and communication.

The general public felt that they possessed certain key skills, such as creativity and communications skills. But they didn't see these as skills needed by engineers – even though they clearly are.

Respondents over 20 years old identified being practical (87%), numerate (78%), inventive or innovative (76%) and well-organised (75%) as qualities needed to make engineers good at their jobs.

There are some mismatches, however, between the qualities engineers are seen to need and the qualities that the general public consider themselves to have. A majority of 17- to 19-year-old respondents considered themselves to be practical (55%), well-organised (53%) or numerate (43%). However, only around a third considered themselves to be inventive or innovative (37%).

On the other hand, being good with people was the second most frequently identified trait amongst 17- to 19-year-old respondents (61%). Yet it was the quality deemed least important for engineers (41%), alongside being a good communicator (53%).

If good communication and social skills are in reality a key requirement of engineering roles, then shifting the focus from an emphasis on practicality and numeracy to the social characteristics needed may generate interest among a broader cross-section of the population, especially females. This could be done in part by using different language to talk about the industry, emphasising the need for those qualities that people more commonly believe that they themselves possess.

Encouragingly, younger people were slightly more likely to think of themselves as inventive or innovative (37% of 17- to 19-year-olds and 27% of those over 20), which may yield opportunities for further promotion of engineering among those who are yet to make career decisions. If measures or programmes can be put in place which develop or feed off activities that engender innovation and inventiveness from an early age, then a stronger pipeline of candidates interested in, and suited to, engineering disciplines could be formed.

To reverse the negative view of engineering and make it more accessible and attractive to females, the creative and people aspects of engineering need to be communicated better. There also needs to be better access to female role models.

One target group that would seem to be most responsive to a shift in emphasis would be women, who are currently under-represented in engineering roles. This is partly a result of a self-perpetuating cycle of perception of a male-dominated industry, which leads to greater male uptake and, in turn, reinforces perceptions.

Overall, the 2010 Brand Monitor shows that men tend to have slightly more positive perceptions of STEM subjects and STEM careers, whereas women are more likely to consider them to be dull and technical.

Males in the 20+ group are more likely to think of themselves as inventive or innovative (33% of males, compared with 22% of females) and numerate (64% of males, against 47% of females). Whereas women are more likely to consider themselves creative (44% of females, against 38% of males), well-organised (61% versus 56%) and good with people (66% versus 62%). It is clear that both men and women have traits which are considered important for engineers. Creativity and innovation are arguably relatively similar qualities. However, innovation perhaps has undertones of technicality and application, whereas creativity may be thought of as freer and less functional. It would seem that both could, in fact, be applied to engineering and, depending on which is used, attract or repel different groups in varying proportions. A more tailored approach, emphasising key traits using alternative terminology, could be one way of maximising the reach and appeal of the industry. It certainly seems that greater emphasis on the social and human aspects of the role are likely to be more relevant to women and thereby enhance appeal.

Among the 17- to 19-year-old group, females were more likely to report little knowledge of engineering (70% versus 46%) and males were more likely to report good knowledge of engineering (21% versus 7%).

Engineering also fared worse as a profession among females than males, compared with other roles. For example, in the 17- to 19-year-old group, more males said engineers are better paid than lawyers, whereas more females say engineers are worse paid than lawyers. Similarly, more males said engineers have a better reputation than lawyers and accountants, whereas more females say engineers have worse reputations than lawyers and accountants.

Males are also more likely than females to consider there to be a greater general awareness of what engineers do. For example, in the North West region, 29% of females disagreed that "hardly anyone knows what engineers do", whereas 33% of males disagreed.

Public awareness of engineers is lower than other professions, despite them being viewed as the group most likely to get the country back on track.

Despite their role within the infrastructure of modern society, the relative lack of awareness displayed about engineers among the general public (eg 45% of over 20s) suggests they are in some ways viewed as being 'behind the scenes'. From a list of prominent professions including, amongst others, politicians and police, engineers were identified by the most people aged over 20 (55%) as the group most likely to be trusted to "get the country back on track". This could be a reflection of the part that engineers are expected to play in some of the big challenges faced by society. Climate change and the recent high-profile BP Deepwater Horizon explosion may be seen to present problems which engineers are in a stronger position to directly resolve than other professions.

Nevertheless, engineers are notably absent from everyday social commentary. Perhaps, as a result, they are therefore value-neutral – unlike, for example, politicians or environmental campaigners. This perceived neutrality could result in engineers being seen as more objective and trustworthy than other groups.

Celebrities were the only group identified by the study as having a negative influence on perceptions of engineering (-1.53 on a -10 to +10 scale: the only negative mean score among respondents over 20 years old). It is not clear in what ways they are perceived to exert this negative influence. However, counteracting the negative influences of those who are ever-present in the media may be a challenge for the engineering industry so long as it sits outside of the social conversation and lacks a media 'face'.

7.3 Key findings on manufacturing, science and technicians

Many of the observations made about engineering are broadly applicable to manufacturing, science and technicians. However, due to the smaller number of questions asked specifically about these three areas, fewer high level themes have been identified. Instead, the sub-sections below outline some specific observations that have been made from the findings within each category.

Manufacturing

- The vast majority of respondents had not seen or heard any promotion of the manufacturing industry over the past year
- Overall perceptions of manufacturing careers are a mixture of positive and negative
- More males than females think positively of manufacturing and manufacturing careers
- Females generally view manufacturing careers as male-dominated
- 'Production', 'technology' and 'design' were the words most commonly associated with manufacturing
- Older people have more positive associations with manufacturing careers than younger people
- Academic requirements for a manufacturing career were perceived to be lower than for an engineering career

Science

- People tend to have positive associations with the word 'science' and most would recommend a science career to their friends/family
- Science is more popular among girls than boys at younger ages
- 'Experiments', 'chemistry', 'biology' and 'physics' come to mind most when people think of science

Technicians

- The technician role was most commonly viewed as a helpful, supportive, practical function
- There was widespread lack of knowledge about technicians, especially among younger people and females
- Words most commonly associated with technicians can be grouped into 'technical', 'supportive' and 'practical' categories
- Healthcare, scientific and ITC sectors were the three in which technicians were most commonly thought to be employed
- There was much variation by age about the level of qualification required for a job as a technician
- Women and young people are more likely to think higher level qualifications are required to be a technician, perhaps suggesting the role should be demystified
- Educators are most likely to recommend a career as a technician to practical students, to those who show an interest, or to problem solvers

Part 1 Engineering in Context
8.0 UK population changes

ONS[81] has published projected population statistics from 2008 to 2033, and then for selected years beyond 2033. The projections are filtered by age or age group and are further broken down by gender.

Figure 8.0 shows the projected changes in population numbers in five-year age bands. The number of people aged 15-19 is predicted to decline annually until 2018, when it will have reached 3,472,540: a decline of 12.9% from 2008. After 2018, the number of 15- to 19-year-olds is expected to rise: by 2033, the number of 15- to 19-year-olds is predicted to be 0.9% higher than it was in 2008.

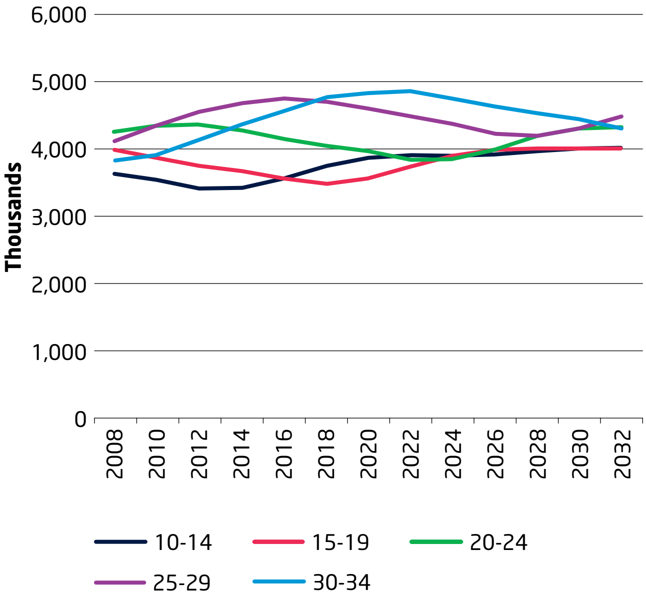
Figure 8.1 looks at the projected number of 18-year-olds from 2008 to 2033, which is predicted to rise in 2009 before starting to decline. From 2009 to 2020, the number of 18-year-olds will decline annually; from 819,098 to 685,823. This 16.3% decline will undoubtedly have a detrimental effect on university recruitment. The population is then projected to rise sharply until 2026, when it will start to fall back slowly.

In July 2010, the new government announced the abolition of the fixed retirement date from October 2011.[82] At present, the impact on employment trends of abolishing the retirement age can't be predicted.

81 http://www.statistics.gov.uk/downloads/theme_population/NPP2008/NatPopProj2008.pdf

82 http://www.bis.gov.uk/policies/employment-matters/strategies/default-retirement

Fig. 8.0: Predicted UK populations by age last birthday (2008 base year)



Source: ONS

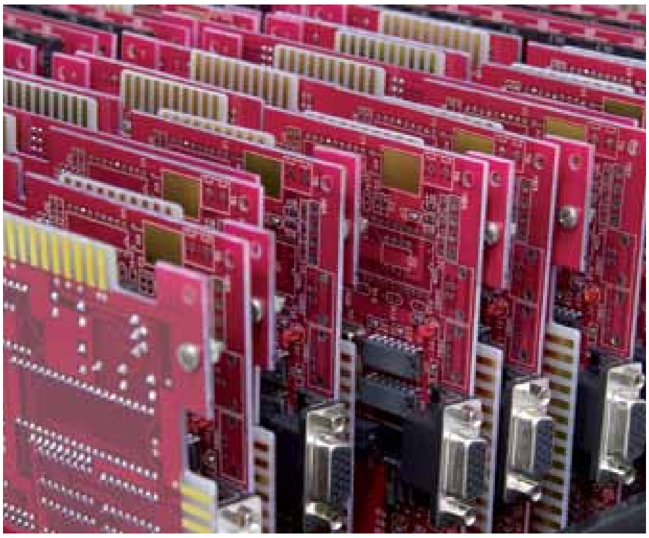
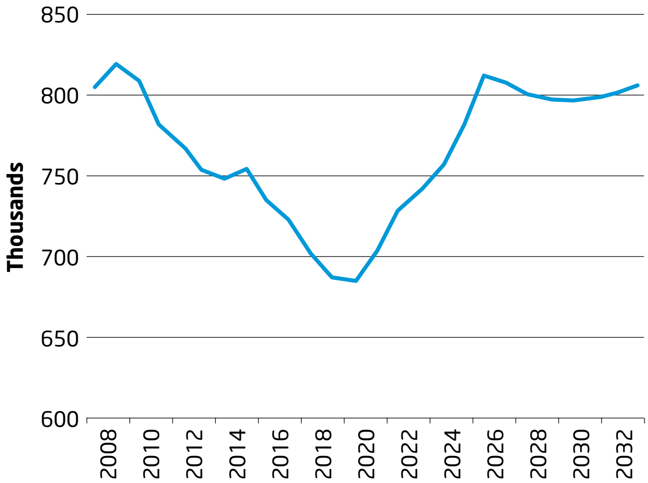


Fig. 8.1: Projected 18-year-old population (2008 base year)



Source: ONS

Part 2 Engineering in Education and Training
9.0 GCSEs

The education system in England has entered a period of transformational change.

On 29th July 2010, the coalition government passed The Academies Bill,[83] which gave every school in England the ability to opt out of local council control. Since the bill was passed, 32 schools have converted to academy status, making them essentially centrally-funded independent schools.

Since their inception in 2002, the rise in the number of academy schools has been slow, reaching only 203 by July 2010.[84] However, the coalition government has now written to all head teachers in England asking if they are interested in academy status, and 1,560 have responded positively. If a large number of schools do choose to take academy status, they will sit alongside UTCs,[85] a much-heralded initiative being driven by Lord Baker. Together, these would represent a significant change in the composition of the education system in England.

The current budget deficit will also impact on the education sector. In its emergency budget, the government made more than £300 million of savings in the 4-19 education budget.[86] These included making cuts of £80 million from education-sector quangos, including the abolition of Becta and a reduced budget for the Qualifications and Curriculum Development Agency (QCDA).

The government's Public Policy Reform proposals in October (Quangos Cull) also added the General Teaching Council for England to the bonfire, along with several bodies who at the time of writing are 'under consideration'.

UK secondary school pupil data broken down by nation for 2008/09

	England	Scotland	Wales	Northern Ireland
Number of pupils in state-funded secondary schools (thousands)	3,271.1	304.0	205.4	148.0
Percentage of students eligible for free school meals	13.4%	12.3%	14.8%	14.8%
Percentage of students claiming free school meals	10.3%	6.8%	11.6%	11.0%

83 http://services.parliament.uk/bills/2010-11/academieshl/documents.html

84 http://cep.lse.ac.uk/pubs/download/pa011.pdf

85 http://www.utcolleges.org/

86 http://www.guardian.co.uk/politics/2010/may/24/coalition-government-education-cuts

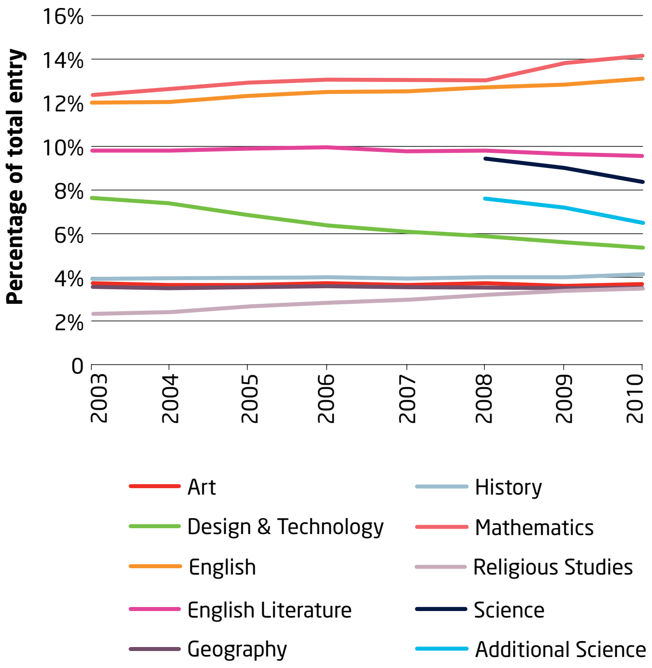
9.1 Entrant numbers

The General Certificate of Secondary Education (GCSE) is the primary qualification taken by secondary school pupils aged 14-16 in England, Wales and Northern Ireland. It can also be taken with other awards, such as the National Vocational Qualification (NVQ).

The number of entries for GCSE in the core subjects (English, mathematics and science, and Welsh in Wales) is determined by the statutory requirements of the National Curriculum in England, Northern Ireland and Wales. Most pupils studying these subjects will go on to take GCSEs in them.

Figure 9.0 (the top ten GCSE subject taken in 2010) shows that, as in 2009, mathematics remained the most popular qualification by proportion of entries (14.2%). English and English literature were second and third, with 13.1% and 9.6% of all entrants respectively. Science and additional science came in fourth and fifth place, with 8.4% and 6.6% of all entrants, while design and technology came sixth with 5.4%, making it the largest of the non-core subject.

Fig. 9.0: Top ten GCSE subjects (2010) – all UK entrants



Source: Joint Council for Qualifications (JCQ)

Research by the Wellcome Trust[87] shows the importance of good quality science teaching in encouraging students to learn science at school. Over half (52%) of those interviewed said that having a good teacher encouraged them to learn science. Conversely, 47% said that a bad teacher had put them off. Against this background, it is encouraging to see that entrant numbers to biology (165.8%), chemistry (160.0%) and physics (158.3%) more than doubled since 2000 (Figure 9.1 and Table 9.0). This is particularly impressive when overall entrant numbers have declined 10.7%. The rise in GCSE physics is important as GCSE and A level physics is needed for progression into engineering courses at many Higher Education Institutions.

This increase in single science subjects is partly due to the government's recognition of the importance of science education as an economic driver and the introduction in 2008 of an entitlement, allowing all pupils who achieve at least a level 6 at Key Stage 3 to study three separate science GCSEs.

A new specification for science, with a core GCSE and additional GCSE, was examined in 2007 and 2008 respectively and has begun to replace the previous Double Science qualification (science and additional science).

Mathematics is the largest subject overall, with its entrant numbers growing by 13.3% over the 10 years and by 1.1% in 2010. However, both design and technology (-32.2%) and ICT (-37.7%) have shown a decline in entrant numbers over the 10-year period.

87 Wellcome Trust monitor tracking public views on medical research, Sarah Butt, Elizabeth Clery, Varunie Abeywardana and Miranda Phillips - September 2009

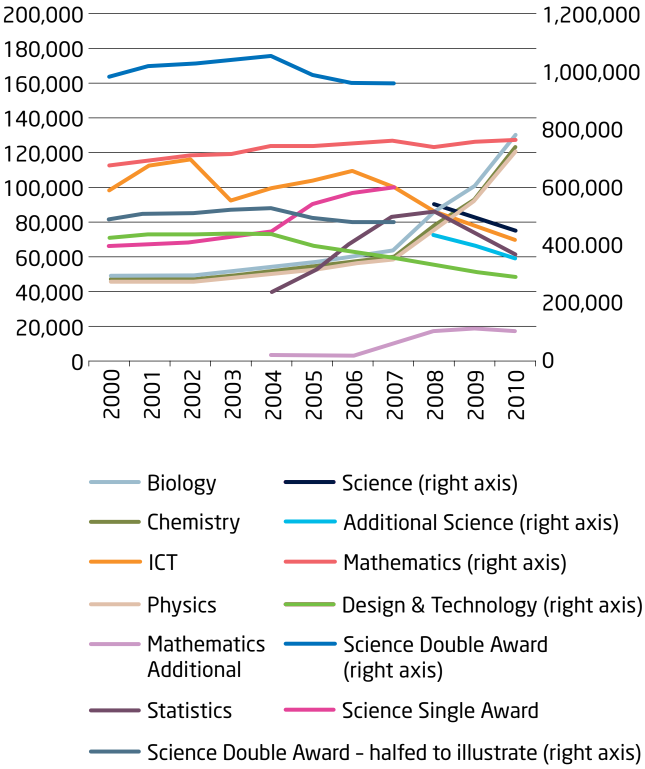
Table 9.0: GCSE full courses entries (2001-2010) – all UK Candidates

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Change over one year	Change over 10 years
Science Double Award -halved to illustrate	489,913	509,242	511,871	519,575	527,017	494,450	479,789	478,028	*[88]	*	*	*	*
Science Double Award	979,826	1,018,484	1,023,742	1,039,150	1,054,034	988,900	959,578	956,056	*	*	*	*	*
Science	*	*	*	*	*	*	*	*	537,606	493,505	449,697	-8.9%	*
Additional Science	*	*	*	*	*	*	*	*	433,468	396,946	352,469	-11.2%	*
Mathematics	673,056	690,704	709,027	712,830	741,682	741,422	750,570	760,299	738,451	754,738	762,792	1.1%	13.3%
Design & Technology	424,468	436,963	433,594	439,617	437,403	396,668	371,672	354,959	332,787	305,809	287,701	-5.9%	-32.2%
Biology	48,715	48,958	49,171	51,156	53,389	56,522	60,082	63,208	85,521	100,905	129,464	28.3%	165.8%
Chemistry	46,917	46,862	47,068	48,802	51,225	53,428	56,764	59,219	76,656	92,246	121,988	32.2%	160.0%
ICT	97,963	111,890	116,033	92,054	98,833	103,400	109,601	99,656	85,599	73,519	61,022	-17.0%	-37.7%
Physics	46,627	46,477	46,511	47,953	50,404	52,568	56,035	58,391	75,383	91,179	120,455	32.1%	158.3%
Science Single award	66,036	66,702	68,393	71,184	74,095	89,348	96,374	98,485	*	*	*	*	*
Statistics	*	*	*	*	39,666	51,432	68,331	82,682	86,224	77,744	69,456	-10.7%	*
Mathematics (Additional)	*	*	*	*	3,205	3,256	3,282	9,793	16,973	18,765	17,183	-8.4%	*
All subjects	5,481,920	5,632,936	5,662,382	5,733,487	5,875,373	5,736,505	5,752,152	5,827,319	5,669,077	4,983,465	4,894,657	-1.8%	-10.7%

Source: Joint Council for Qualifications (JCQ)

88 *means data has not been provided or the course wasn't running in that particular year.

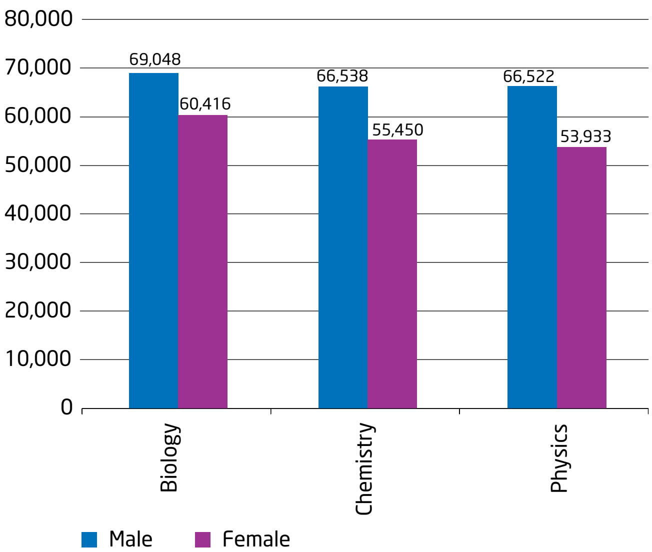
Fig. 9.1 GCSE full courses entries (2001-2010) – all UK Candidates



Source: Joint Council for Qualifications (JCQ)

Figure 9.2 shows that females make up less than 50% of the entrants for each of the single science subjects in 2010. In its recent research project,[89] the Wellcome Trust identified that young women held less positive attitudes towards school science than young men and were less likely to agree that science was a popular subject for young people. This is concerning. If we are to address the gender imbalance in engineering, we also need to address the issue of young women having a less positive attitude towards science.

Fig. 9.2: Entrant numbers to separate science GCSEs by gender (2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

89 Wellcome Trust monitor tracking public views on medical research, Sarah Butt, Elizabeth Clery, Varunie Abeywardana and Miranda Phillips – September 2009

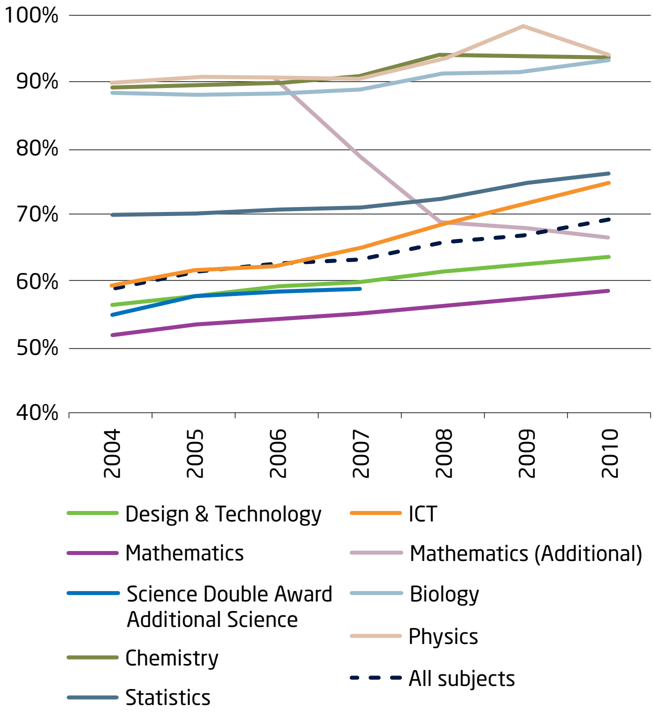
9.2 A*-C[90] achievement rates

Figure 9.3 and Table 9.1 show the average pass rate A*-C for different STEM subjects. Among these selected STEM subjects, the lowest pass rate was for mathematics which, at 59%, was below the average for all subjects (69%). Mathematics is a compulsory GCSE subject[91] and, as such, will be taken by students with a wide range of abilities. This goes some way to explain why the percentage A*-C pass rate is below average. More encouragingly, the A*-C pass rate for mathematics has improved each year since 2004. Additional mathematics was also slightly below average, with an A*-C pass rate of 67%. Whereas the A*-C pass rate for mathematics has been rising each year, the A*-C pass rates for additional mathematics fell to 67% in 2010, from 91% in 2006.

At 64%, the A*-C pass rate for design and technology, an optional subject, was also below average. The pass rate for this subject has been consistently below average since 2004. The number of students taking design and technology is also falling. These findings are an area of concern for the future and warrants further investigation.

The three single sciences all have very high pass rates, with biology achieving 93% passes at grades A*-C, while chemistry and physics both had an A*-C pass rates of 94% – physics having fallen from 99% in 2009.

Fig. 9.3: GCSE A*-C pass rates (2004-2010) - all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 9.1: GCSE A*-C pass rates (2004-2010) – all UK candidates

	2004	2005	2006	2007	2008	2009	2010
Design & Technology	56%	57%	59%	60%	61%	63%	64%
ICT	59%	61%	62%	65%	68%	71%	75%
Mathematics	52%	53%	54%	55%	56%	57%	59%
Mathematics (Additional)	90%	91%	91%	79%	69%	68%	67%
Science Double Award/ Additional Science	55%	57%	58%	59%	*	*	*
Biology	89%	88%	88%	89%	91%	92%	93%
Chemistry	90%	90%	90%	91%	94%	94%	94%
Physics	90%	91%	91%	91%	94%	99%	94%
Statistics	70%	70%	71%	71%	73%	75%	76%
All subjects	59%	61%	62%	63%	66%	67%	69%

Source: Joint Council for Qualifications (JCQ)

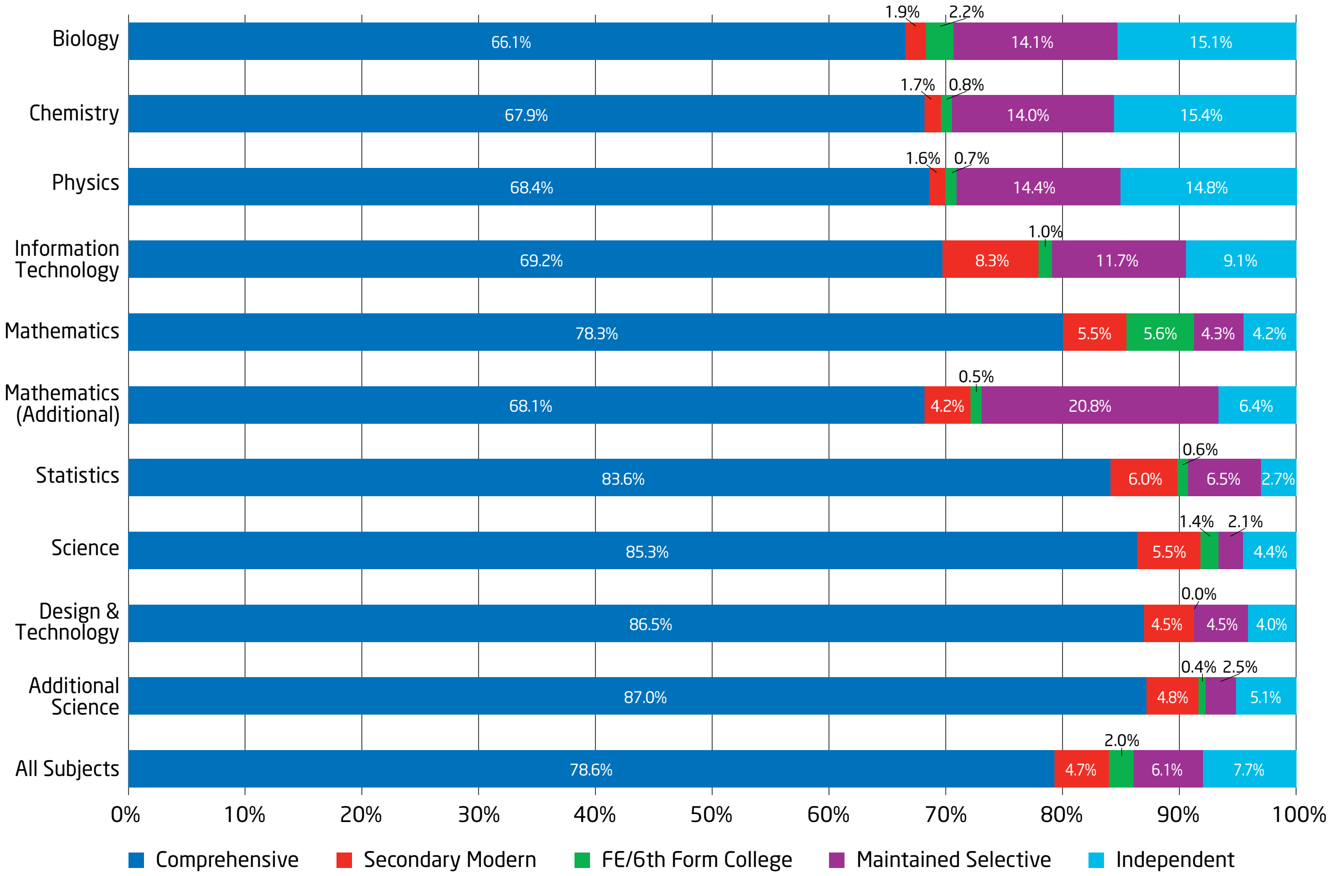
90 Grades A*GE are passes within GCSEs. However, we purposely only analyse/group passes at grades A*-C, as this is the range of grades required for entry into AS level courses.

91 A list of compulsory and optional GCSE subjects can be found at http://www.direct.gov.uk/en/EducationAndLearning/14To19/Years10And11/DG_10013568

9.3 GCSEs by school type

Figure 9.4 clearly shows that independent schools and maintained selective schools are over-represented when you look at students studying single science courses. This highlights the disproportionate importance of these schools in supplying future STEM graduates. Conversely, comprehensive schools are more likely than average to provide students studying science and additional science. Around one in five (20.8%) students studying additional mathematics comes from a maintained selective school.

Fig. 9.4: GCSE subject choices by school and college type (2010) – all UK candidates



Source: Guardian online[92]

92 http://www.guardian.co.uk/news/datablog/2010/aug/24/gcse-results-2010-exam-breakdown

Part 2 Engineering in Education and Training
10.0 Scottish Standards

Scotland has introduced its Curriculum for Excellence which aims to achieve a transformation in education by providing a coherent, more flexible and enriched curriculum from 3 to 18, with every school working towards full engagement of the Curriculum for Excellence from August 2010.

In June 2009, two new qualifications were announced, called National 4 and National 5. In 2013, these will replace Standard grade General and Credit, and Intermediate 1 and 2 qualifications.

Access, Higher and Advanced Higher courses will also be revised to provide progression to and from the new National 4 and National 5 qualifications.

Scotland's curriculum for Excellence 3-18 is designed to provide young people with the knowledge, skills and attributes they need for learning, life and work in the 21st century. It has built upon the existing good practice across all sectors of Scottish education and takes account of research and international comparisons. It recognises the professionalism of teachers and the importance of this in exercising the freedom and responsibility associated with broader guidance. In particular, the learning across the curriculum allows practitioners to make links between subjects, drawing on a range of themes and topics. The learning will be genuinely interdisciplinary, supporting learners in using knowledge and skills from different disciplines. By applying and deepening their learning in relevant contexts, it helps them to make real connections across subjects and disciplines, where appropriate.

This radical and transformational change will undoubtedly be watched with interest by the other devolved nations.

The Scottish Qualifications Authority (SQA) has responsibility for the development, assessment and certification of most qualifications in Scotland, excluding university degrees. Standard grades or intermediates are taken by students aged 14-16 in Scotland and broadly align with GCSEs. There are three 'tiered' levels at which Standard grade examinations can be taken, Foundation, General and Credit.[93]

All the analysis for Standard grades, Access 3 and Intermediate 1 and Intermediate 2 levels are for 2005 to 2010. In each instance, the 2010 data will be the pre-appeals data,[94] so numbers may vary slightly after the appeals process has been completed.

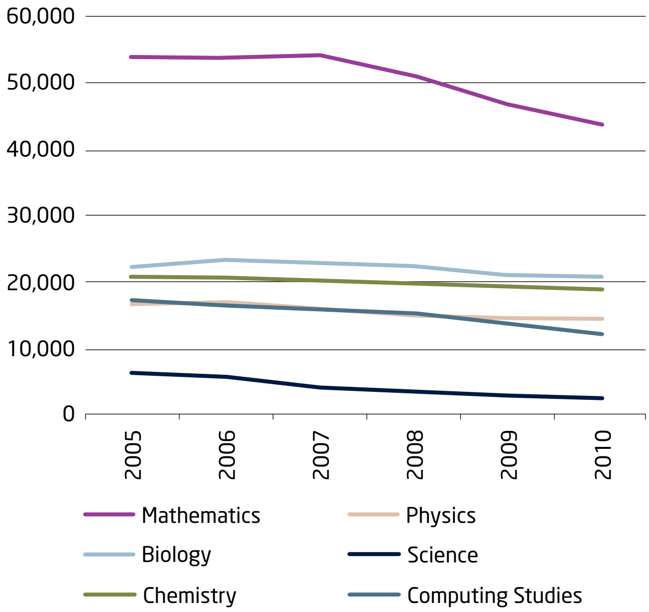
93 http://www.sqa.org.uk/sqa/42135.2629.html

94 Pre-appeals data is from the start of August. Post-appeals data is usually from the start of November when all appeals against grades awarded have been considered.

10.1 Standard grades

Superficially, it appears as if the uptake of STEM courses at Standard grade is declining (Figure 10.0 and Table 10.0), with each of the STEM subjects identified having a lower entry volume in 2010 than they did in 2009, and with numbers being significantly lower than they were in 2005. However, when you look at the proportion of students taking STEM subjects as a proportion of all students studying Standard grades (Figure 10.1), you see that the proportion has stayed broadly similar. The only STEM subject area to show a significant decline is science, which fell from 1.5% of all students in 2005 to 0.8% in 2010.

Fig. 10.0: Standard grade entry volumes (2005-2010) - Scotland



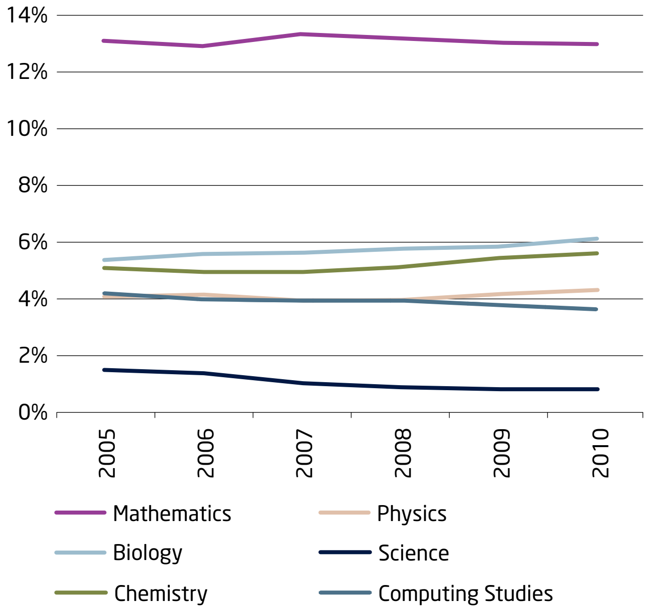
Source: SQA

Table 10.0: Standard grade entry volumes (2005-2010) - Scotland

	2005	2006	2007	2008	2009	2010	Change in last year	Change of six years
Mathematics	53,842	53,782	53,979	50,982	46,782	43,985	-6.0%	-18.3%
Biology	22,213	23,200	22,787	22,319	21,029	20,570	-2.2%	-7.4%
Chemistry	20,876	20,688	20,078	19,773	19,475	18,905	-2.9%	-9.4%
Physics	16,917	17,064	15,940	15,299	14,780	14,571	-1.4%	-13.9%
Science	6,206	5,741	4,205	3,525	2,961	2,607	-12.0%	-58.0%
Computing Studies	17,237	16,508	16,040	15,383	13,586	12,390	-8.8%	-28.1%
All students	411,324	416,052	404,850	387,085	358,728	339,398	-5.4%	-17.5%

Source: SQA

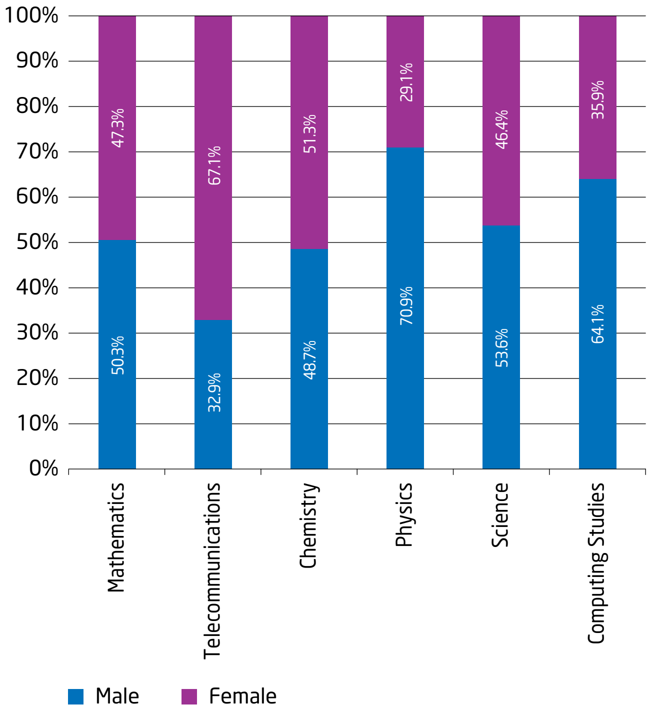
Fig. 10.1: Standard grade entry volumes as a percentage of all entries (2005-2010) - Scotland



Source: SQA

In 2010, the only STEM courses which were close to a 50:50 gender split (Figure 10.2) were mathematics, chemistry and science. Biology was quite heavily skewed towards female students, with 67.1% of all entrants being female. Conversely, physics and computing studies tended to attract predominately male students. For physics, the gender breakdown was 70.9% male and 29.1% female. While for computing studies, nearly two thirds (64.1%) were male and a third (35.9%) were female.

Fig. 10.2: Standard grade entry volumes by gender (2010) - Scotland



Source: SQA

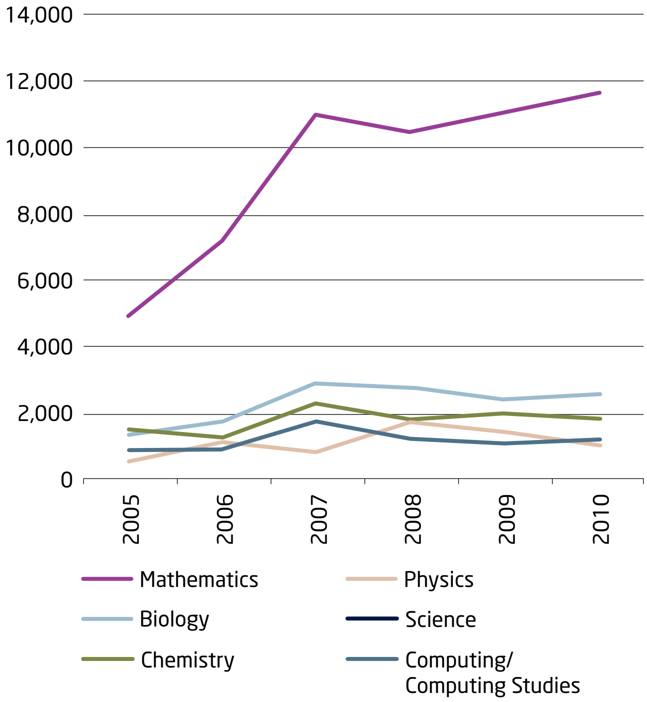
10.2 Access 3

Access 3 courses are equivalent to a Foundation level Standard grade. Although the number of students taking Access 3 courses is small (33,283 in 2010) they have, however, been gaining in popularity: the number of students taking the course has more than doubled in six years (Table 10.1).

The entry volumes for students taking biology and computing/computing studies have both nearly doubled in six years (Figure 10.3), although computing studies did decline 29.9% in 2010. The STEM subject area which has shown the largest growth has been mathematics, where the number of students enrolling on the course has increased 137.6%.

Chemistry (24.7%) and physics (39.7%) have both shown a comparatively small but positive growth in entry volumes, compared with the average six-year growth for all students of 110.4%.

Fig. 10.3: Access 3 entry volumes (2005-2010) - Scotland



Source: SQA

Table 10.1: Access 3 entry volumes (2005-2010) - Scotland

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**Change in last year**	**Change of six years**
Mathematics	4,868	7,145	10,943	10,408	11,002	11,566	5.1%	137.6%
Biology	1,268	1,691	2,812	2,696	2,336	2,474	5.9%	95.1%
Chemistry	1,395	1,211	2,192	1,742	1,881	1,740	-7.5%	24.7%
Physics	789	861	1,654	1,148	1,029	1,102	7.1%	39.7%
Computing/ Computing Studies	486	1012	767	1,653	1,356	951	-29.9%	95.7%
Total	15,820	19,444	30,196	30,756	31,836	33,283	4.5%	110.4%

Source: SQA

10.3 Intermediate 1 and Intermediate 2

Intermediate qualifications are becoming increasingly popular as they align better with Scottish Higher examinations. Intermediate 1 qualifications are equivalent to a General Standard grade,[95] while the Intermediate 2 is equivalent to the Credit Standard grade.[96]

Entry volumes for intermediate 1 (Figure 10.4) has increased by 89.6%, rising from 36,653 in 2005 to 69,510 in 2010 (Table 10.2). However, among the selected STEM subjects, the only subject to have risen by more than 89.6% was engineering craft skills, which increased by 283.6% – albeit from an extremely small base of only 55 in 2005. Chemistry increased its entry volumes by 83.1%, reaching 2,934 in 2010. However, computing studies only rose by 18.3% and actually showed a decline of 13.6% in 2010.

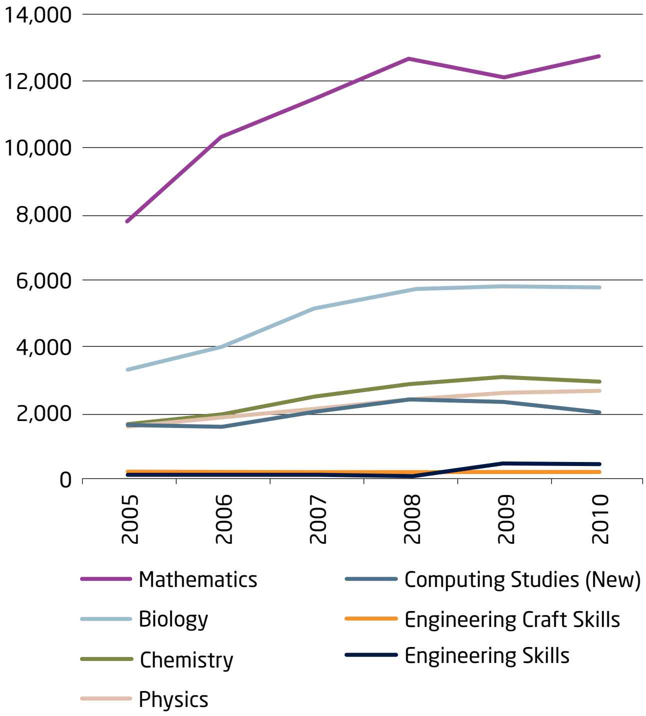
The most important selected STEM subject at Intermediate 1 level was mathematics, with an entry volume of 12,720 (Table 10.2).

The rise in entry volumes (Figure 10.5) for Intermediate 2 has been lower than for Intermediate 1, with growth of 49.7% over the six years (Table 10.3). Three of the selected STEM subjects grew by more than average over the six-year period. These were physics (65.9%), chemistry (58.2%) and engineering craft skills, which grew by an impressive 114.3% – although this was from a small base of 307 in 2005.

Two of the STEM subject areas at Intermediate 2 showed a decline over the six-year period. Information systems had a decline of 41.3%, falling from 2,637 in 2005 to 1,547 in 2010 (Table 10.3). Between 2009 and 2010, entry volumes fell 12.4%.

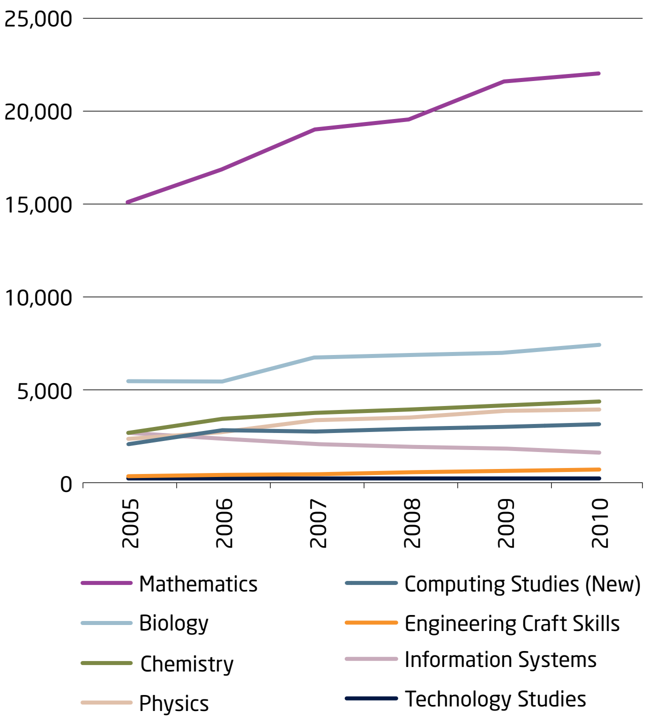
The other Intermediate 2 STEM subject area which had a decline was technological studies, falling by 22.8%. Most of this decline was in the last year: between 2009 and 2010, numbers fell 18.8%. However, it should be noted that technological studies is a very small subject area, with only 224 students in 2005.

Fig. 10.4: Intermediate 1 entry volumes (2005-2010) - Scotland



Source: SQA

Fig. 10.5: Intermediate 2 entry volumes (2005-2010) - Scotland



Source: SQA

95 Standard Grade General is a SCQF level 4 qualification.

96 Standard Grade Credit is a SCQF level 5 qualification.

Table 10.2: Intermediate 1 entry volumes (2005-2010) – Scotland

	2005	2006	2007	2008	2009	2010	Change in one year	Change in six years
Mathematics	7,799	10,317	11,446	12,650	12,082	12,720	5.3%	63.1%
Biology	3,295	3,975	5,146	5,699	5,750	5,716	-0.6%	73.5%
Chemistry	1,602	1,929	2,479	2,824	3,058	2,934	-4.1%	83.1%
Physics	1,555	1,845	2,092	2,379	2,558	2,608	2.0%	67.7%
Computing Studies (New)	1,674	1,552	2,024	2,403	2,294	1,981	-13.6%	18.3%
Engineering Craft Skills	55	63	73	152	138	211	52.9%	283.6%
Engineering Skills	-	-	-	33	455	433	-4.8%	-
Total	36,653	45,174	53,840	60,267	65,735	69,510	5.7%	89.6%

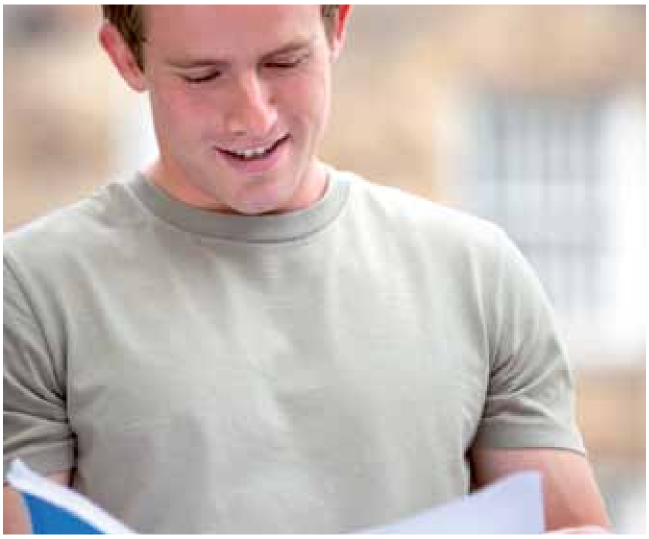
Source: SQA

Table 10.3: Intermediate 2 entry volumes (2005-2010) – Scotland

	2005	2006	2007	2008	2009	2010	Change in one year	Change in six years
Mathematics	15,172	16,789	18,989	19,480	21,487	21,927	2.0%	44.5%
Biology	5,336	5,326	6,615	6,755	6,927	7,354	6.2%	37.8%
Chemistry	2,728	3,369	3,725	3,918	4,110	4,317	5.0%	58.2%
Physics	2,354	2,645	3,352	3,488	3,796	3,905	2.9%	65.9%
Computing (New)	2,094	2,742	2,682	2,865	2,948	3,079	4.4%	47.0%
Engineering Craft Skills	307	367	354	526	602	658	9.3%	114.3%
Information Systems	2,637	2,263	1,993	1,846	1,765	1,547	-12.4%	-41.3%
Technological Studies	224	197	207	155	213	173	-18.8%	-22.8%
Total	87,100	94,686	107,340	113,388	122,463	130,380	6.5%	49.7%

Source: SQA

Part 2 Engineering in Education and Training
11.0 AS levels and A levels



Despite much debate and controversy over many years, A levels generally are still regarded as the 'gold standard' by the populous at large. However, whilst the UK is still wedded to A levels, concerns over the ever increasing proportion of Grade As, and the resultant challenge for universities and/or employers to be able to differentiate between bright candidates, has resulted in a recent change to the way that A level (but not AS level) subjects are graded in 2010.

A new A* grade has been brought in to differentiate the brightest students. In order to achieve an A* at A level, a student needs to:[97]

- Achieve an overall A grade for their A level
- Score 90% or more of the total A2 marks available

In the first year of operation, 8% of pupils received at least one A* grade, which is slightly higher than the 7% predicted by Ofqual. [98]

The *Sir Richard Sykes Review*[99] considers the future of the qualifications and assessment system in English schools, specifically in relation to academic qualifications. The review's recommendations included reforms designed to lead to a better experience for the students, teachers, employers and universities involved. These ideas are gaining some support.

As the government raises the school leaving age to 17 in 2013 and 18 in 2015, the number of students progressing through to A levels will only increase. What impact this change will have in the number of students studying STEM courses at A level, or on the percentages gaining an A*-C pass rate, can't be determined at this stage.

97 http://www.ofqual.gov.uk/files/2010-02-11-open-letter-a-star-grade.pdf

98 http://www.bbc.co.uk/news/education-11012369

99 http://www.conservatives.com/News/News_stories/2010/03/~/media/Files/Downloadable%20Files/Sir%20Richard%20Sykes_Review.ashx

11.1 AS level entrant numbers

Of all the STEM subjects, further mathematics has had the largest growth over a seven-year period, growing by a massive 274.0% against an average of only 15.2% for all subjects (Figure 11.0 and Table 11.0). In 2010 alone it grew 13.1% to reach 14,884 candidates. Mathematics candidates also increased dramatically over the same period, with numbers rising by 81.7% over the period and by 9.2% in 2010. Over the seven-year period, applicant numbers have gone up from 62,098 to 112,847, making it the largest STEM subject in 2010.

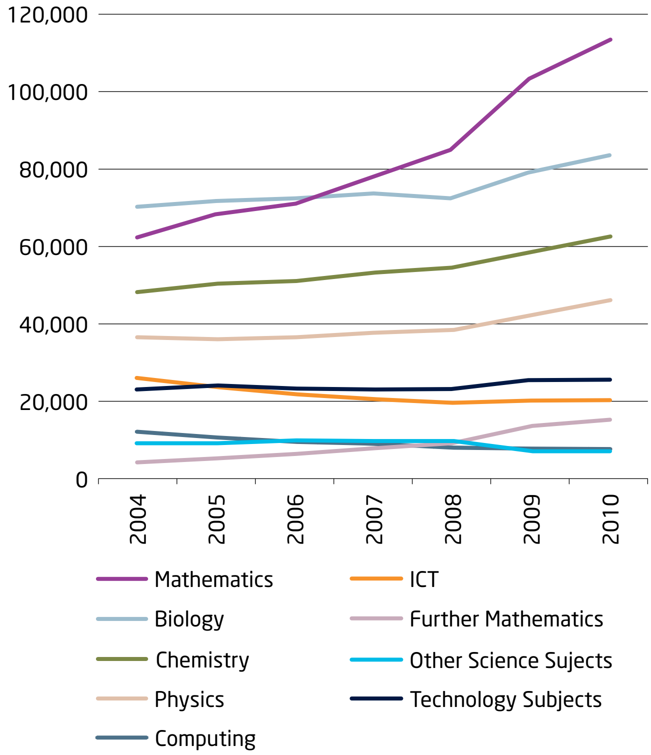
In 2004, biology was the largest STEM subject, with 70,035 entrants. However, entrant numbers have only grown by 19.1% over seven years, peaking at 83,408 in 2010 and relegating it to second position.

Chemistry entrant numbers grew by 6.4% over the last year and by 29.2% over the seven years, reaching 62,232 in 2010. In comparison, physics grew slightly faster in 2010 (8.5%) but had lower overall growth over the seven-year period (24.1%). In 2010, there were 45,534 entrants for physics.

Technology subjects barely increased their share of entrants in 2010, growing by only 0.3%. The overall rise in candidates over seven years was 11.4%, which was below the average for all subjects. In 2010, there were 25,201 entrants, compared with 22,629 in 2004.

It is disturbing to note that the two computer-related subject areas have seen a decline in entrant numbers over the seven years. Computing has seen a 38.4% drop in entrant numbers over seven years, falling 4.5% in 2010 to 7,223, compared with 11,722 in 2004. ICT numbers fell by 22.1% over the same period. Although, more promisingly, numbers did rise by 1.1% in 2010. In total, 19,910 candidates took ICT in 2010, compared with 25,558 in 2004.

Fig. 11.0: GCE AS level STEM subject entrant volumes (2004-2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 11.0: GCE AS level STEM subject entrant volumes (2004-2010) – all UK candidates

	2004	2005	2006	2007	2008	2009	2010	Change over one year	Change over seven years
Biology	70,035	71,346	72,246	73,572	72,239	79,112	83,408	5.4%	19.1%
Chemistry	48,166	49,951	50,855	52,835	54,157	58,473	62,232	6.4%	29.2%
Computing	11,722	10,247	9,208	8,719	7,821	7,564	7,223	-4.5%	-38.4%
ICT	25,558	23,444	21,790	20,422	19,266	19,696	19,910	1.1%	-22.1%
Mathematics	62,098	68,178	70,805	77,387	84,613	103,312	112,847	9.2%	81.7%
Further Mathematics	3,980	5,054	6,292	7,426	8,945	13,164	14,884	13.1%	274.0%
Physics	36,700	35,828	36,258	37,323	38,129	41,955	45,534	8.5%	24.1%
Other Science Subjects[100]	8,892	9,053	9,801	9,343	9,529	6,947	6,873	-1.1%	-22.7%
Technology Subjects[101]	22,629	23,736	23,099	22,702	22,953	25,120	25,201	0.3%	11.4%
All subjects	1,039,379	1,079,566	1,086,634	1,114,424	1,128,150	1,177,349	1,197,490	1.7%	15.2%

Source: Joint Council for Qualifications (JCQ)

Table 11.1 shows the ten AS subjects with the highest percentage growth in 2010. Further mathematics comes top, with growth in candidate numbers of 13.07%. However, it is noticeable how many other STEM subjects are also in the top ten, indicating a possible renaissance for STEM.

Table 11.1: Top ten AS level subjects for percentage increase in the number of entrants (2009-2010) – all UK candidates

Subject (2009 raniking in brackets)		Changes from 2009-2010		
		% change	2009 Number of candidates	2010 Number of candidates
1 (2)	Mathematics (Further)	13.07	13,164	14,884
2 (26)	Other Modern Languages	12.96	7,822	8,836
3 (34)	Communication Studies	11.19	3,405	3,786
4 (3)	Mathematics	9.23	103,312	112,847
5 (5)	Physics	8.53	41,955	45,534
6 (9)	Chemistry	6.43	58,473	62,232
7 (10)	Political Studies	5.84	16,499	17,462
8 (13)	Spanish	5.74	9,694	10,250
9 (25)	Sociology	5.61	42,244	44,612
10 (6)	Biology	5.43	79,112	83,408

Source: Joint Council for Qualifications (JCQ)

100 Includes all science subjects except biology, chemistry and physics

101 Covers a range of technology-related subjects

11.2 AS level A-C[102] achievement rates

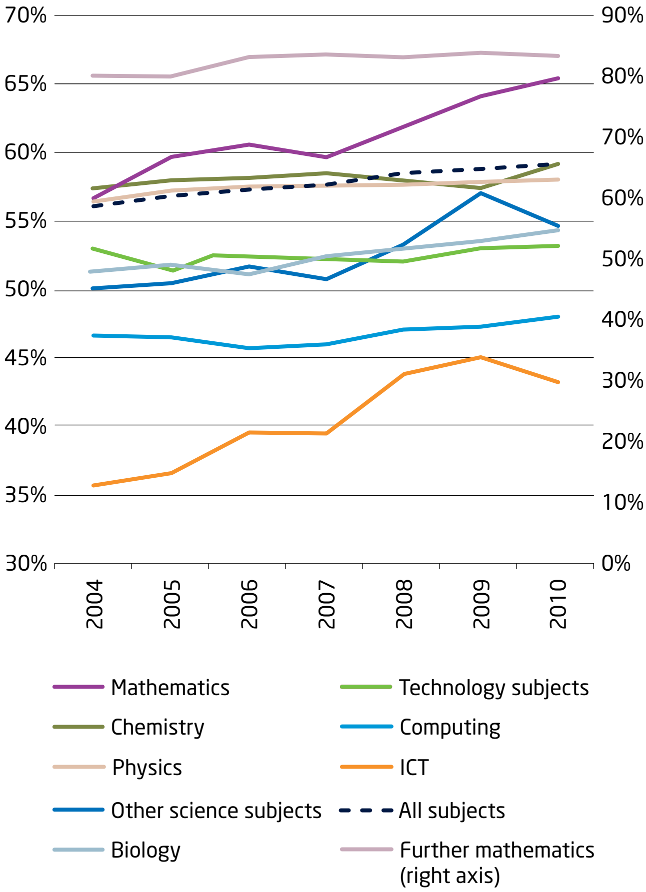
The overall A-C pass rate has increased each year since 2004, rising to 59.1% in 2010 (Figure 11.1 and Table 11.2). It is notable that six of the eight STEM subjects have a lower-than-average A-C pass rate. There has been a long-running debate over the relative difficulty of STEM subjects compared with some other courses; the fact that six out of the eight STEM subjects have a below average A-C pass rate could be seen to support the argument that STEM courses are more difficult.

It is also notable that computing and ICT, which have both seen a large percentage decline in the number of entrants, also have the lowest A-C pass rates. This raises the possibility that the low A-C pass rate is adversely affecting entrance numbers to these courses.

Three subjects had an above average A-C pass rate. Of these, further mathematics stands out, with an A-C pass rate of 83.5% (although this is slightly down on 2009's 83.6%). Mathematics also had an impressive A-C pass rate, at 65.4%, up from 64.1% in 2009.

The only science to have an above average A-C pass rate was chemistry. But at 59.2%, it was only 0.1% above the average for all subjects. Biology was the worst performing science, with an A-C pass rate of 54.5%. In fact, all the science subjects were close to each other in terms of their A-C pass rate.

Fig. 11.1: GCE AS level STEM subject A-C achievement rates (2004-2010) - all UK candidates



Source: Joint Council for Qualifications (JCQ)

102 Grades A-E are passes within A levels. However, we purposely only analyse/group passes at grades A-C as these are generally the grades required for entry into STEM honours degree courses.

Table 11.2: GCE AS level STEM subject A-C achievement rates (2004-2010) – all UK candidates

	2004	2005	2006	2007	2008	2009	2010
Further Mathematics	79.9%	80.0%	82.8%	83.4%	83.1%	83.6%	83.5%
Mathematics	56.4%	59.6%	60.6%	59.6%	61.7%	64.1%	65.4%
Chemistry	57.3%	57.9%	58.1%	58.5%	57.7%	57.3%	59.2%
Physics	56.4%	56.7%	57.6%	57.3%	57.7%	57.7%	58.1%
Other Science Subjects	50.0%	50.5%	51.6%	50.7%	53.2%	57.0%	54.6%
Biology	51.2%	51.7%	51.2%	52.3%	52.7%	53.3%	54.5%
Technology Subjects	52.8%	51.3%	52.4%	52.3%	52.0%	52.9%	53.2%
Computing	46.6%	46.5%	45.7%	46.1%	47.1%	47.2%	48.0%
ICT	35.6%	36.6%	39.5%	39.5%	43.7%	45.0%	43.3%
All subjects	56.1%	56.8%	57.3%	57.6%	58.5%	58.7%	59.1%

Source: Joint Council for Qualifications (JCQ)

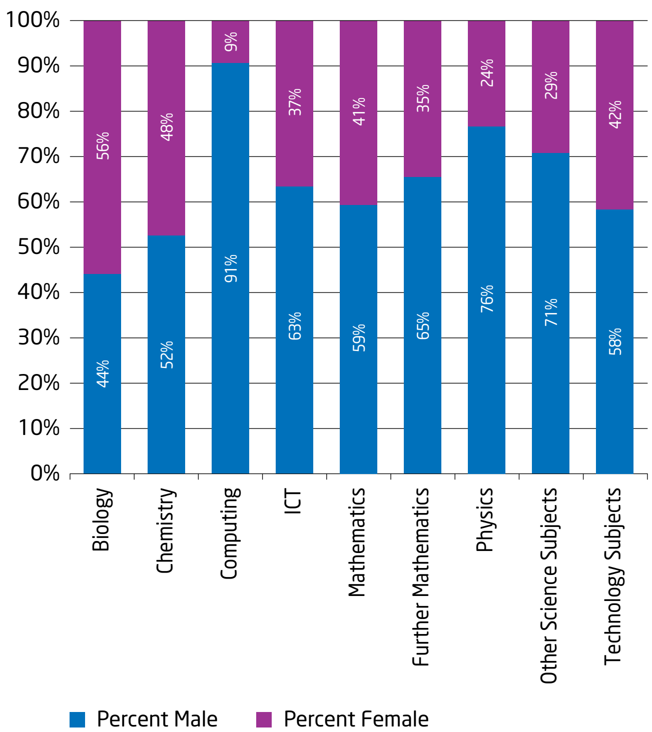
11.3 AS level gender balance

Examining the proportion of entrants to different STEM subjects by gender (Figure 11.2 and Table 11.3) shows a great deal of variation. There are four subjects where the gender split is close to parity. Two of these are physical sciences: chemistry (52% male and 48% female) and biology (44% male and 56% female). The other two subjects are technology studies (58% male and 42% female) and mathematics (59% male and 41% female).

By comparison, computing is almost exclusively male (91%). It is interesting to note that ICT has a better gender balance, with 63% of entrants being male and 37% female. But it is still a long way off parity.

Three quarters (76%) of entrants to physics are male, compared with 24% female, making it the science subject with the worst gender balance.

Fig. 11.2: AS level gender balance amongst entrants (2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 11.3: AS level gender balance amongst entrants (2010) – all UK candidates

	Total male	Total female	Total
Biology	36,585	46,823	83,408
Chemistry	32,429	29,803	62,232
Computing	6,537	686	7,223
ICT	12,557	7,353	19,910
Mathematics	66,579	46,268	112,847
Further Mathematics	9,701	5,183	14,884
Physics	34,726	10,808	45,534
Other Science Subjects	4,861	2,012	6,873
Technology Subjects	14,589	10,612	25,201

Source: Joint Council for Qualifications (JCQ)

Table 11.4 looks at the seven-year trend of female entrants to each of the different STEM courses. The table shows that the proportion of female entrants has been stable over the period, with all STEM subjects only showing only a 0-4% change in the proportion of females. Five of the STEM subjects have actually shown a slight decline in the proportion of female entrants, compared with only three which have shown an increase.

It is clear that further work needs to be done to encourage female students to take STEM subjects at AS level if we are to move to a position where all STEM subjects have a broadly equal proportion of male and female students. In particular, computing needs to be investigated to understand why such a low proportion of women take this course, particular when compared with ICT.

103 Includes all science subjects except biology, chemistry and physics

104 Covers a range of technology-related subjects

Table 11.4: Percentage of female entrants for STEM GCE AS level courses (2004-2010) – all UK candidates

	2004	2005	2006	2007	2008	2009	2010
Biology	60%	59%	59%	58%	57%	57%	56%
Chemistry	50%	50%	50%	49%	49%	48%	48%
Computing	12%	11%	11%	11%	11%	10%	9%
ICT	37%	37%	37%	38%	38%	37%	37%
Mathematics	40%	40%	41%	41%	42%	42%	41%
Further Mathematics	33%	34%	35%	34%	35%	35%	35%
Physics	25%	25%	24%	25%	24%	24%	24%
Other Science Subjects	31%	32%	33%	34%	35%	30%	29%
Technology Subjects	39%	41%	42%	41%	41%	42%	42%

Source: Joint Council for Qualifications (JCQ)

11.4 A level entrant numbers

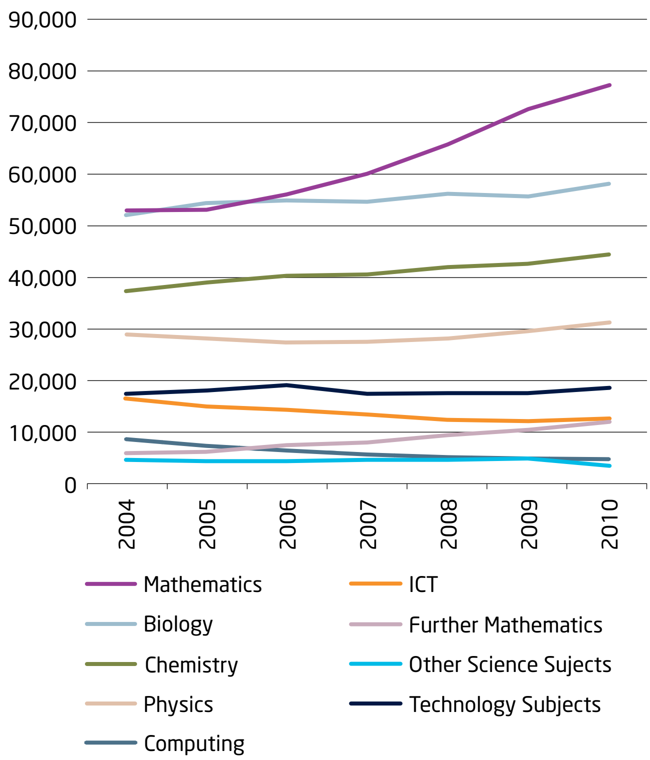
In 2010, the growth in entrants to all subjects was 0.8% (Figure 11.3 and Table 11.5). All but two of the STEM subjects had higher-than-average growth in the number of entrants. The only two subjects to have performed worse than all subjects in 2010 was computing, which experienced a 13.7% drop in entrants, and other science subjects, which declined by a quarter (25.2%).

The largest growth in entrants over seven years has been for further mathematics, which more than doubled in numbers (104.2%). This is not surprising when we recall that at AS level, entrant numbers to further mathematics grew by 274.0%. Mathematics was the STEM subject with the second largest growth in A level entrant numbers over seven years (45.9%). In 2010, mathematics grew by 6.2% to 77,001 entrants, the biggest entrance pool of all the STEM subjects.

The three physical sciences have all shown positive growth both over the seven-year period and in the last year, with chemistry rising 18.2%, biology 10.7% and physics 7.9% since 2004. It should be noted that while biology is the second largest STEM subject by entrant numbers in 2010 (57,854), it was the largest in 2005. This could be attributable to the rapid growth in popularity of mathematics, which attracted 19,147 more entrants than biology in 2010.

Unsurprisingly, given the fall in AS level entrants, the number of entrants to A level computing and ICT have both fallen heavily over the seven-year period. Computing has fallen by over half (52.1%) from 8,488 entrants in 2004 to only 4,065 in 2010. The decline of ICT has not been as dramatic. Although it attracted 24.3% fewer entrants over the period (down from 16,106 to 12,186), entrant numbers did grow in the last year, by 2.0% – a slightly larger increase than was achieved in AS level entrants in 2010.

Fig. 11.3: GCE A level STEM subject entrant numbers (2004-2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 11.5: GCE A level STEM subject entrant numbers (2004-2010) – all UK candidates

	2004	2005	2006	2007	2008	2009	2010	Change over one year	Change over seven years
Biology	52,264	53,968	54,890	54,563	56,010	55,485	57,854	4.3%	10.7%
Chemistry	37,254	38,851	40,064	40,285	41,680	42,491	44,051	3.7%	18.2%
Computing	8,488	7,242	6,233	5,610	5,068	4,710	4,065	-13.7%	-52.1%
ICT	16,106	14,883	14,208	13,360	12,277	11,948	12,186	2.0%	-24.3%
Mathematics	52,788	52,897	55,982	60,093	65,593	72,475	77,001	6.2%	45.9%
Further Mathematics	5,720	5,933	7,270	7,872	9,091	10,473	11,682	11.5%	104.2%
Physics	28,698	28,119	27,368	27,466	28,096	29,436	30,976	5.2%	7.9%
Other Science Subjects[103]	4,444	4,414	4,209	4,544	4,555	4,496	3,361	-25.2%	-24.4%
Technology Subjects [104]	17,261	17,914	18,684	17,417	17,396	17,442	18,417	5.6%	6.7%
All subjects	766,247	783,878	805,698	805,657	827,737	846,977	853,933	0.8%	11.4%

Source: Joint Council for Qualifications (JCQ)

The A level subject which had the highest percentage growth in 2010 was further mathematics, which attracted 11.54% more entrants (Table 11.6). It is also noticeable that mathematics had the third highest percentage growth, while technology subjects came fourth. It can also be seen that all three of the physical science A level subjects made the top ten, with physics fifth, biology sixth and chemistry ninth. This means that five of the top ten subjects for growth were STEM subjects.

Table 11.6: Top 10 A level subjects for percentage increase in the number of entrants (2009-2010) – all UK candidates

Subject (2009 ranking in brackets)		% change	Changes from 2009-2010 2009 Number of candidates	2010 Number of candidates
1 (2)	Mathematics (Further)	11.54	10,473	11,682
2 (3)	Economics	9.00	20,987	22,875
3 (4)	Mathematics	6.24	72,475	77,001
4 (24)	Technology Subjects	5.59	17,442	18,417
5 (9)	Physics	5.23	29,436	30,976
6 (25)	Biology	4.27	55,485	57,854
7 (11)	Spanish	4.02	7,334	7,629
8 (23)	Psychology	3.91	52,872	54,940
9 (19)	Chemistry	3.67	42,491	44,051
10 (26)	Performing / Expressive Arts	3.26	3,591	3,708

Source: Joint Council for Qualifications (JCQ)

103 Includes all science subjects except biology, chemistry and physics

104 Covers a range of technology-related subjects

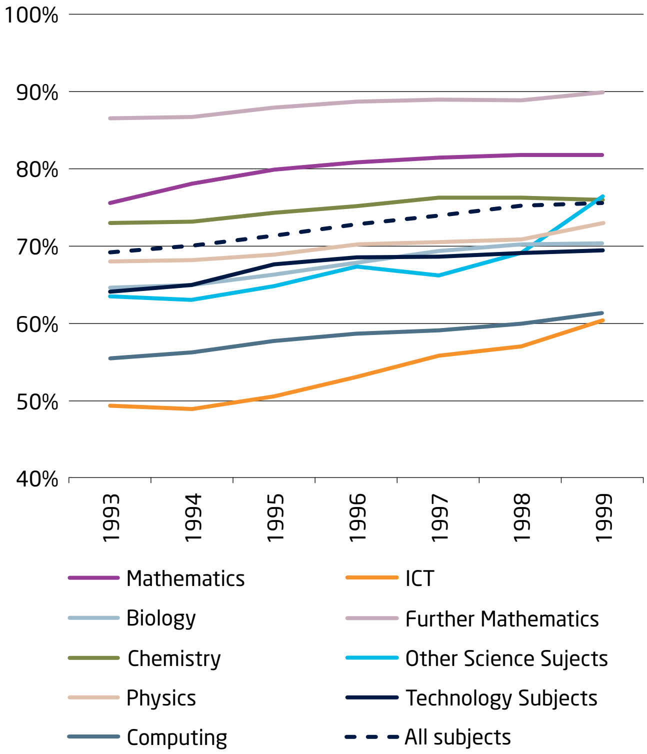
11.5 A level A*-C achievement rates

In 2010, the average A*-C pass rate was 75.4% which was a slight increase on the previous year. It has also risen from 2004, when the pass rate was 69.0% (Figure 11.4 and Table 11.7).

There was a wide degree of variation in the A*-C pass rate for STEM A level subjects, ranging from a low point of 60.2% for ICT to a very impressive 89.8% for further mathematics. Since last year, seven of the nine STEM subjects have seen an increase in the A*-C pass rate. The largest increase was for other science subjects, which went up from 69.0% in 2009 to 76.3% in 2010. ICT also had a large rise, going from 56.9% in 2009 to 60.2% the following year.

By comparison, only two STEM subject areas have seen achievement rates fall, mathematics and chemistry. However, in each case the fall on 2009 figures is very small.

Fig. 11.4: Proportion achieving grade A*-C at GCE level (2004-2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 11.7: Proportion achieving grade A*-C at GCE level (2004-2010) – all UK candidates

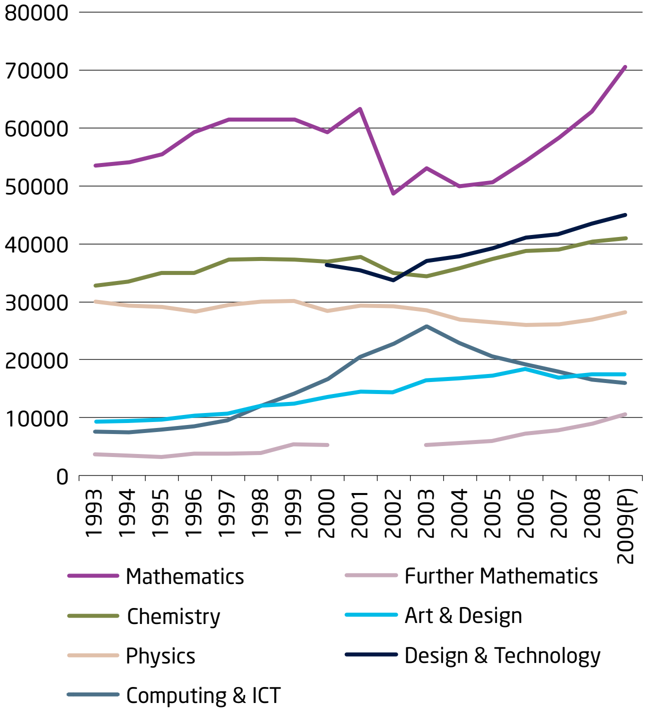
	2004	2005	2006	2007	2008	2009	2010
Further Mathematics	86.5%	86.6%	87.9%	88.5%	88.9%	88.9%	89.8%
Mathematics	75.7%	77.9%	79.9%	80.7%	81.3%	81.8%	81.7%
Chemistry	73.0%	73.1%	74.2%	75.2%	76.3%	76.2%	75.8%
Physics	67.9%	68.1%	68.9%	70.2%	70.6%	70.8%	72.9%
Biology	64.1%	65.0%	66.3%	67.7%	69.2%	70.2%	70.3%
Technology Subjects	63.5%	64.8%	67.6%	68.6%	68.6%	69.1%	69.6%
Computing	55.6%	56.2%	57.8%	58.7%	59.0%	59.9%	61.3%
ICT	49.4%	49.0%	50.6%	53.0%	55.8%	56.9%	60.2%
Other science subjects	63.4%	63.0%	64.9%	67.4%	66.2%	69.0%	76.3%
All subjects	69.0%	69.9%	71.3%	72.8%	73.9%	75.1%	75.4%

Source: Joint Council for Qualifications (JCQ)

11.6 Long-term A level trend: 1993-2009

Figure 11.5 shows the 17-year trend in achieved A levels for selected subjects. Following the revision of A level mathematics in 2000, 2002 saw a very sharp decline in the number of mathematics A levels achieved.

Fig. 11.5: GCE A levels achieved in selected A level subjects (1993-2009) – all UK candidates

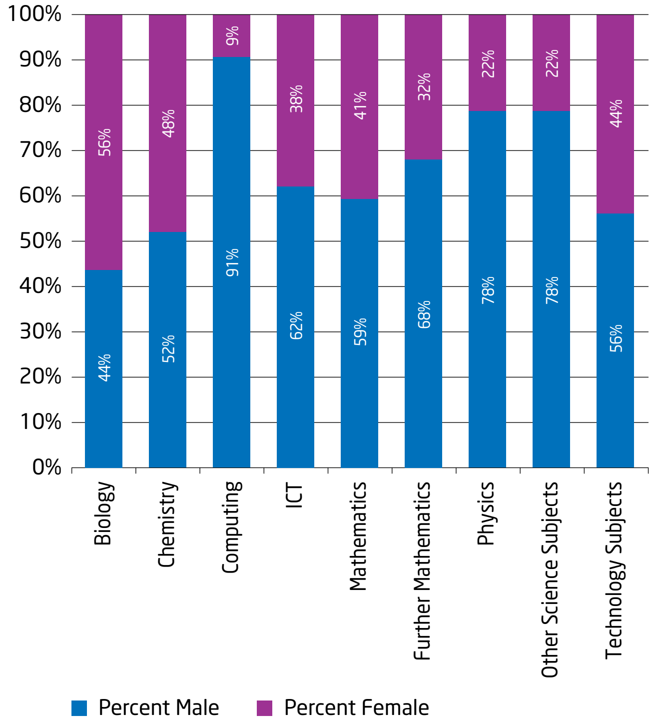


Source: Joint Council, AQA/JCQ

11.7 Gender balance within STEM A levels

Figure 11.6 and Table 11.8 show the gender breakdown of different STEM subjects. For most of these subjects, the pattern is very similar to that identified at AS level, with only biology, chemistry, mathematics and technology subjects having a gender profile that is close to parity.

Fig. 11.6: Gender balance within STEM A level (2010) – all UK candidates



Source: Joint Council for Qualifications (JCQ)

Table 11.8: GCE A level entry volumes by gender (2010) – all UK candidates

	Male	Female	Total
Biology	25,219	32,635	57,854
Chemistry	22,994	21,057	44,051
Computing	3,704	361	4,065
ICT	7,543	4,643	12,186
Mathematics	45,737	31,264	77,001
Further Mathematics	7,954	3,728	11,682
Physics	24,308	6,668	30,976
Other Science Subjects	2,638	723	3,361
Technology Subjects	10,368	8,049	18,417

Source: Joint Council for Qualifications (JCQ)

Table 11.9 shows the proportion of female entrants to STEM A level subjects over seven years. The proportion of female entrants does stay remarkably consistent, with most subjects only varying by up to 4%.

Table 11.9: Percentage of female entrants for STEM GCE A level courses (2004-2010) – all UK candidates

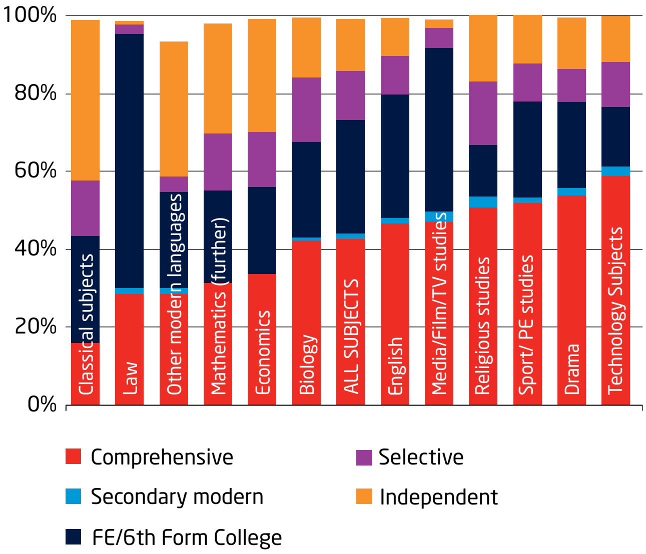
	2004	2005	2006	2007	2008	2009	2010
Biology	60.3%	59.1%	58.8%	58.7%	58.1%	57.3%	56.4%
Chemistry	50.8%	49.4%	49.1%	49.8%	48.7%	48.4%	47.8%
Computing	12.2%	11.3%	9.7%	10.2%	9.5%	9.6%	8.9%
ICT	34.9%	35.5%	36.3%	37.3%	38.0%	38.6%	38.1%
Mathematics	38.7%	38.1%	39.1%	40.0%	39.4%	40.6%	40.6%
Further Mathematics	28.4%	28.6%	29.8%	29.4%	30.4%	31.3%	31.9%
Physics	22.3%	22.0%	21.8%	22.2%	21.9%	22.2%	21.5%
Other Science Subjects	27.5%	26.9%	27.1%	27.7%	27.0%	27.8%	21.5%
Technology Subjects	37.7%	39.1%	40.7%	41.9%	41.3%	41.5%	43.7%

Source: Joint Council for Qualifications (JCQ)

11.8 A level choices and achievements by school/college type

As part of its analysis of A level results for 2010, the Guardian website includes an analysis of the Joint Council for Qualifications (JCQ) data, looking at A level subjects by school/college type (Figure 11.7). Further mathematics attracts a disproportionately large percentage of students from independent schools, while technology subjects are mainly studied by students in comprehensive schools.

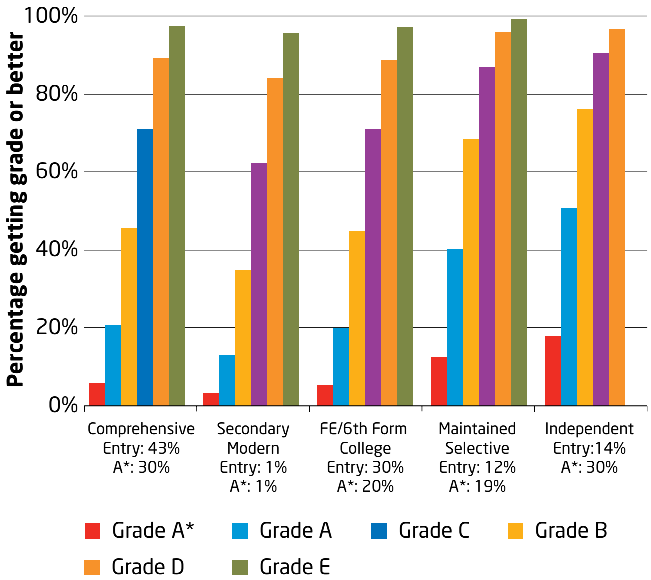
Fig. 11.7: Guardian analysis of A level subjects by school/college type (2010) – England



Source: Guardian online[105]

It is also possible to explore grades achieved by school/college type (Figure 11.8). Independent schools represent 14% of all entrants. However, 18% of students in independent schools received at least one A*, compared with the national average of 8% and 6% of students in state schools.

Fig. 11.8: A level grades achieved by school/college type (2010) – England

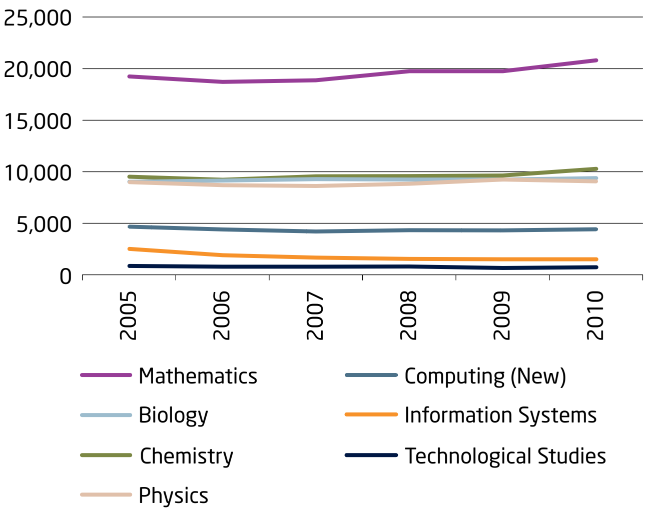


Source: Joint Council for Qualifications (JCQ)

105 http://www.guardian.co.uk/news/datablog/2010/aug/19/a-levels-results-analysis-subject-school#zoomed-picture

Part 2 Engineering in Education and Training
12.0 Scottish Highers and Advanced Highers

Fig. 12.0: Higher entry volumes (2005-2010) – Scotland



Source: SQA

12.1 Scottish Highers

In Scotland, the equivalent qualifications to A levels are the Higher grade or Advanced Higher grade, usually known as 'Highers'. These are set at SCQF level 6, roughly equivalent to NQF level 3.

Figure 12.0 and Table 12.0 show the six-year trend in entries for selected STEM subjects. Over the six-year period, there has been an average growth in entries of 6.9%. Four of the STEM subject areas have seen positive growth, with mathematics (7.7%) and chemistry (8.1%), growing by more than average.

However, three subject areas also saw a decline in popularity over the six years. Computing entrant numbers have been static since 2007 and saw an overall decline of 5.9%. Technological studies has suffered an overall decline in numbers of 14.2%, but saw a rise of 17.2% in 2010. Information systems is a cause for concern. Entrant numbers fell 42.0% over the six years, from 2,469 in 2005 to 1,432 in 2010.

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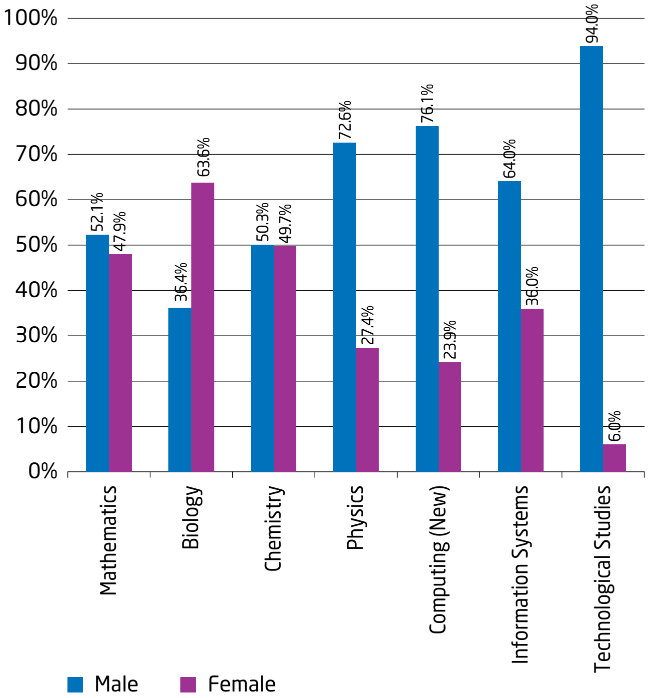
Table 12.0: Higher entry volumes (2005-2010) – Scotland

	2005	2006	2007	2008	2009	2010	Change over one year	Change over six years
Mathematics	19,181	18,623	18,792	19,636	19,638	20,654	5.2%	7.7%
Biology	8,943	9,044	9,169	9,132	9,107	9,291	2.0%	3.9%
Chemistry	9,411	9,168	9,490	9,505	9,582	10,177	6.2%	8.1%
Physics	8,952	8,617	8,582	8,765	9,002	9,014	0.1%	0.7%
Computing (New)	4,628	4,356	4,180	4,256	4,307	4,356	1.1%	-5.9%
Information Systems	2,469	1,904	1,656	1,484	1,413	1,432	1.3%	-42.0%
Technological Studies	848	771	771	758	621	728	17.2%	-14.2%
All entries	164,142	159,140	161,081	162,576	167,792	175,492	4.6%	6.9%

Source: SQA

Examining the Scottish Highers entry data by gender (Figure 12.1), it is noted that mathematics and chemistry have a near 50:50 gender split. Nearly two thirds (63.6%) of biology entrants are female. Technological studies is very male-dominated, with a 94% bias. Computing, physics and information systems are also predominately male courses, at 76.1%, 72.6% and 64.0% of entrants respectively.

Fig. 12.1: Higher entry volumes by gender (2010) – Scotland



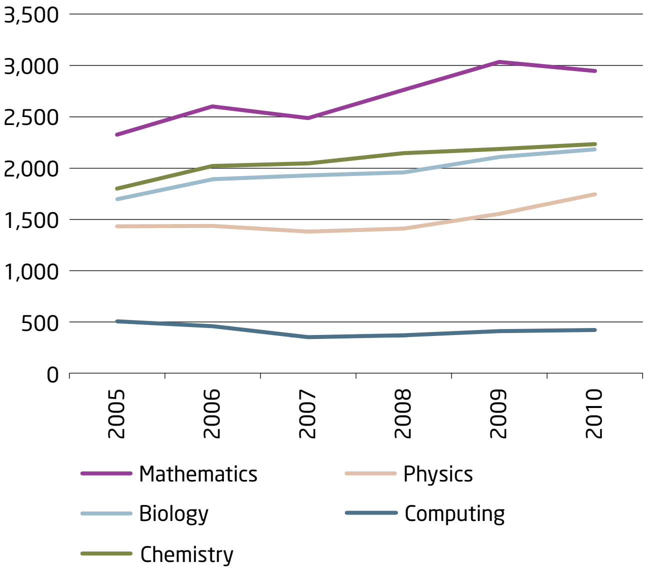
Source: SQA

12.2 Advanced Highers

Four of the five STEM subject areas, biology (28.6%), mathematics (26.6%), chemistry (24.2%) and physics (21.7%) have all grown by more than the average across all entries (20.1%) over the six-year period (Figure 12.2 and Table 12.1). Physics had particularly strong growth in 2010, with a rise in entrant numbers of 12%, while mathematics slipped back slightly (down by 3%).

Computing is the smallest of the five STEM subject and is the only STEM subject which has shown a decline in entrant numbers over the six-year period: down 17.0% from 499 in 2005 to 414 in 2010.

Fig. 12.2: Higher entry volumes (2005-2010) – Scotland



Source: SQA

Table 12.1: Advanced Higher entry volumes (2005-2010) – Scotland

	2005	2006	2007	2008	2009	2010	Change over one year	Change over six years
Mathematics	2,318	2,598	2,484	2,752	3,027	2,935	-3.0%	26.6%
Biology	1,693	1,886	1,929	1,955	2,095	2,177	3.9%	28.6%
Chemistry	1,792	2,016	2,039	2,143	2,183	2,225	1.9%	24.2%
Physics	1,426	1,437	1,380	1,403	1,550	1,736	12.0%	21.7%
Computing	499	450	349	366	411	414	0.7%	-17.0%
All entries	17,140	18,264	17,831	18,854	19,648	20,580	4.7%	20.1%

Source: SQA

Figure 12.3 shows the gender breakdown of entries to the different STEM subjects. Chemistry is the only subject area which is nearly balanced in terms of gender. Biology is favoured by females, who make up nearly two thirds of entrants (65.4%). Computing is the subject with the lowest proportion of women; they represent only 16.9% of all entrants. Physics (23.4%) and mathematics (38.5%) also have a low proportion of female entrants.

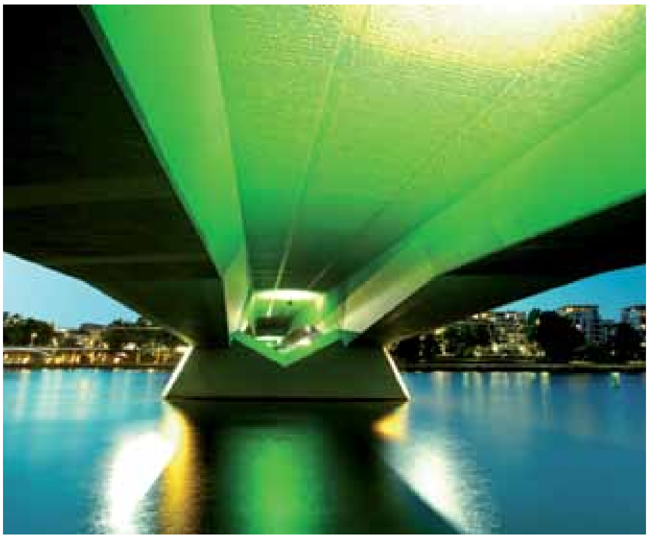
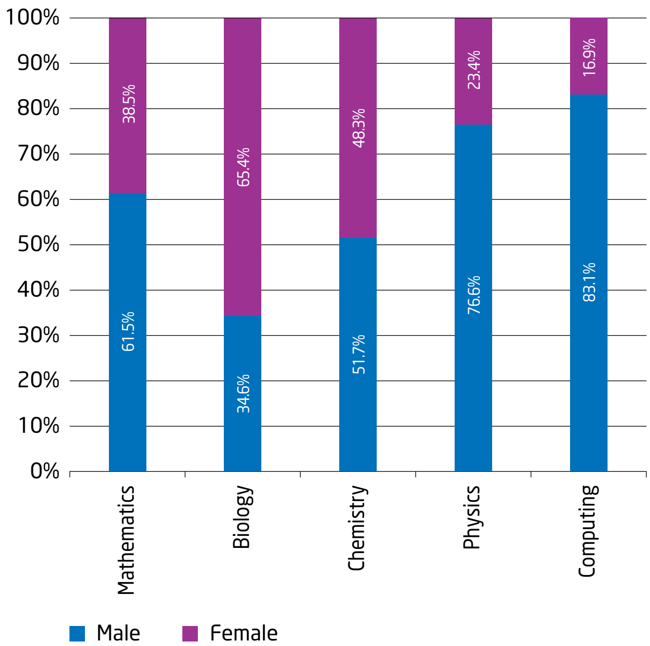


Fig. 12.3: Advanced Higher entry volumes by gender (2010) – Scotland



Source: SQA

Part 2 Engineering in Education and Training

13.0 Mining the talent pool

Employers and Higher Education Institutions have, in the main, very good processes for attracting and recruiting the 'usual suspects' from academic pathways and are even more adept at doing the same from vocational routes. However, the projected future demand for engineers, coupled with a declining cohort of young people entering the workforce, makes it imperative that we make sure more young people – including those in danger of becoming NEETs (not in education, employment or training) – have opportunities and accessible pathways to follow engineering learning paths.

A 2007 study by The Prince's Trust[106] put the economic cost of youth unemployment alone at £4.80 billion a year. A 2002 government study[107] estimates that the lifetime costs to society of each young person who is out of school or work are over £90,000.

The report[108] by New Philanthropy Capital, *Getting back on track: Helping young people not in education, employment and training*, calculates that someone who was NEET as a young person will have earned around £51,000 less by age 33 than someone who was not.[109]

106 Prince's Trust (2007) *The Cost of Exclusion: Counting the cost of youth disadvantage in the UK*

107 Godfrey, C. et al. (2002) *Estimating the Cost of Being 'Not in Education, Employment or Training' at Age 16–18*. Department for Education and Skills

108 *Getting back on track: Helping young people not in education, employment or training in England A guide for funders and charities*, October 2009, John Copps, Sarah Keen, New Philanthropy Capital

109 Keen, S. *Valuing Potential: An SROI on Columba 1400*

13.1 Size of the opportunity

In March 2010, over 927,000[110] 16- to 24-year-olds were unemployed, with youth unemployment expected to exceed 1,000,000 in 2010. Within the 16-18 year cohort, the proportion of NEETs increased from 9.7% at the end of 2007 to 10.3% at the end of 2008. In 2007, 56% of young people not in education or training were in work. In 2008, this fell to 49%. More than one in ten young people aged 16–18 in England are NEETs (Table 13.0). This means that in 2008 almost 208,000 young people aged 16–18 struggled to make the transition from school to Further Education or the workplace. Recent data[111] suggests that by their eighteenth birthday, 4% of young people have been NEETs for a year or more.

This problem of 16- to 18-year-old NEETs is likely to remain, despite the statistical shift which will occur as a result of raising the participation age to 17 in 2013 and 18 in 2015.

There is also a wide variation by UK region.[112] For example, in the North East, some 17% of 16- to 18-year-olds are NEETs, while in the East of England the figure is much lower at 7%.

Table 13.0: NEETs in England[113]

Year	16 year olds	17 year olds	18 year olds	No of 16-18 year olds	% of 16-18 year olds
1996	39,800	60,800	73,000	173,600	9.9%
1997	35,700	49,400	74,900	160,000	8.9%
1998	39,700	51,600	75,400	166,600	9.2%
1999	40,600	42,500	62,400	145,500	8.1%
2000	40,700	44,200	71,300	156,100	8.7%
2001	48,500	58,900	75,000	182,400	9.9%
2002	49,100	57,800	81,500	188,400	10.0%
2003	49,600	49,200	84,800	183,500	9.8%
2004	48,800	60,500	80,500	189,800	9.6%
2005	50,600	70,200	92,900	213,700	10.7%
2006	44,600	65,000	100,100	209,700	10.4%
2007	36,900	62,400	95,700	195,000	9.7%
2008	34,000	61,300	113,200	208,600	10.3%

110 *Changing the NEET mindset: achieving more effective transitions between education and work*, LSN, May 2010

111 ibid

112 ibid

113 www.dcsf.gov.uk/rsgateway/DB/STR/d000870/NEETquarterlyBriefQ22009.pdf

It is also worth noting[114] that around 15% of 18-year-olds who are NEETs are taking a gap year before starting university. Others are moving between low-skilled jobs and unemployment, frustrated with their options after getting poor grades at GCSE. A significant minority are dealing with serious issues such as substance abuse that mean any type of employment is far out of reach.

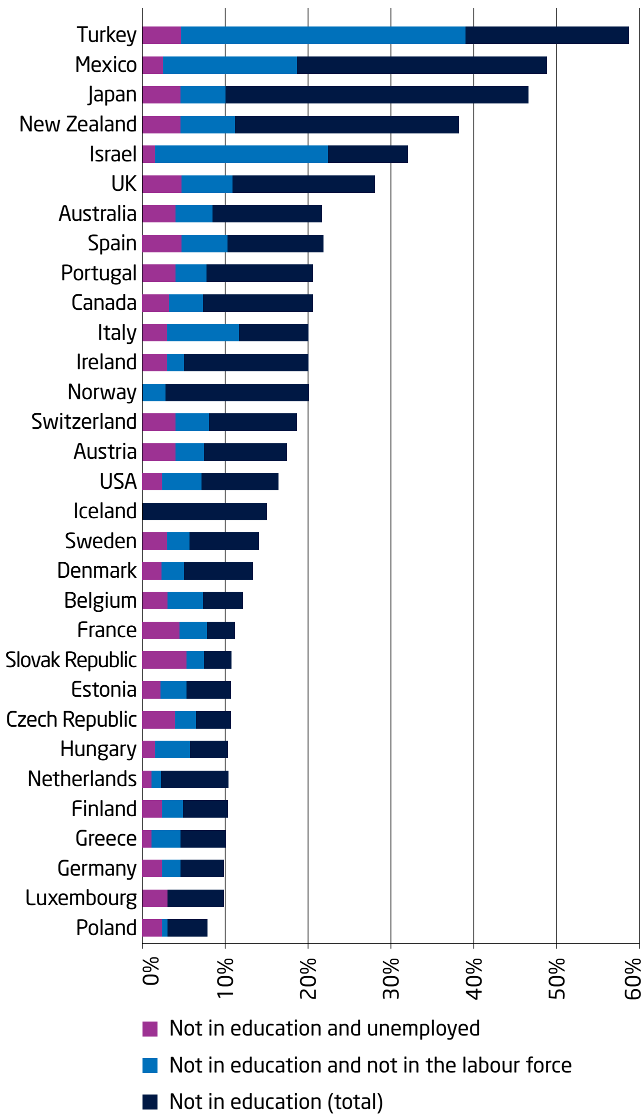
The *Final Report from the Panel on Fair Access*[115] shows that, when it comes to social mobility, we've raised the glass ceiling in Britain. The exam achievements of school children have improved significantly, more people are on apprenticeship programmes, far more people from less well off backgrounds are now going to university. The gender pay gap has narrowed. But we still have some way to go because, for too many, the door to the professions is still closed and, while they may have the talent, they don't get the chance.

The report showed that 75% of judges, 70% of finance directors, 45% of top civil servants and 32% of MPs were independently schooled, and yet only 7% of our children go to a private school. The great talent and ability of Britain's children is not limited to the few, or concentrated in private schools, but evident in the many. We must do more to nurture, encourage and realise this potential. Otherwise, on the current trajectory, tomorrow's professionals will be drawn almost entirely from the better-off 30% of families in this country. That is not fair, and it cannot be good enough for us.

13.2 International comparison

OECD data (Figure 13 .0) suggests that the number of teenage NEETs in the UK tends to be higher than in other comparable countries.[116] With the exception of Japan, the UK has a much higher number of young people not in employment, education or training than its OECD partners. Our current 13.4% compares with 6–7% of the USA's 16- to 19-year-olds and only around 4.8% of Germany's.

Fig. 13.0: Percentage of 15- to19-year-olds not in education and unemployed or not in education and not in the labour force (2006)



Source: OECD

114 *Getting back on track: Helping young people not in education, employment or training in England A guide for funders and charities*, October 2009, John Copps, Sarah Keen, New Philanthropy Capital

115 *Unleashing Aspiration: The Final Report of the Panel on Fair Access to the Professions*, July 2009. Available at www.cabinetoffice.gov.uk/strategy/publications.aspx.

116 Chart extracted from; *Changing the NEET mindset: achieving more effective transitions between education and work*, LSN, May 2010

Finally, an additional related but unresolved issue that EngineeringUK has identified in need of further research and investigation, is the significant loss of potential talent not progressing to level 3 after GCSE; 52% of students in England in 2008 did not advance their studies.[117]

13.3 Factors influencing higher education participation for disadvantaged pupils

Poor attainment in secondary schools is more important in explaining lower Higher Education (HE) participation rates among students from disadvantaged backgrounds in England than barriers arising at the point of entry into HE.

This is the finding of research from the Institute for Fiscal Studies,[118] using newly-linked English administrative data to explore factors which influence HE participation amongst people from socio-economically disadvantaged backgrounds. Some key findings were:

- There was a pronounced socio-economic gradient in HE participation rates. Being in the bottom socio-economic quintile (in comparison with the top socio-economic quintile) reduced the chance of going to university at age 19 or 20 by 40.2 percentage points for males and 44.3 percentage points for females.
- Including controls for individual/school characteristics and prior attainment reduced the impact of socio-economic status on HE participation rates.
- There were large socio-economic differences in the likelihood of attending a high-status university. Males in the bottom socio-economic quintile were 31.2 percentage points less likely to attend a high-status university than males in the top quintile, while the difference was 31.9 percentage points for females.

The report suggests that widening participation schemes may be more effective if targeted at younger age groups, rather than at young people at the point of entry to HE, and that there should be a greater emphasis on improving the educational attainment of disadvantaged children in secondary schools.

117 *Engineering UK 2009/10*, EngineeringUK, p65

118 *Widening Participation in Higher Education: Analysis using Linked Administrative Data*, IFS Working Paper W10/04, May 2010

119 *Reducing the numbers of young people not in education, employment or training: what works and why*, Ofsted, March 2010

13.4 Good practice in engaging young people not in education, employment and training

Ofsted has published a report examining the key factors that have contributed to reducing the proportion of 16- to 18-year-olds not in education, employment or training in twelve local authority areas.[119] The areas that were selected were those that had shown significant improvements between 2005 and 2008 in reducing the overall numbers of young people who were not in employment, education or training.

The report highlights a number of common elements in the approach taken in the sample local authorities.

The most successful providers recognised that young people who were disengaged from education and training often needed help to resolve personal and social problems before they could return.

The local authorities had also increased their focus on certain priority groups. This included the allocation of resources to reduce the numbers of young people who stayed out of learning for more than 12 months, and targeting young people from particular schools or localities where levels of disengagement were historically high. The use of informal settings such as local social centres and youth clubs often worked well in attracting young people to participate.

Ofsted identifies further elements of good practice in terms of:

- Engaging partners and integrating services
- Using data to plan programmes and target resources
- Developing preventative measures
- Gaining maximum value from the work of Connexions
- Meeting complex needs
- Devising programmes that engage and motivate participants

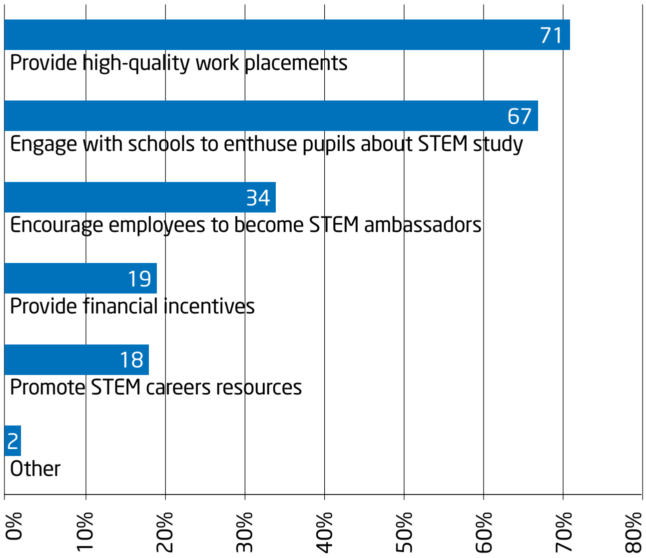
The report also noted that there were opportunities for greater involvement on the part of employers in developing strategies. It observes that there were too few activities in schools to allow young people to develop a good understanding of work and the skills needed for specific occupations.

Research undertaken by the Learning and Skills Network (LSN),[120] also confirms that NEET disengagement is not something that just happens between the ages of 14 and 16 but often sets in far earlier. If young people are disengaged by the age of 16, re-engagement becomes progressively more difficult. Their research indicates that many young people vulnerable to becoming NEETs become disengaged during Key Stage 3. Youngsters at risk of disengaging should have the option of a year out of the National Curriculum to experience long-term taster courses, a mix of vocational and other options, in order to explore and determine what they find rewarding for future study. Australian and Canadian experience suggests that the development of a new category of 'pre-apprenticeship' training would help to smooth transition to skilled employment without devaluing the apprenticeship brand. Pre-apprenticeship training would help to ensure smooth transitions between school and apprenticeships or other vocational qualifications. International evidence suggests that pre-apprenticeship training works best when it is tailored around specific occupations rather than generic 'work-ready' skills, and progression routes from these skilled technical qualifications into HE or trades must be made clear and be supported.

The specific position regarding pre-apprenticeship training is one that was also proposed by EngineeringUK in March 2010 through the briefing paper, *The Apprenticeship Renaissance*.[121]

The common elements for engaging NEETs in education and training constitute a sub-set of the skills that the CBI[122] recommended were required across all learners (Figure 13.1).

Fig. 13.1: Steps business should take to encourage STEM study %



120 *Changing the NEET mindset: achieving more effective transitions between education and work*, LSN, May 2010

121 http://www.engineeringuk.com/viewitem.cfm?cit_id=383260

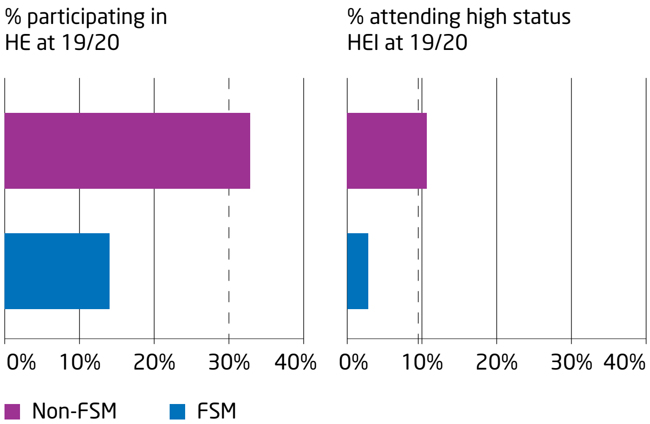
122 CBI, *Ready to grow, business priorities for education and skills 2010* page 37

13.5 Disadvantaged students

There is a widely held view that all NEETs have disadvantaged backgrounds. While this is not universally the case, the report by New Philanthropy Capital[123] does highlight that 17% of 17-year-olds eligible for free school meals are NEETs, compared with 7% of 17-year-olds who are not eligible. Only 2% of those who achieve five GCSEs at A*–C are NEET the following year, compared with 36% of those who gain no qualifications at all. Persistent truants are over five times more likely to become NEET at 16 than those who have never played truant. And of those excluded from school in years 10 or 11, 21% are NEET by the time they are 16.

The Widening Participation in Higher Education paper by the Institute for Fiscal Studies convincingly showed (Figure 13.2) that only 14% of pupils who are eligible for free school meals participate in higher education at age 19/20, compared with 33% of pupils who are not eligible for free school meals: a very large gap indeed.[124]

Fig. 13.2: Raw socio-economic gap in HE participation rates amongst state school students at age 19/20



Note: This figure is based on data for two cohorts of state school students in England who took their GCSEs in 2001-02 or 2002-03. The dashed lines indicate average participation rates for participation overall (left hand panel) and participation in a high status institution (right hand panel) respectively.

123 *Getting back on track: Helping young people not in education, employment or training in England A guide for funders and charities*, October 2009, John Copps, Sarah Keen, New Philanthropy Capital

124 *Widening Participation in Higher Education: Analysis using Linked Administrative Data*, IFS Working Paper W10/04, May 2010

125 www.engineeringuk.com

126 http://www.equalityhumanrights.com/uploaded_files/publications/equally_professional_june_2010.pdf.

13.6 Diversity practice and the STEM professions

This section was authored by Robin Lynn, Policy Manager, Equality and Human Rights Commission

Websites can be very ephemeral places. That is partly in their nature; they have to reflect what's current. But a visit to the EngineeringUK website[125] shows that, in the STEM sector, some themes appear ever-present. Consider some current news items:

- The need to ensure that young people and their influencers are informed and aware of all the benefits to be gained from an engineering career.
- The continuing lack of female engineers and how this is one of three major barriers to tackling skills shortages in the UK sector. (The UK is ranked worst in Europe for the number of female engineering professionals.)
- The need to help partner organisations focus their efforts so that pupils, teachers and parents can have a better understanding of engineering, including the many pathways into the profession. (A role fulfilled by the Tomorrow's Engineers scheme.)

These three news items share the common theme of how to increase the size and diversity of the profession – the focus of considerable effort, judging from the evidence on the site.

Interestingly, the story about the shortage of female engineers identifies learning from European peers as a key strategy. And the Equality and Human Rights Commission's own work with professional bodies demonstrates that engineering is by no means the only discipline facing such challenges. As a recent report from the Commission shows, interest in and commitment to equality and diversity has become more widespread and mainstream amongst professional bodies. The report, *Equally Professional: Like minds on different journeys*,[126] describes the work of a network of professional bodies, Equally Professional, committed to promoting equality and diversity in, and through, their memberships, thereby widening access to opportunity and broadening their membership bases. With support from the Commission and input from the Professional Associations Research Network (PARN), Equally Professional is creating a repository of knowledge and good practice which addresses all aspects of diversity in the professions, based on peer-to-peer learning.

Professional bodies in Equally Professional share a commitment to common principles on raising their members' awareness, monitoring their memberships, raising awareness amongst their leadership and staff, reaching out to groups who are under-represented in their memberships, and working for greater equality of opportunity and social inclusion. EHRC facilitates the network by providing critical input and expertise at meetings and by raising the profile of the network as widely as possible. There are twenty organisations in the network with a collective membership of over 1.5 million professionals.[127]

Member outputs

As part of the commitment to diversity, and taking action on the principles of the network, many members have developed their own initiatives. The report gives interesting examples of these, including the following from the STEM sector.

Inclusiv-IT-y 2009 was a one-day event providing a comprehensive background on what BCS, the Chartered Institute for IT, is doing to enlighten its members on making IT accessible for disabled people. The Institute's Accessibility Achievement Day in October 2009 launched two new awards. One focused on the achievements of BCS-approved testing centres, to acknowledging their accessibility, experience and expertise. The second award recognised the achievements made by examination candidates with disabilities during 2008 and 2009.

In recent years, the Institute of Physics has worked hard to understand the relatively low numbers of girls and students from minority ethnic backgrounds studying physics. Research with the Royal Society of Chemistry observed that, while students from certain Asian backgrounds are very well represented in higher education in general, they are significantly under-represented in physics, despite there clearly being no lack of ability. It was felt that factors for this included a lack of knowledge the career choices opened up by studying physics, and the influence of family.

In November 2009, the Institute formed a partnership with a school that offers A level physics and also has a high proportion of students from minority ethnic backgrounds. This pilot project aims to better understand how to inspire students about physics and to encourage more to study the subject at A level and beyond. The project will provide expertise and resources to enhance the teaching of physics, as well as emphasising the wide-ranging career options open to physics graduates.

The Institution of Civil Engineers is embedding equality and diversity across all aspects of its work. Workshops are currently being run for senior members and staff to equip them with the necessary skills and tools. One aim is to train them in delivering equality and diversity impact assessments across all areas and activities of the ICE. Another aim is to identify areas where they can take positive action.

Collaborative outputs

As well as developing and sharing individual practice, the network has collectively contributed to a number of government-sponsored initiatives, focusing on research and guidance for professional bodies, and promoting the interests of the professions in public debates relating to wider access. To quote the Institute of Physics:

"Input into consultations related to equality and diversity provides the Institute with a stronger, more authoritative voice on these important issues."

Through Gateways to the Professions, BIS funded the PARN to lead two research projects, supported by members of the network. One looked at how professional bodies are embedding awareness and support for diversity, leading to the development of a *Diversity Toolkit*.[128] Building on this, a *Professional Recruitment Guide*[129] was developed to assist employers of professionals diversify their recruitment.

BIS also funded QED-UK, a Bradford-based charity working with ethnic minorities, to undertake a project to examine the problems members of ethnic minority communities have accessing the professions. This study led to the report, *Striving for Success*.[130]

127 The report *Equally Professional: Like minds on different journeys*, records the activities of a small group of professional bodies committed to improving equality and diversity practice. Equally Professional with the PARN Diversity SIG is looking for more input from other professional bodies and encourages them to take part in the SIG. For more details contact PARN at info@parnglobal.com

128 http://www.bis.gov.uk/policies/higher-education/access-to-professions/equality-diversity-toolkit

129 http://www.bis.gov.uk/policies/higher-education/access-to-professions/prg.

130 http://www.qed-uk.org/s4s-web.pdf

How can other professional bodies connect to this process?

As a means of making this experience and practice available to other professional bodies, Equally Professional has recently joined with PARN to create a diversity Special Interest Group (SIG) which is open to all professional associations at no cost. The SIG offers regular workshops, increased networking and collaboration with the wider professional association community. It is disseminating information and examples of good practice through the PARN website, and setting challenges for all professions. To quote another member of the network:

"A key benefit of membership for us is listening, learning and contributing to meetings and diversity Special Interest Group events, to explore practical solutions to current challenges."

Institute of Careers Guidance

13.7 NEETs and the low carbon economy

Green jobs are often heralded as the solution to the twin challenges of lowering our greenhouse gas emissions and bringing down unemployment. However, very little has been said about what new green jobs might look like, who will be doing them, how much will they pay and where they will be.

The Institute for Public Policy Research (ippr) paper *Green and decent jobs*[131] sheds light on these questions. It gives case studies from across the globe where the idea of training NEETs to address the low carbon economy is not only gaining supporters, but also being seen to work.

However, unequal access to jobs, low pay and a lack of progression routes are endemic problems in some parts of the UK labour market. For that reason, the ippr paper also argues that we must make sure that green jobs are also good jobs, paying a decent wage and offering more and better employment opportunities to a wider range of people if we want to maximise the benefits of the green jobs revolution.

131 *Green and Decent Jobs: The case for local action – An ippr scoping paper*, IPPR, June 2010

Part 2 Engineering in Education and Training

14.0 14-19 Diplomas

14.1 Diploma in Engineering

This section was authored by Bill Sutton, Project Manager, Operations and Development, Semta

Introduction

The Diploma in Engineering – now in its second year – is a unique secondary educational qualification, tailored to meet employer needs and give young people (aged 14-19) experience in applied contemporary engineering.[132]

Available at three levels (Foundation, Higher and Advanced), the focus is on employability skills, with learners exposed to real industrial situations. In effect, the Diploma prepares learners for entry into engineering via their chosen route, whether that is Higher Education, apprenticeship or technician training. In the case of Higher Education, the learner will have undertaken the innovative Maths for Engineers unit, which will adequately prepare them for the rigour of undergraduate study.

Development of the Diploma in Engineering was led by Semta, in conjunction with five Sector Skills Councils; Cogent, Summitskills, Go-Skills, EU Skills and IMI Automotive.

The present situation

Approximately 95 Consortia are delivering the Diploma in Engineering; more will start both this and next autumn. In total, 199 Consortia are cleared (or are in the final stages of the approvals process) to deliver the Diploma.

About 6,500 students are currently studying the Diploma – the majority at the Higher Level (around 70%). Similar numbers are expected to start this September. The principal learning of the Diploma is at present accredited by four awarding bodies: C&G/AQA (a joint venture), OCR and Edexcel. An array of other awarding organisations, including EAL, have accredited individual units within the Additional and Specialist Learning component.

Early experience suggests that the Diploma is meeting the young people's 'learning agenda', adapting physics and applied mathematics to all styles of learning and combining this with practical engineering. Hence, the Diploma is becoming acknowledged as a high quality educational qualification with the potential to make a positive contribution towards the STEM sector's recruitment needs. The number of girls studying the Diploma in Engineering (7.7% of all learners) is an early example of useful diversity not previously achieved by other STEM qualifications.

This summer will see the first graduation of Diploma learners. Measures are in hand to capture the impressions of employers and HE admission officers, to determine if this cohort is better prepared for engineering training than their predecessors, who came through traditional GCSE/A level routes. Early indications would signal that they are.

132 Further information is available at http://www.engineeringdiploma.com and www.semta.org.uk

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The medium and longer term

Following the government's recent announcement that Diploma development funding would be withdrawn from 30 September 2010, the Engineering Diploma Development Partnership (EDDP), a collective of engineering employers, professional bodies, learned societies and trade unions, has devised a continuation strategy. Because the new government has also removed the entitlement of students to study for a Diploma, employer engagement will be pivotal, as it will be employer demand – rather than a compulsory offer – that will now stimulate student choice. So the EDDP will continue to identify employer demand and send out clear signals that it exists. Efforts in this area would focus on Consortia support, since the true unique selling point of the Diploma is the way it is delivered in the classroom. In addition, the EDDP will continue to lobby hard for further funding and fair conditions whilst the Diploma is still in its infancy.

The Department for Education has further announced that the requirement to deliver Diplomas via the Consortia model will be removed after 2011 and, in effect, schools and colleges are free to deliver any Diploma 'line' autonomously. The EDDP stands ready to assist any deliverer in the field of employer engagement.

Freedom to choose a career in engineering

Under the previous compulsory arrangements, Diploma learner numbers were anticipated to grow exponentially, tripling year-on-year from an inaugural intake of 2,800 in 2008, to reach a stable critical mass by around 2013. This would undoubtedly have yielded a significant number of learners to feed the urgent and worsening demographic recruitment needs of the STEM sector.

Without a constantly expanding consortia network, such numbers are now unrealistic. However, the previous arrangements would have resulted in some learners being cajoled into taking the Diploma in Engineering by default. It is now becoming apparent that this change could lead to a more willing and self-motivated number taking the Diploma through choice rather than compulsion. This possibly is a once-in-a-generation opportunity and could result in a cadre of well-motivated young people who have chosen a career in engineering. To achieve this, the engineering industry must take steps to foster and grow demand by positively promoting the Diploma to prospective learners, their parents and advisors.

Employer support

The EDDP steering group includes employer representation from Rolls Royce, the JCB Academy, Dyson, MBDA, Jaguar, RWE, npower, VT, Siemens and SMC. Professional societies are represented by the Royal Academy of Engineering, the Institution of Mechanical Engineers (IMechE), the Institution of Engineering and Technology (IET), the EEF, STEMNET, the Engineering Construction Industry Training Board (ECITB), the Specialist Schools and Academies Trust (SSAT) and EngineeringUK. Assistance has also been received from the Engineering Professors' Council, the HE Engineering Subject Centre and a number of Engineering Consortia.

BAE Systems already requires new applicants for apprenticeships to hold the Diploma. JCB has constructed a purpose-build academy to teach the Diploma in Engineering and the Diploma in Manufacturing and Product Design.

Summary

For a qualification which has been in delivery less than two years, the Diploma in Engineering has been exceptionally well-received by employers, professional and trade bodies, and teaching practitioners. The Diploma has already been praised as a means of bringing engineering to life in the classroom and of promoting modern opportunities within the sector to a vast array of young people from all backgrounds, including many who may not have previously had such a career aspiration.

Considerable support is now gathering for the Diploma from prime employers and professional bodies. Letters have already been forwarded to the Secretary of State for Education, articulating the contribution of the Diploma to potentially removing the 'hackneyed' divide between academic and vocational education. The value of the Maths for Engineers Unit has been particularly acknowledged.

14.2 Diploma in Construction and the Built Environment

This section was authored by Nick Gooderson, Head of Education, Training and Qualifications, ConstructionSkills

Overview

The Diploma in Construction and the Built Environment (C&BE) is designed to deliver a programme of applied and practical learning which introduces young people to the fabric of the world around them and the impact it has on individuals and communities.

The primary sectors it covers are:

- Construction: public and private housing, infrastructure, public non-housing, housing and non-housing repair and maintenance, and industrial and commercial
- Building services engineering (electrotechnical, heating, ventilating, air conditioning, refrigeration and plumbing industries)
- Property, cleaning services and facilities management
- Energy and utilities (electricity, gas, waste management and water industries)
- Process and manufacturing industries (coatings, extractives, building products, glass and print)
- Design, construction and maintenance of process plants for the oil, gas, water, environmental, food power generation, pharmaceutical and chemical industries

It was developed to give young people the skills which employers said were lacking in school and college leavers. For successful teaching, the Diploma relies on the involvement of employers. So far, over 1,000 in this sector are actively helping their local school or college. They do this in a variety of ways, such as offering site visits, providing work-shadowing opportunities, setting projects and providing work experience placements. The learners benefit tremendously from this involvement, as it helps them appreciate that their learning will give them the knowledge and skills needed to progress onto an apprenticeship or Further or Higher Education.

In September 2010, 1,529 students enrolled on the C&BE Diploma.

Content

The Diploma in C&BE is available at three different qualification levels:

- Foundation Diploma: equivalent to 5 GCSEs at grades D to G
- Higher Diploma: equivalent to 7 GCSEs at grades A* to C
- Advanced Diploma: equivalent to 3.5 A levels

It is a progressive qualification and builds up the learners' knowledge of the sector as they progress, looking at how we:

- Design the built environment
- Create the built environment
- Value and use the built environment

Foundation level

The Foundation level is a broad, generic introduction to the construction and built environment sector. The learner explores and understands the nature and extent of the built environment, and the phases of its life cycle. Learners also have the opportunity to explore construction methods and techniques and the roles of individuals employed in this sector.

Higher level

The Higher level expects the learners to gain more technical understanding. It gives them an opportunity to develop and apply a range of skills and knowledge applicable to the development, maintenance and use of the built environment. This covers topics such as design (including preparation and use of drawings and other technical information), specific job roles for key functions, tools and practical techniques used, and properties of materials used in the built environment.

Advanced level

The Advanced Diploma in C&BE is designed to prepare learners for further and higher study, and employment at technical or professional levels in the construction and built environment sector. It is designed to develop a range of analytical and investigative skills in the learner. The content includes the social, economic and cultural contribution of the built environment to the community, sustainability and resourcing. It also covers the management of projects and factors and principles influencing the design, creation, maintenance and management of the built environment.

Case studies

Bernice Waghorn, aged 17, from Kent

"It was when I started the Diploma in C&BE that I began to understand just how many opportunities there are for women in construction and how my course will help me towards my career goals. We have recently visited a local eco-house where I got to see how what I had learnt about the environment in the classroom applied to real-life. I also got to present what I had learnt to the Secretary of State at an event at the Victoria and Albert Museum in London. Trips like this and the people that I meet on them are some of the things that make the Diploma a great course to study." March 2010

Connaught work experience from a C&BE learner at Manchester Vocational Centre

"I worked at Connaught, shadowing the different jobs of people and asking questions to find out what they do and how it works and fits together, and how each different job role works with each other.

I have done the following jobs: office manager, site manager, tenant liaison officer, health and safety management, stores manager, building surveyor and quantity surveyor. After completing my ten days' work experience with Connaught, I believe I have gained a very valuable experience and understanding of how the industry works, and how a large social housing company such as Connaught operates. I have been able to determine the jobs I don't like and those I may look at considering in the future." March 2010

Diploma in action – Spirax Sarco, an engineering company, based in the South West

Leading Cheltenham engineering company, Spirax Sarco, hosted a site visit for 16 Diploma in Engineering students from the Sir Bernard Lovell School in Kingswood, near Bristol. Malcolm Holmes, the HS&E Officer at Spirax Sarco said: "We took the students on a tour of the factory, showing them two of our three sites, including the machine shop. We were delighted to see how engaged and enthusiastic the students were. We were particularly impressed with their ability to conceptualise and relate things I was saying back to their schoolwork, coupled with an ability to think 'across the boundaries'. This clearly demonstrates that the practical approach of the Diploma is effective, giving young people a thirst for education that I haven't seen for a long time."

Department for Education Diploma update, July 2010

Schools Minister Nick Gibb gave a speech on 2 July 2010 to the Reform think tank in which he set out the government's vision for schools and education in the future – including Diplomas.

Schools and colleges will be allowed to choose how many and which Diploma lines of learning they offer. The Diploma Entitlement will not be implemented, so schools and colleges can offer the lines of learning they want and that they know will meet the needs of their students.

Schools and colleges will not have to obtain approval from the Department for Education before delivering new Diploma subjects.

The government is relaxing the requirement to offer the Diploma collaboratively through consortia. They think that schools and colleges already work in partnership on many fronts, because there are advantages in doing so, and they may decide to continue to collaborate on delivering Diplomas.

Part 2 Engineering in Education and Training

15.0 The Further Education sector

Once viewed as the Cinderella of education, the Further Education (FE) sector has truly arrived at the ball and is now correctly recognised as a significant part of the UK's education system. In 2008/09, the FE sector in England engaged with over 4.8 million learners, of whom more than 3.7 million were aged 19 or above.[133] The importance of the FE sector to delivering education in the UK has been recognised by the new coalition government.

"I am a believer in rigour and excellence – in vocational qualifications just as much as in academic ones."

David Willetts, Minister of State for Universities and Science, University of Birmingham, 20th May 2010.

Size of the FE sector

In April 2010, there were 425 colleges in the UK, of which 352 were in England.[134] The breakdown of colleges is as follows:

- 352 colleges in England
- 22 colleges and 2 FE institutions in Wales
- 43 colleges in Scotland
- 6 colleges in Northern Ireland

Colleges in England can be further broken down into:

- 228 General Further Education colleges (GFE)
- 94 sixth form colleges (SFC)
- 16 land-based colleges (AHC)
- 4 art, design and performing arts colleges (ADPAC)
- 10 special designated colleges (SD)

133 The Data Service – Statistical First Release, June 2010

134 http://www.aoc.co.uk/en/about_colleges/index.cfm

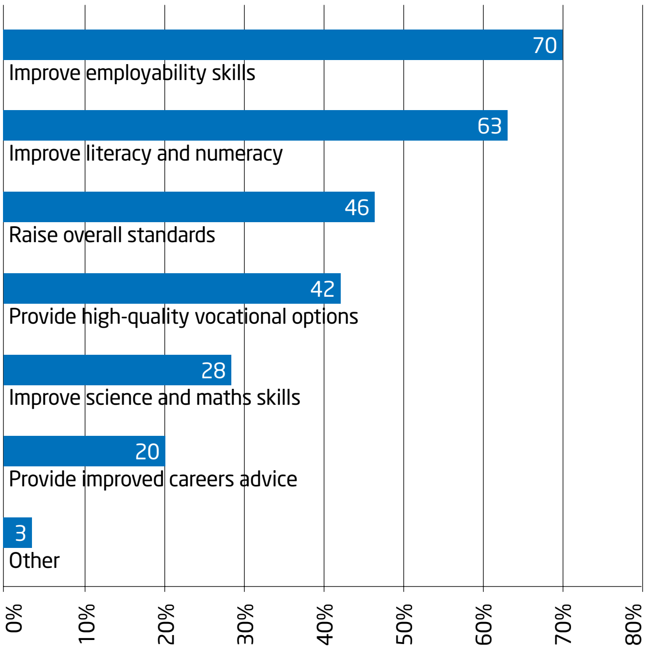
15.1 Meeting employer needs

In its 2010 report, *Ready to Grow: business priorities for education and skills*, the CBI identified the top priorities for schools and colleges. The top priority was improving employability skills (70%), with improving literacy and numeracy coming second at 63% (Figure 15.0). The CBI identified employers' satisfaction with school/college leavers' employability skills (Figure 15.1). Of specific relevance to the FE sector were 68% of employers not satisfied with business and customer awareness skills, 57% not satisfied with self-management skills and 55% unhappy with employees' international cultural awareness.

Finally, the CBI's research identified the business priorities required for delivering workforce skills (Figure 15.2). Unsurprisingly, reducing bureaucracy for government-funded programmes was the top business priority (75%). It is also important to note that the two FE-specific business priorities were reforming vocational qualifications, so that they are more business relevant (38%), and ensuring that training providers are more responsive to employer needs (30%).

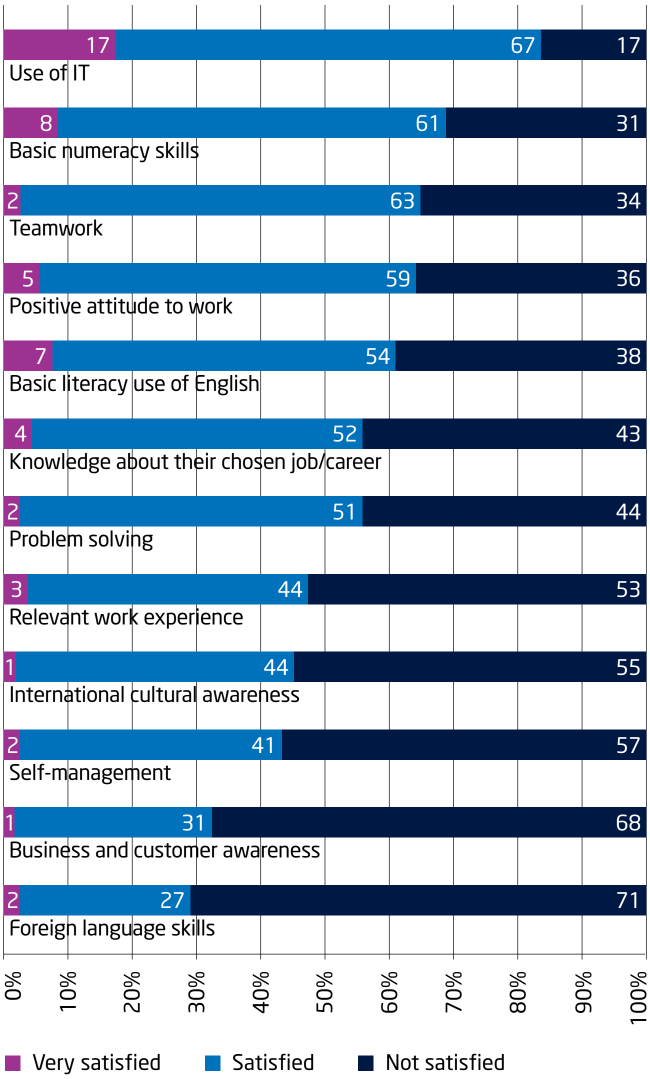
It is recognised that these issues affect the whole education system and are the responsibility of all parts of the education system. However, as the UK economy comes out of recession, the FE sector (as well as other parts of the education system) need to ensure that they are equipping students with the skills and abilities that businesses need. The FE sector is the most responsive part of the education system and, as such, has the opportunity to lead the way in providing students with a rigorous education and solid business skills. Also, the FE sector engages with learners from the age of 14 through to those in retirement, those in custody or with learning difficulties and those looking for skills to enter the workforce for the first time. This mean it can exert significant influence across a broad range of learners.

Fig. 15.0: Business priorities for schools and colleges (%)



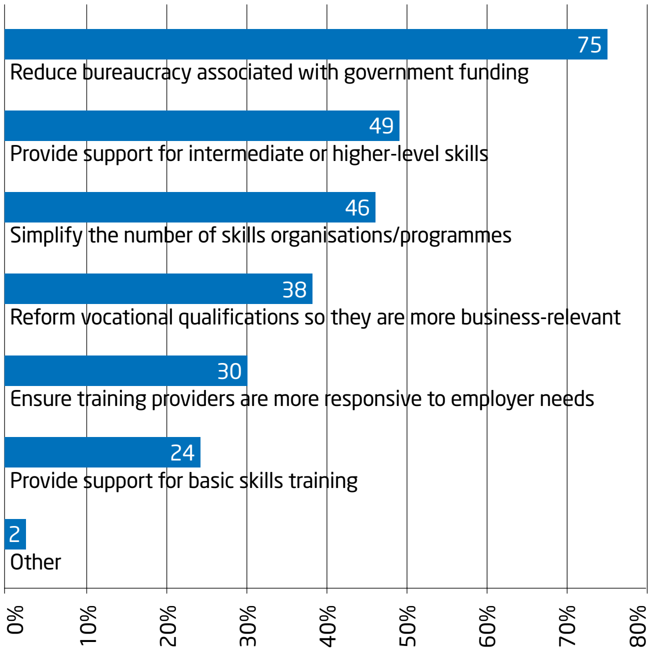
Source: CBI

Fig. 15.1: Business priorities for workforce skills for employees (%)



Source: CBI

Fig. 15.2: Business priorities required for delivering workforce skills (%)

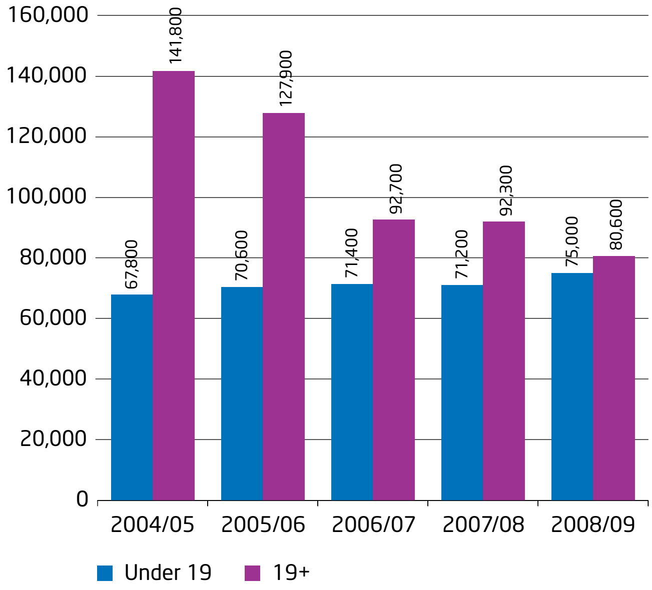


Note: Respondents were asked to identify their top three priorities
Source: CBI

15.2 Participation in FE

Figure 15.3 and Table 15.0 shows the five-year trend for all participation in engineering and manufacturing technologies. Although the data for 2008/09 is not directly comparable to earlier years,[135] it is clear that overall participation in engineering and manufacturing technologies has been declining. The total number of students has fallen by a quarter (25.8%) since 2004/05. However, this top level analysis hides the fact that participation among the under 19s[136] has increased 10.6%, while participation among adults has fallen by 43.2%.

Fig. 15.3: Overall participation (aims) in FE, all levels, engineering and manufacturing technologies (2004/05-2008/09) – England



Source: The Data Service

Table 15.0: Overall participation (aims) in FE, all levels, engineering and manufacturing technologies (2004/05-2008/09) – England

	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over five years
Under 19	67,800	70,600	71,400	71,200	75,000	5.3%	10.6%
19+	141,800	127,900	92,700	92,300	80,600	-12.7%	-43.2%
All engineering and manufacturing technologies	209,600	198,500	164,100	163,500	155,600	-4.8%	-25.8%

Source: The Data Service

135 Figures for 2008/09 for all Sector Subject Areas are not directly comparable to earlier years, as the introduction of demand-led funding has changed how data is collected and how funded learners are defined from 2008/09 onwards.

136 The overall totals for GCSEs, AS and A2 qualifications, in the separate sections of the Engineering UK report, include those students studying these qualifications at an FE provider.

Looking at construction, planning and the built environment (Figure 15.4 and Table 15.1), it can be seen that over the five-year period, participation has also fallen by 16.7% overall. In 2004/05, 70.9% of all participants were aged 19 or above. By 2008/09, this had dropped to 49.9%. In fact, over the five-year period to 2008/9, the number of 19+ participants has fallen from 111,300 to 65,100. By comparison, participation among those aged under 19 has increased: by 4% in the last year and by 43.9% over the period.

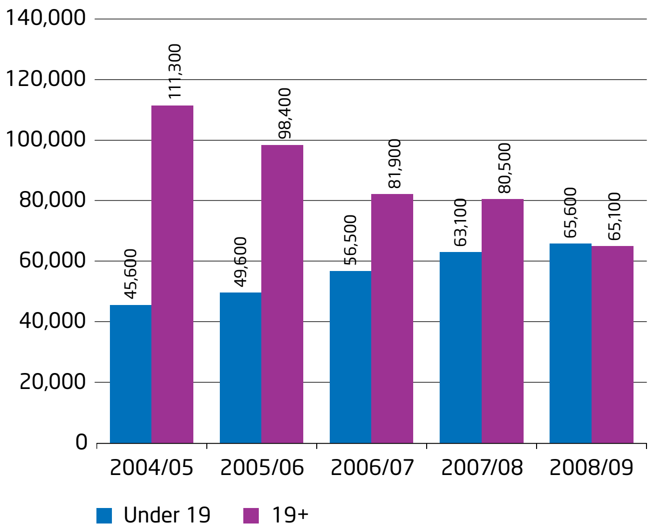
Overall participation in information and communication technology has shown a very sharp decline over the five-year period (Figure 15.5 and Table 15.2): from 906,000 in 2004/05 to 336,000 in 2008/09. At 62.9%, this is a massive decline. Unlike engineering and manufacturing technologies, and construction, planning and the built environment, the number of participants in information and communication technology has been falling among both the under-19s (25.3%) and the over-19s (69.5%).

Table 15.1: Overall participation (aims) in FE, all levels, for construction, planning and the built environment (2004/05-2008/09) – England

	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over five years
Under 19	45,600	49,600	56,500	63,100	65,600	4.0%	43.9%
19+	111,300	98,400	81,900	80,500	65,100	-19.1%	-41.5%
Overall	156,900	148,000	138,400	143,600	130,700	-9.0%	-16.7%

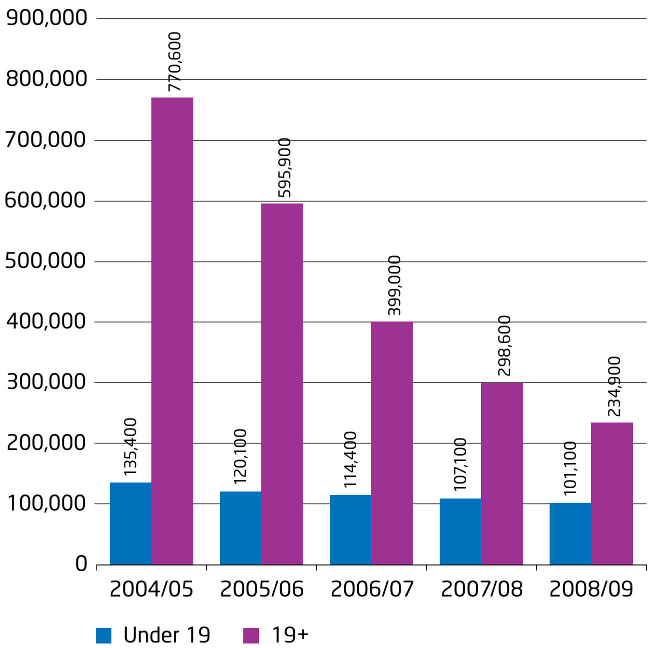
Source: The Data Service

Fig. 15.4: Overall participation (aims) in FE, all levels, for construction, planning and the built environment (2004/05-2008/09) – England



Source: The Data Service

Fig. 15.5: Overall participation (aims) in FE, all levels, information and communication technology (2004/05-2008/09) – England



Source: The Data Service

Table 15.2: Overall participation (aims) in FE, all levels, information and communication technology (2004/05-2008/09) – England

	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over five years
Under 19	135,400	120,100	114,400	107,100	101,100	-5.6%	-25.3%
19+	770,600	595,900	399,000	298,600	234,900	-21.3%	-69.5%
Overall	906,000	716,000	513,400	405,700	336,000	-17.2%	-62.9%

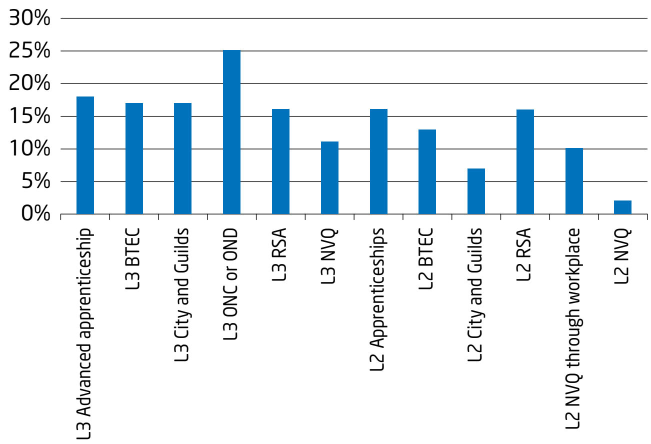
Source: The Data Service

15.3 Wage returns from level 2 and level 3 qualifications

As a general rule, as the qualification level of workers increases, so does their earning potential. However, not all qualifications have the same level of impact on earning potential.[137] Figure 15.6 shows the estimated wage returns of different level 2 and level 3 qualifications. It is worth noting that a level 2 NVQ has a wage return of less than 5%, whereas a level 2 apprenticeship (for which an NVQ will form a substantial element) has a wage return of more than 15%.

At 25%, the highest wage return for a level 2 or level 3 qualification was for a level 3 ONC or OND.

Fig. 15.6: Estimated wage returns to levels 2 and 3 qualifications[138]



Source: BIS Skills for Sustainable Growth

137 See section 21.0 for more details

138 BIS Skills for Sustainable Growth

15.4 FE STEM data project[139]

The FE and skills sector is a very dynamic and complex part of the UK education system. At any one time, there are over 1,500 training providers who are contracted to provide publically-funded provision. The underlying provider base has over 5,000 potential providers, ranging from the very large, with more than 100,000 students, to the very small, serving fewer than 30 students.

A working party was established to look at how STEM data in the FE sector could be improved. The working party included members from the BIS, the Department for Education (DfE), The Data Service and the wider STEM community, including EngineeringUK.

The aim of the project was to establish a reliable and accessible source of data on the contribution to the STEM agenda made by the FE and skills sector, in order to support better policy making across government, partner organisations, professional bodies, employer bodies and the institutions that make up this sector. The remit of the project is limited to data on the FE and skills sector in England, with the contribution of the sector in Wales, Scotland and Northern Ireland being an ambition subject to further funding.

The working party defined which courses fell into the STEM fields or were related to these fields. The following snapshot shows some analysis of engineering data using these definitions. The FE data project was looking at all qualifications taken in FE and so the data presented will not be directly comparable to any of the other chapters on specific qualifications. It does, however, give an overall indication of the importance and impact of the FE sector in training people with STEM skills. The intention is to carry out this analysis annually, which will, in the longer term, allow us to carry out robust trend analyses.

Table 15.3[140] shows the number of engineering qualifications being taken in the FE and skills sector. It shows that there were 348,835 achievements in engineering in 2008/09 with a further 62,792 achievements in courses related to engineering. However, only 134,354 (38.5%) of the engineering-specific achievements were at level 3 and above.

Level 3 qualifications are technician grade and are recognised as such by the Engineering Council in its UK Standard for Professional Engineering Competence (UK-SPEC)[141] for registration. The long term economic benefit of people operating at levels 2 and below has not been proven; as a result we need to ensure that there are suitable progression routes from level 2 and below into level 3 and above.

It was noted that 85,442 students undertaking engineering-specific courses either withdrew or transferred. This is an area of concern that needs further exploration.

Tables 15.4 to 15.6 show the comparable figures for science, technology and mathematics. In total, there were 201,394 achievements in science in 2008/09, which makes it the smallest of the four STEM sectors. Mathematics had a total of 246,149 achievements, with a further 53,185 achievements in subjects related to mathematics and a huge 303,099 achievements in numeracy – although most of these were at either entry level (75,155) or level 1 (226,373). There was a total of 80,056 achievements in 2008/09 for technology, with a further 308,055 achievements in subjects related to technology.

139 Report published on the data service website: http://www.thedataservice.org.uk

140 The total student numbers in Tables 15.3 to 15.6 are subject to change as the catalogue of STEM courses are refined

141 http://www.engc.org.uk/professional-qualifications/standards/uk-spec

Table 15.3: Number of engineering qualifications being taken in FE and skills sector (2008/09) – England

Engineering	QCF/NVQ level	Achievements	Completions	Withdrawals/ Transfers	Continues
Engineering	Entry	1,403	1,552	350	14
	1	25,376	27,649	6,621	934
	2	186,878	196,535	44,987	89,458
	3	133,722	144,588	33,264	100,635
	4 and above	632	805	145	702
	Not assigned	824	901	75	34
Total		348,835	372,030	85,442	191,777
Engineering-related	Entry	4,865	5,214	989	132
	1	8,674	9,455	2,354	368
	2	35,034	35,521	8,217	16,365
	3	7,446	8,002	1,292	4,253
	4 and above	1,158	1,227	223	796
	Not assigned	5,615	5,814	271	244
Total		62,792	65,233	13,346	22,158
Overall total		411,627	437,263	98,788	213,935

Source: FE and skills STEM data working group

Table 15.4: Number of science qualifications being taken in FE and skills sector (2008/09) - England

	QCF/NVQ level	Achievements	Completions	Withdrawals/ Transfers	Continues
Science	Entry	648	679	159	0
	1	1,928	2,040	597	98
	2	43,189	45,863	7,295	7,109
	3	153,911	176,017	25,177	19,633
	4 and above	136	187	33	222
	Not assigned	1,582	1,621	257	335
Overall total		201,394	226,407	33,518	27,397

Source: FE and skills STEM data working group

Table 15.5: Number of technology qualifications being taken in FE and skills sector (2008/09) – England

Technology	QCF/NVQ level	Achievements	Completions	Withdrawals/ Transfers	Continues
Technology	Entry	943	1,036	216	10
	1	3,498	3,936	702	121
	2	17,322	19,401	4,033	1,558
	3	58,044	64,352	15,387	21,609
	4 and above	124	141	66	132
	Not assigned	125	133	18	16
Total		80,056	88,999	20,422	23,446
Technology related	Entry	32,286	35,744	6,535	1,509
	1	117,748	142,013	37,927	26,094
	2	117,255	146,665	36,140	36,139
	3	34,009	41,078	9,981	18,501
	4 and above	74	77	4	23
	Not assigned	6,683	7,124	692	114
Total		308,055	372,701	91,279	82,380
Overall total		388,111	461,700	111,701	105,826

Source: FE and skills STEM data working group

Table 15.6: Number of mathematics qualifications being taken in FE and skills sector (2008/09) – England

	QCF/NVQ level	Achievements	Completions	Withdrawals/ Transfers	Continues
Mathematics	1	2,906	3,332	844	0
	2	198,089	227,066	56,641	66,111
	3	44,999	53,438	7,777	2,033
	4 and above	151	201	17	49
	Not assigned	4	5	0	0
Total		246,149	284,042	65,279	68,193
Mathematics related	1	10,583	13,781	1,997	180
	2	17,819	21,442	4,068	2,801
	3	19,253	24,017	3,794	3,677
	4 and above	4,094	6,013	1,012	2,960
	Not assigned	1,436	1,546	277	364
Total		53,185	66,799	11,148	9,982
Numeracy	Entry	75,155	87,413	23,426	7,957
	1	226,373	249,770	76,965	76,094
	2	1,368	1,477	174	40
	Not assigned	203	208	6	26
Total		303,099	338,868	100,571	84,117
Overall total		602,433	689,709	176,998	162,292

Source: FE and skills STEM data working group

Part 2 Engineering in Education and Training

16.0 Apprentices

Apprentices are generally employees and learn job-specific and other skills through achieving a National/Scottish Vocational Qualification (N/SVQ). They also study for other qualifications with a training provider. Apprenticeships play a key role in providing intermediate technician skills – which was identified in the National Employer Skills Survey 2009[142] (NESS09) as an area where the UK experiences skills shortage vacancies.

Apprenticeships are available at three different levels:[143]

1. Apprenticeships (equivalent to five good GCSE passes)
2. Advanced apprenticeships (equivalent to two A level passes)
3. Higher apprenticeships

In addition to developing their professional skills, apprentices also progress from their vocational training into Higher Education, including university degrees.

From October 2010 all apprentices under the age of 19, or apprentices over the age of 19 in their first year of apprenticeship, will benefit from a new National Minimum Wage (NMW) for apprentices of £2.50 per hour. While from 2013, local authorities will have a duty of care to ensure that every young person will be able to have an apprenticeship, if they meet the relevant entry criteria.

The ten largest apprenticeship frameworks for 2007/08 are shown in Table 16.0; four of these frameworks fall within the engineering footprint and, between them, make up 27.8% of all apprenticeships (highlighted in purple). The largest framework overall is construction, which had 39,956 apprentices, representing nearly one in ten (9.8%) of all apprentices. Engineering was the third largest framework with 33,218 apprentices, or 8.2% of all apprentices in 2007/08.

Table 16.1 shows the top five frameworks for each Sector Skills Council (SSC), with those likely to directly relate to engineering and technology being colour-coded into themes.

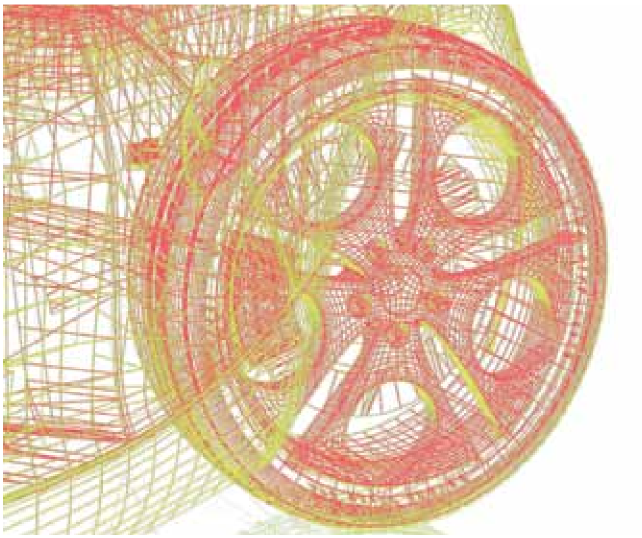
142 See section 21.0 for more details on the National Employer Skills Survey

143 http://www.apprenticeships.org.uk/

Table 16.0: Ten largest apprenticeship frameworks (2007/08) – England

Framework	Apprenticeship numbers	Apprenticeships (% of total)	Completion rates	
			Level 2	Level 3
Construction	39,956	9.8 %	44%	54%
Hairdressing	33,284	8.2%	49%	50%
Engineering	33,218	8.2%	51%	48%
Customer service	30,828	7.6%	54%	57%
Business administration	29,130	7.2%	53%	61%
Children's care learning and development	27,844	6.8%	46%	41%
Hospitality and catering	26,172	6.4%	47%	48%
Electrotechnical	21,148	5.2%	50%	44%
Health and social care	19,695	4.8%	39%	46%
Vehicle maintenance and repair	18,531	4.6%	59%	74%

Source: LSC 2009d,[144]



Key for Table 16.1

- Construction frameworks
- Engineering frameworks
- Plumbing frameworks
- Electrotechnical frameworks
- Heating, ventilation, air conditioning and refrigeration frameworks
- Vehicle maintenance frameworks
- Chemical, pharmaceutical, petro-chemical manufacturing & refining industries frameworks
- IT services and development frameworks
- Land-based services frameworks
- Rail transport engineering frameworks
- Security industry frameworks
- Automotive Industry frameworks

144 LSC (2009d). *Identifying sectors with prospects for expanding the number of Apprenticeships*. Coventry: LSC Figure 4.5: Ten largest apprenticeship frameworks www.lsc.gov.uk/LSCGOVUK/Scripts/PublicationDownload.aspx?id=cb74013a-5a3e-4d30-b049-08b584b15e05

145 LSC (2009d). *Identifying sectors with prospects for expanding the number of apprenticeships*. Coventry: LSC Figure 4.2 Leading apprenticeship frameworks for each SSC. www.lsc.gov.uk/LSCGOVUK/Scripts/PublicationDownloadaspx?id=cb74013a-5a3e-4d30-b049-08b584b15e05

Table 16.1: Leading apprenticeship frameworks for selected SSCs – England
(top five frameworks for each SSC, as measured by proportions of apprentices)

SSC	FRAMEWORK 1	2	3	4	5
Construction Skills	Construction (61%)	Engineering (10%)	Plumbing (7%)	Electrotechnical (6%)	Business administration (4%)
SummitSkills	Electrotechnical (64%)	Plumbing (24%)	Heating, ventilation, air conditioning and refrigeration (5%)	Engineering (3%)	Business administration (1%)
SEMTA	Engineering (50%)	Business administration (8%)	Vehicle maintenance (6%)	Customer service (6%)	Electrotechnical (5%)
Skillsmart Retail	Retail (51%)	Customer service (25%)	Management (7%)	Business administration (3%)	Engineering (2%)
Automotive Skills	Vehicle maintenance (59%)	Automotive industry (9%)	Vehicle body and paint operations (9%)	Vehicle fitting (7%)	Vehicle parts operations (3%)
Government Skills (inc. local govt)	Business administration (42%)	Engineering (13%)	Customer service (8%)	Accountancy (6%)	Construction (6%)
Skills for Logistics	Engineering (19%)	Business administration (13%)	Customer service (13%)	Public services (13%)	Vehicle maintenance (5%)
Cogent	Engineering (34%)	Retail (16%)	Business administration (12%)	Customer service (7%)	Chemical, pharmaceutical, petro-chemical manufacturing & refining industries (6%)
Improve	Engineering (35%)	Business Administration (10%)	Management (7%)	Customer service (7%)	Accountancy (6%)
e-Skills	UK customer service (34%)	Contact centres (13%)	Business administration (10%)	Sales and telesales (8%)	IT services and development (7%)
Lantra	Veterinary nursing (33%)	Animal care (15%)	Amenity horticulture (11%)	Agricultural crops (10%)	Land-based services (7%)
Skillfast-UK	Customer service (40%)	Retail (18%)	Business administration (14%)	Management (7%)	Engineering (4%)
GoSkills	Engineering (26%)	Vehicle maintenance (21%)	Customer service (10%)	Transport engineering and maintenance (9%)	Business administration (9%)
Energy and Utility Skills	Engineering (19%)	Business administration (19%)	Electrotechnical (14%)	Electricity industry (11%)	Customer service (10%)
Asset Skills	Business administration (23%)	Property services (20%)	Construction (19%)	Customer service (11%)	Plumbing (6%)
Proskills	Printing (25%)	Rail transport engineering (19%)	Engineering (15%)	Business administration (13%)	Customer service (7%)
Skills for Justice	Business administration (37%)	Customer service (34%)	Security industry (8%)	Rail transport engineering (4%)	Community justice (4%)
Skillset	Customer service (40%)	Retail (17%)	Business administration(11%)	Management (10%)	Construction (5%)

Source: SC Source, ILR 2007/8[145]

16.1 Employer awareness and engagement

NESS09 asked businesses about their awareness of apprenticeships. Table 16.2 shows that, overall, 93% of engineering businesses were aware of apprenticeships. Awareness increased slightly with company size, rising to 97% for those with more than 100 employees.

Table 16.2: Awareness of apprenticeships (2009) – England

		Establishment size				
	Total	**2-4**	**5-24**	**25-99**	**100-199**	**200+**
Weighted base	306,744	176,336	102,107	21,991	3,907	2,403
Yes	93%	92%	94%	95%	97%	97%
No	7%	7%	6%	5%	3%	2%
Don't know	*[146]%	*%	*%	*%	*%	1%

Source: NESS 2009

The NESS09 survey also asked respondents whether their company had any staff undertaking an apprenticeship. One in ten companies did have staff currently taking an apprenticeship. However, this varied significantly by establishment size (Table 16.3). Among engineering establishments with 2-4 employees, 6% had at least one member of staff on an apprenticeship. In establishments with 5-24 employees, it more than doubles to 13% and for establishments with at least 200 employees, it rose to 34%.

This evidence of increasing involvement in apprenticeships is supported by the education and skills survey published by the CBI[147] (Figure 16.0). This survey identified that 90% of companies with at least 5,000 employees were involved in apprenticeships. However this figure declined sharply to only 17% for those with 1-49 workers.

Both surveys serve to emphasise the perennial challenge of engaging small and medium-sized businesses in investing in the training and development of their employees.

146 Percentage greater than 0% but less than 0.5%

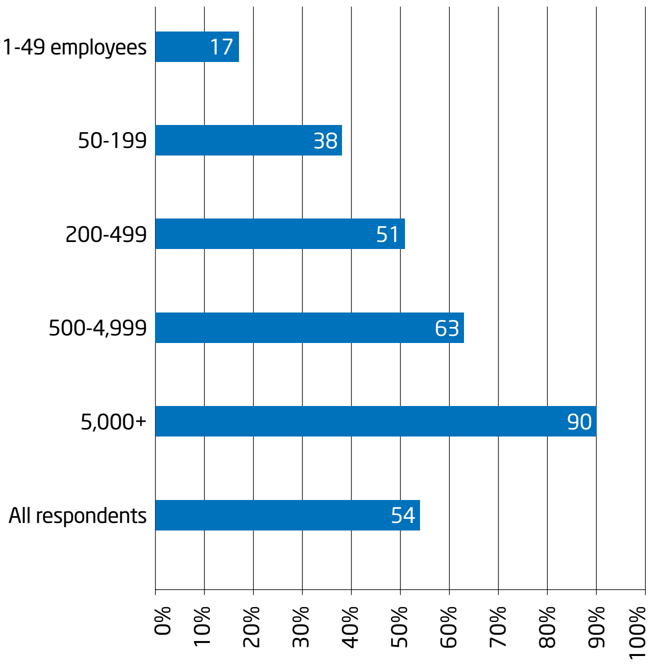
147 http://www.cbi.org.uk/pdf/20100501-cbi-education-and-skills-survey-2010.pdf

Table 16.3: Whether company currently has any staff undertaking an apprenticeship by, all aware of apprenticeships, and company size (2009) – England

		Establishment size				
	Total	**2-4**	**5-24**	**25-99**	**100-199**	**200+**
Weighted base	285,960	163,054	95,921	20,871	3,777	2,337
Yes	10%	6%	13%	17%	25%	34%
No	90%	94%	86%	82%	74%	63%
Don't know	*%	*%	*%	1%	1%	3%

Source: NESS 2009

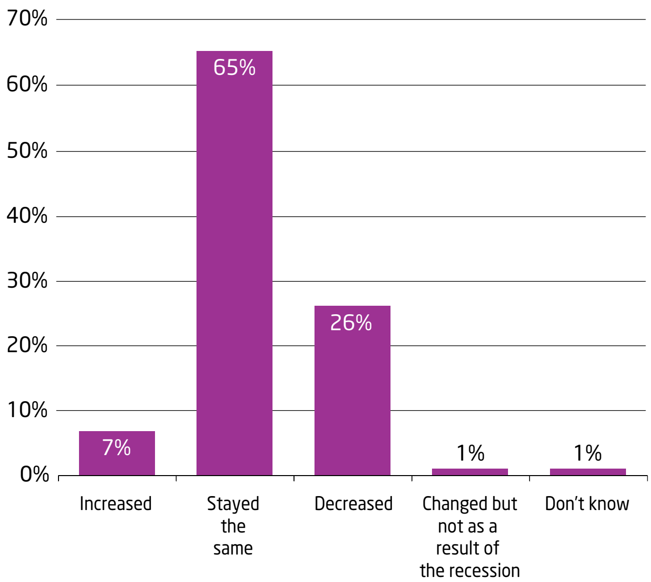
Fig. 16.0: Current involvement in apprenticeships by company size (%)



Source: CBI

NESS09 explored whether companies had changed the number of apprenticeships or new trainees as a result of the recession. Just over a quarter (26%) of establishments said that they had decreased the number of apprenticeships and new trainees (Figure 16.1). However, encouragingly, 7% of businesses used the recession to invest for the future by increasing the number of apprentices and trainees. Two thirds (65%) of businesses reported no change.

Fig. 16.1: Whether the amount of apprenticeships and/or new trainees has changed as a result of the recession by all companies that have/offer apprenticeships (2009) – England



Source: NESS 2009

Research in February 2008 for the Learning and Skills Council[148] (LSC) identified that 77% of employers believe that apprenticeships make them more competitive, while 76% reported that they led to higher productivity.

148 http://www.apprenticeships.org.uk/Employers/Business-Benefits.aspx

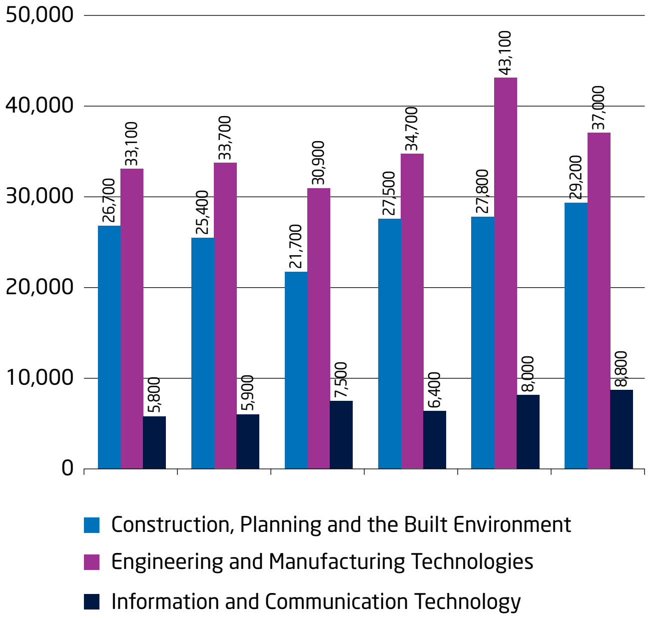
16.2 Programme starts[149 150]

Apprenticeship programme starts have increased by 23.9% across all Sector Subject Areas in the six years since 2003/04 (Figure 16.2 and Table 16.4). Among the three Sector Subject Areas that fall within the engineering footprint, only information and communication technology outstripped the overall growth in apprenticeship programme starts, with an increase of 51.7% and growth of 10% between 2007/08 and 2008/09. However, despite this strong growth, information and communication technology remains the smallest of the three engineering-related Sector Subject Areas, with only 8,800 programme starts in 2008/09. It should also be noted that information and communication technology includes practitioner skills, which are engineering-specific, and user skills, which are not part of the engineering footprint.

Over the six-year period, engineering and manufacturing technology grew by 11.8%. However, this top-level figure hides a lot of fluctuation: in 2008/09, the number of programme starts actually declined by 14.2% compared with the previous year. Of all the engineering-related Sector Subject Areas, engineering and manufacturing technology had the highest number of programme starts: 37,000 in 2008/09.

Construction, planning and the built environment showed the lowest percentage growth in programme starts. Since 2003/04, it has grown by only 9.4%, (although overall programme starts only grew by 5.0% in 2008/09 to 29,200).

Fig. 16.2: Apprenticeship programme starts by Sector Subject Area (2003/04-2008/09) – England



Source: Data Service

Table 16.4: Apprenticeship programme starts by Sector Subject Area (2003/04-2008/09) – England

	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
Construction, Planning and the Built Environment	26,700	25,400	21,700	27,500	27,800	29,200	5.0%	9.4%
Engineering and Manufacturing Technologies	33,100	33,700	30,900	34,700	43,100	37,000	-14.2%	11.8%
Information and Communication Technology	5,800	5,900	7,500	6,400	8,000	8,800	10.0%	51.7%
All apprenticeships	193,600	189,000	175,000	184,400	224,800	239,900	6.7%	23.9%

Source: Data Service

149 Volumes are rounded to the nearest hundred

150 '-' Indicates a base value of less than fifty

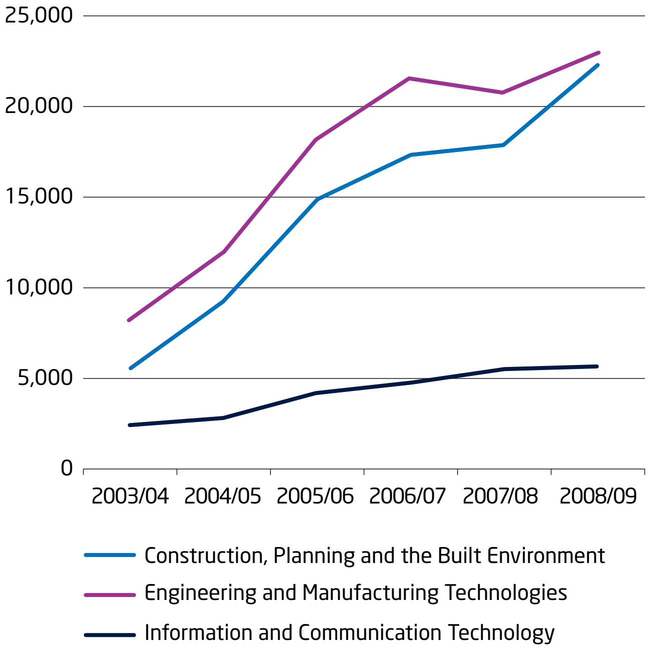
16.3 Framework achievements[151]

Figure 16.3 and Table 16.5 show framework achievements by the three engineering-related Sector Subject Areas. The lowest growth was for information and communication technology, at 128.0% over the six-year period – below the average for all framework achievements (190.9%). With 5,700 achievements in 2008/09, this was the lowest number of framework achievements of the three engineering subjects.

Construction, planning and the built environment has enjoyed very strong growth in the number of framework achievements over the six-year period, rising 298.2% from 5,600 in 2003/04 to 22,300 in 2008/09.

While engineering and manufacturing technologies was the largest of the three engineering Sector Subject Areas, with 22,900 achievements in 2008/09, its growth was below average, at 175.9%.

Fig. 16.3: Apprenticeship framework achievements by Sector Subject Area (2003/04-2008/09)



Source: Data Service

151 Unlike participation figures, figures for 2008/09 are comparable with earlier years as demand-led funding rules are not applied to achievements.

Table 16.5: Apprenticeship framework achievements by Sector Subject Area (2003/04-2008/09)

	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
Construction, Planning and the Built Environment	5,600	9,300	14,900	17,300	17,800	22,300	25.3%	298.2%
Engineering and Manufacturing Technologies	8,300	12,000	18,200	21,500	20,800	22,900	10.1%	175.9%
Information and Communication Technology	2,500	2,900	4,300	4,900	5,500	5,700	3.6%	128.0%
All apprenticeships	49,300	67,200	98,700	111,800	112,600	143,400	27.4%	190.9%

Source: Data Service

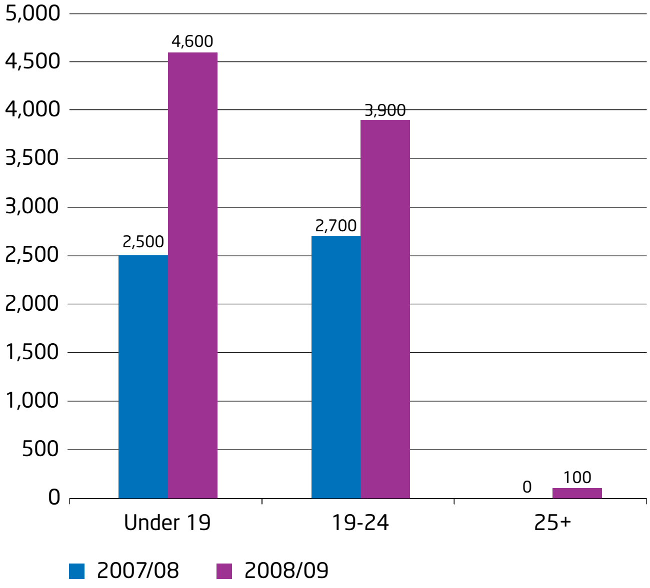
Examining framework achievements at level 3 (Figure 16.4) shows that for construction, planning and the built environment, the number of achievements rose in each of the three age categories between 2007/08 and 2008/09. This is not surprising considering the earlier analysis, which showed that for all apprenticeship levels, framework achievements had increased by 25.3% (Table 16.5). The largest increase in framework achievements was for the under-19s, growing from 2,500 in 2007/08 to 4,600 in 2008/09.

Figure 16.5 shows the number of level 3 framework achievements for engineering and manufacturing technologies. Between 2007/08 and 2008/09, the number of framework achievements for those aged 19-24 stayed the same, at 4,200. However, among the under-19s, there was a noticeable decline, from 6,300 in 2007/08 to 4,500 in 2008/09.

Overall, information and communication technology showed no change in the total number of level 3 framework achievements. However, when you examine the data by age (Figure 16.6), you can see that there was a slight increase in the number of achievements among students aged under 19 and over 25, but a corresponding decrease in those aged 19-24.

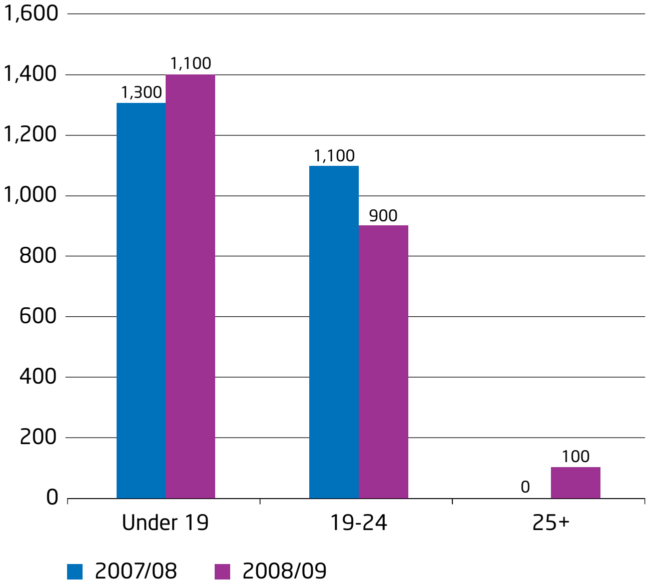
Worryingly, our analyses shows that for all three engineering-related Sector Subject Areas, there were very few framework achievements in the over-25 age group.

Fig. 16.4: Level 3 apprenticeship framework achievements for construction, planning and the built environment by age (2007/08-2008/09) – England



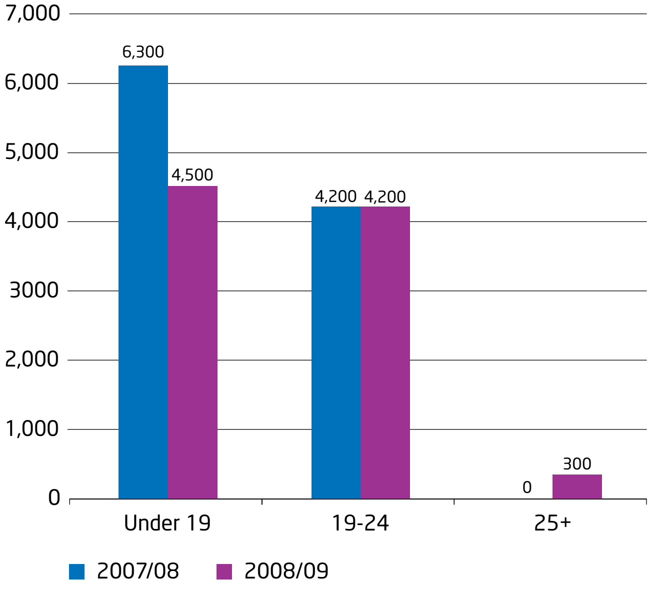
Source: Data Service

Fig. 16.6: Level 3 apprenticeship framework achievements for information and communication technology by age (2007/08-2008/09) – England



Source: Data Service

Fig. 16.5: Level 3 apprenticeship framework achievements for engineering and manufacturing technologies by age (2007/08-2008/09) – England



Source: Data Service

16.4 Success rates[152]

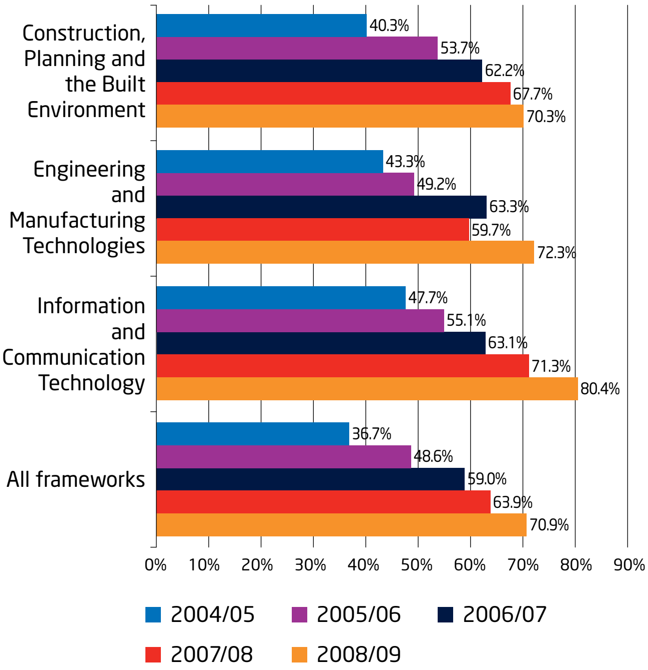
Looking at the success rates data for all three engineering-related Sector Subject Areas (Figure 16.7), it is noticeable how rapidly success rates have risen. In 2004/05, the success rate for all frameworks was 36.7% but by 2008/09 this had risen to 70.9%.

Success rates for construction, planning and the built environment for the period 2004/05 to 2007/08 were above the average. However, in 2008/09 they fell to 70.3% – just below the average of 70.9%.

Engineering and manufacturing technology was the only engineering-related Sector Subject Area not to show a year-on-year increase in success rates. From 2004/05 to 2006/07, success rates were above the overall average. However, in 2007/08 the success rate fell from 63.3% to 59.7%, which put it below the overall average. Success rates then rebounded sharply in 2008/09, increasing to an above-average 72.3%.

Success rates for information and communication technology were consistently above average for each of the five years examined. In addition, with the exception of 2006/07, this subject had the highest success rate of the different engineering-related Sector Subject Areas.

Fig. 16.7: Apprenticeship success rates by Sector Subject Area (2004/05-2008/09) - England



Source: Data Service

152 Apprenticeship success rates are based on the number of learners who meet all of the requirements of their apprenticeship framework, divided by the number of learners who have left training or successfully completed their training in the academic year.

16.5 Cost of an apprenticeship

This section was authored by Nick Linford, Head of the Pearson Centre for Policy and Learning, Pearson Education

The apprenticeship funding formula

Apprenticeships in England are funded by the Skills Funding Agency using an 'employer-responsive' funding formula. The funding formula is applied to each individual qualification within the relevant framework.

Table 16.6: The funding formula for 2010/11

Standard Learner Number (SLN)	The SLN represents the size of the qualification, which is 'listed' within the online Learning Aim Database for the relevant year. For example, the SLN for a Certificate in Engineering might by 1.067 SLN
X	
National Funding Rate (NFR)	The National Funding Rate is set each year and applied based on the age of the apprentice when they start their framework. The apprenticeship national funding rates for 2010/11 are as follows: 16-18 £2,920 19-24 £2,732 25+ £2,186
X	
Programme Weighting (PW)	Like the SLN, the programme weighting is assigned each year to the relevant qualification and can be found on the Learning Aim Database. Programme weightings recognise that, irrespective of size, some qualifications are more costly to deliver than others.
X	
Disadvantage Uplift (DU)	The disadvantage uplift is based on the learner's home postcode and applied equally to all qualifications within their framework. It ranges from 8-32% for learners living in the most deprived 27% of England.
X	
Area Cost Uplift (ACU)	The area cost uplift recognises that the relative cost of delivery in London and the South East is higher than the rest of England. It is applied based on the delivery location of each individual qualification and rises from 1% in parts of West Sussex to a maximum of 20% for the inner London boroughs.
=	
Funding	In a limited number of cases, the percentage of funding earned is locally negotiated. In addition, a large employer factor was introduced in 2010/11, which reduces funding by 25% where the employer of the apprentice has more than 1,000 employees.

Note: the Skills Funding Agency has consulted on the potential to introduce a significantly revised and potentially simpler funding formula for 2011/12.

Employer co-funding

Although 16- to 18-year-olds are fully-funded, apprentices aged 19 or over at the start of their framework (with limited exceptions) are funded at only 50% in 2010/11. It is expected that this shortfall in funding will be met by the employer in the form of a 'co-funded' fee, although this is at the discretion of the apprenticeship provider. The Skills Funding Agency is considering new ways to ensure co-funding is paid by employers in 2011/12.

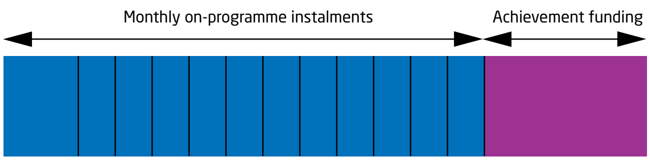
Monthly on-programme instalments and achievement funding

The funding for each qualification is paid to apprenticeship providers monthly during the period of training. It is calculated by applying the funding formula to apprenticeship-provider enrolment data, which they submit online every month.

The amount paid each month for each qualification is arguably complex. This is because the first month is a double instalment and achievement funding, representing 25% of just the main qualification, is held back and only paid once the full framework has been achieved.

For the purposes of demonstration, Figure 16.8 illustrates what funding instalments for the main qualification over a year might look like.

Fig. 16.8: Example of funding instalments



It is also worth noting that:

- If the qualification duration is more than 24 weeks and the apprentice is on-programme for less than six weeks, then the apprentice is not recorded as a start and zero funding is earned.
- Instalments are calculated using rates within the funding formula for the relevant academic year. This means that apprentices who started in 2009/10 that 'carried-in' to 2010/11 are likely to earn different instalment values from August onwards.

Apprenticeship Framework case study

The table below lists example qualifications and 16- to 18-year-old rates in 2010/11 for an Advanced Apprenticeship in Engineering. In this example, the trainee lives in an area where the disadvantage uplift is 8% and the delivery location is in the outer London boroughs, for which there is an area cost uplift of 12%.

Table 16.7: Example of engineering funding costs

Qualification (and level)	SLN	NFR	PW	DU	ACU	Funding
NVQ in engineering (3)	2.257	£2,920	1.5	1.08	1.12	£11,958
Certificate in engineering (3)	1.067	£2,920	1.3	1.08	1.12	£4,899
Five key skill qualifications (2)	0.08 x 5	£2,920	1	1.08	1.12	£1,413
Total funding						£18,270

16.6 Recouping the investment in apprenticeships

In the Engineering UK Report 2009/10[153] it was shown that companies tended to invest in apprenticeships due to:

- A shortage of fully-experienced workers in the external labour market
- A need to continually replenish the stock of skilled workers in the company
- An on-going need to create a pool of workers steeped in the company values

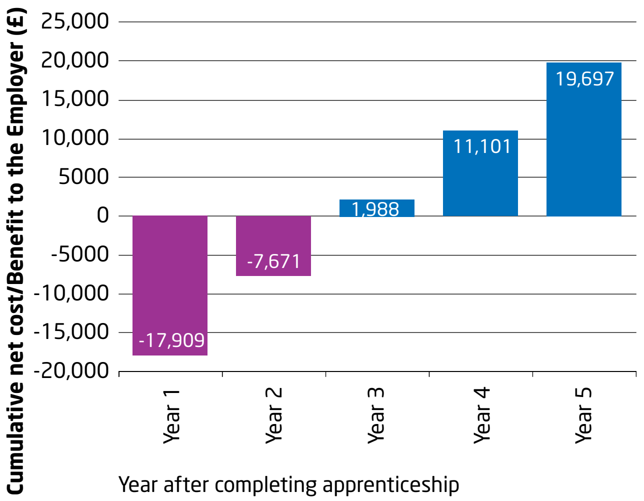
However, few companies carry out a cost benefit analysis. As a result, there is a chance that companies see apprenticeship training as a cost which is incurred rather than an investment which will lead to a return, via higher productivity from the apprentice. Indeed, the cost to a company of training an apprentice is around £29,000. This is equal to 1.25 times the average wage of a fully experienced worker.

The Institute of Employment Research (IER) at the University of Warwick has been using Net Present Value (NPV) to give an indication of the payback period for training an apprentice. A NPV was calculated by summing the future benefits derived by the business from employing the apprentice once fully trained; the net cost of training the apprentices was then deducted from the NPV. As the benefits occur in the future, they were discounted to the present value using a 6% discount rate.[154 155]

There is also a need to take into account the gain to employers from training someone (ie the mark-up on the employee's wage). Employers can recoup the investment in training by paying a wage to workers that is somewhat less than their marginal productivity (as productivity rises, as a result of training, so do wages – but at a lower rate). It is this difference that enables employers to make a return on their investment.

Based on the assumptions laid out above, an estimate of the payback period for apprentices can be provided. Despite the high costs of training an apprentice, the high value of added productivity means that the cost is recouped in 2-3 years (Figure 16.9). Companies that do invest in apprenticeships recognise that they are making a substantial investment and develop a range of measures to ensure they keep the apprentices once training is complete. This can include continued career development and further training.

Fig. 16.9: Payback period for an apprentice in engineering



Comparable analyses looking at the average private net present value of obtaining upper-secondary or post-secondary non-tertiary education as part of initial education across OECD nations showed that it was $28,000 (USD) for females and $40,000 for males. Unfortunately, this figure excludes the United Kingdom. But it does offer an indication of the benefits of investing in education. In the United Kingdom, the net present value of a level 3 apprenticeship is estimated to be around £105,000, and that of a level 2 apprenticeship around £73,000, while an NVQ level 3 is reported to have a net present value of £34,000.[156]

153 http://www.engineeringuk.com/_db/_documents/EngUK09.pdf

154 Roughly equal to the rate of inflation in late 2008 when the analysis was carried out.

155 The calculation can be expressed as follows:

formula is NPV of Apprenticeship =
Σ[S1/(1+r) + S2/(1+r)2 + S3/(1+r)3 ...+ Sn/(1+r)n] – C0
t=1
where Sn is the value of the apprentice at time 1, 2, 3, ...n (n is the number of time periods), r is the discount rate and C0 is the cost of the apprenticeship
t=n

156 Independent Review of Fees and Co-Funding in Further Education in England

16.7 Apprenticeship pay and gender

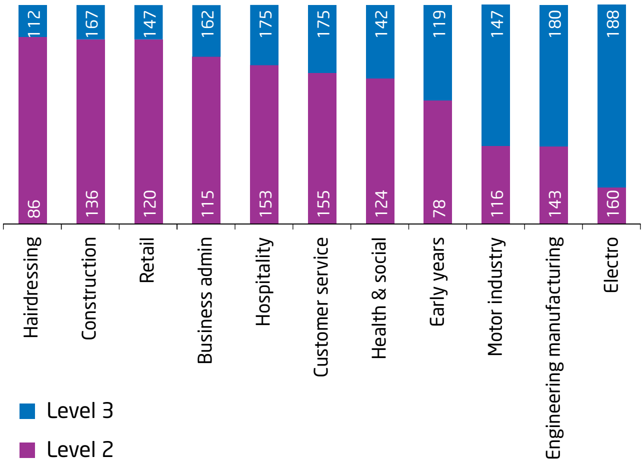
The Engineering UK Report 2009/10[157] explored the issue of apprenticeship pay and gender. Figure 16.10 shows the average net pay for apprentices by sector and by level 2 and level 3 in the top 11 apprenticeship frameworks. Sectors such as electrotechnical and engineering manufacturing were more likely to have male apprentices than female apprentices and were also two of the best-paid apprenticeship frameworks out of the eleven explored. Conversely, hairdressing and early years were more likely to have female apprentices and were two of the worst paid apprenticeship frameworks. This gender issue was reinforced by the fact that, within the four apprenticeship frameworks analysed by gender, men received higher pay than women. Table 16.8 shows that in hospitality, women only received 85% of men's pay, rising to 95% for apprentices doing business administration.

In March 2008, the TUC published *Still More (Better Paid) Jobs for the Boys*,[158] followed by *Decent Pay for Apprentices*[159] in August 2008, which showed the worsening gendered nature of apprenticeships in engineering-related sectors (Table 16.9). The report called for better apprentice pay, employment protection and for developing stronger enforcement mechanisms.

Male-dominated apprenticeships, such as engineering and construction, are more likely than female-dominated sectors to offer training at level 3, which provides qualifications acceptable for entry into Higher Education.

In 2007, the Equality and Human Rights Commission (EHRC) and the Apprenticeship Ambassadors Network emphasised that (still): "Only 2% of engineering apprentices are female, only 4% are from ethnic minority communities and 6% have a learning difficulty, disability or health problem," (EHRC 2007:3).[160]

Fig. 16.10: Average net pay by apprenticeship sector and level



Source: Ullman and Deakin 2005[161]

157 http://www.engineeringuk.com/_db/_documents/EngUK09.pdf

158 TUC (2008a). *Still more (better paid) jobs for the boys: apprenticeships and gender segregation* http://www.tuc.org.uk/extras/genderreport.pdf

159 TUC (2008b). *Decent pay for apprentices.* http://www.tuc.org.uk/extras/apprenticepay.pdf

160 Equality and Human Rights Commission and the Apprenticeship Ambassadors Network (2007). *Daring to be different: the business case for diversity on apprenticeships.* London: Equality and Human Rights Commission. http://wwwequalityhumanrights.com/en/publicationsandresources/Pages/Daringtobedifferent.aspx

161 http://www.education.gov.uk/research/data/uploadfiles/rr674.pdf

Table 16.8 Average weekly pay by gender in retail, customer service, hospitality and business administration

Sector	Average weekly pay Male	Female	Female earnings as percentage of male earnings
Hospitality	£169 (base 190)	£144 (base 146)	85%
Retail	£131 (base 117)	£116 (base 167)	89%
Customer Service	£168 (base 84)	£158 (base 194)	94%
Business Administration	£131 (base 113)	£124 (base 305)	95%

Source: Ullman and Deakin 2005[162]

Table 16.9 Apprenticeship starts – proportion of women apprenticeships in top 10 frameworks (2002/03 and 2006/07)

Apprenticeship Framework	% Women Apprentices (Level 2 and Level 3) 2002/03	2006/7	% change
Construction	1.3	1.3	0
Hairdressing	92.6	91.7	-0.9
Business administration	78.6	79	0.4
Customer service	68.2	67	-1.2
Hospitality and catering	50.6	50.6	0
Children's care learning and development	97.3	97.1	-0.2
Engineering	4.6	2.6	-2
Health and social care	88.9	89.7	0.8
Retail	65.8	66.4	0.6
Vehicle maintenance and repair	2.9	1.4	-1.5

Source: TUC 2008[163]

162 http://www.education.gov.uk/research/data/uploadfiles/rr674.pdf

163 TUC (2008a). *Still more (better paid) jobs for the boys: apprenticeships and gender segregation*. http://www.tuc.org.uk/extras/genderreport.pdf

16.8 Young Apprenticeships

There is growing concern for the Young Apprenticeship (YA) programme, which currently provides progression for 14- to 16-year-olds to pursue full apprenticeships and employment after the age of 16 (see text box). The scheme is now facing competition from the Diplomas scheme and funding is being diverted from it, as government increasingly sees diplomas as the preferred vocational qualification for 14- to 19-year-olds. Employers and young people, however, are keen on the YA programme because of the clear progression it provides to post-16 apprenticeships.

Since the programme began in September 2004 with 1,000 pupils, it has been expanding. From September 2009, a sixth cohort of around 9,000 joined. The programme has expanded through the addition of Diplomas pilots, although there are less than 300 pupils on the YA/Diploma pilot.

.... Ofsted's interviews with employers supporting the Young Apprenticeship programme, which includes 50 days of work experience, provide further evidence of support for the scheme. Employers argued the programme benefited young people because they developed skills and attributes which made them more employable, including a willingness to learn; interpersonal skills (through working with adults in the work place); communication skills; team working; and good timekeeping and attendance. Employers also identified benefits in the programme for their own organisations. In young apprentices they saw young people who were developing the skills and aptitude to progress in their industry. The young apprentices would join the labour market with desirable skills and an understanding of different aspects of the vocational area. These would enable them to make a fuller contribution to an organisation when they entered full-time employment. Employers in some vocational areas saw the programme as a means of introducing more able students to vocational areas which they might not otherwise have considered. Some employers also used the programme for assessing and recruiting potential employees as post-16 apprentices. Young apprentices have gained employment as a result of successful work placements.[164]

At the time of writing, Semta is engaged in a campaign to protect the place and funding of Performing Engineering Operations (PEO) NVQ2 in the Engineering Apprenticeship framework. The Skills Funding Agency and National Apprenticeships Service intend to remove the section in the new framework template which contains "additional employer requirements", as there is no facility for this within the Specification for Apprenticeship Standards in England document. PEO NVQ2 has formed part of "additional employer requirements" since the framework was formalised, and withdrawing funding would mean that alternative funding would need to be found to finance this element of the framework. It would also seriously impact on the coherence of the framework as a whole, which uses PEO NVQ2 as the off-the-job initial training element which ensures the safety and basic engineering competence of apprentices before they enter the workplace and begin training in their specific engineering discipline.

164 Ofsted, *The Young Apprenticeships programme: 2004-07: an evaluation* (2007)

Part 2 Engineering in Education and Training
17.0 Other vocational qualifications

In 2008/09 there were 116,538 awards of NVQs for construction, planning and the built environment: growth of only 17.6% on the previous year. However, despite below-average growth in 2008/09, it grew by 140.1% over the six-year period. In 2003/04 there were just 48,543 awards for construction, planning and the built environment against 116,538 in 2008/09.

Information and communication technology grew by 282.5% over the six-year period: nearly three times the average for all courses. It also grew at an above-average rate of 30.1% in 2008/09. However, despite this impressive growth, information and communication technology is still the smallest of all the engineering-related Sector Subject Areas, with only 35,338 students in 2008/09.

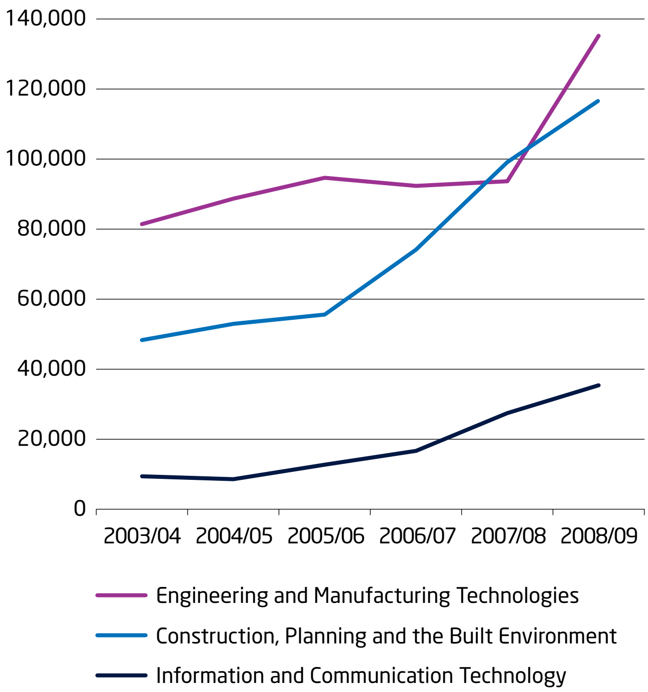
17.1 National/Scottish Vocational Qualifications (N/SVQ)

N/SVQ qualifications recognise the level of skill and knowledge needed to demonstrate competency in the area of work related to the subject studied. Candidates must pass a performance-based assessment, usually in a work environment. It should be noted, however, that N/SVQs are not related to a specific course of study. Since their introduction in 1987, 8.5 million N/SVQs have been awarded to successful candidates.[165] N/SVQ level 3 qualifications also form a substantial element of the Advanced/Modern Apprenticeship.

Figure 17.0 and Table 17.0 show awards of NVQs in the UK for the three engineering-related Sector Subject Areas. It is encouraging to see that all three Sector Subject Areas have grown over the six-year period and that all three also saw growth in the last year.

Engineering and manufacturing technology had the lowest growth over the six years which, at 66.1%, was below the overall average of 95.9%. Most of the growth for engineering and manufacturing technologies occurred in 2008/09, where it grew by 43.8%, making it the largest engineering-related Sector Subject Area again.

Fig. 17.0: Awards of NVQs by Sector Subject Area (2003/04-2008/09) - UK



Source: Data Service

165 Data Service Statistical First Release June 2010 – supplementary table on vocational qualifications

Table 17.0: Awards of NVQs by Sector Subject Area (2003/04-2008/09) – UK

	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
Engineering and manufacturing technologies	81,327	88,865	94,583	92,396	93,906	135,044	43.8%	66.1%
Construction, planning and the built environment	48,543	52,809	55,423	73,953	99,128	116,538	17.6%	140.1%
Information and communication technology	9,239	8,461	12,593	16,623	27,170	35,338	30.1%	282.5%
Total	470,119	538,499	598,586	630,419	728,194	920,935	26.5%	95.9%

Source: Data Service

Looking more generally at N/SVQ awards, (Table 17.1) there were 142,500 awards in total for engineering and manufacturing technologies across the UK in 2008/09. However, the majority of these (105,700) were at level 2 and a further 10,300 were at level 1. In total, only 26,200 (18.4%) were at level 3 and less than a thousand were above level 3.

There was a similar pattern for construction, planning and the built environment. Out of the 124,700 awards given in 2008/09, only 19,200 were at level 3 (15.4%), while 102,600 were at level 2. This pattern was also repeated with information and communication technology, which had 35,500 awards – 4,400 at level 3 (12.4%) and 26,600 at level 2.

Table 17.1: N/SVQ awards by Sector Subject Area and level of award (2008/09) – UK

	Total Awards[166]	Level 1	Level 2	Level 3	Levels 4 & 5
Engineering and manufacturing technologies	142,500	10,300	105,700	26,200	-[167]
Construction, planning and the built environment	124,700	1,000	102,600	19,200	1.9
Information and communication technology	35,500	4,400	26,600	4,400	-

Source: Data Service

166 Numbers may not add up to row and column totals due to rounding

167 Less than 1,000

Analysing the total N/SVQ awards by gender, Table 17.2 shows that only 0.9% of awards in construction, planning and the built environment go to women. Engineering and manufacturing technologies perform slightly better, but still poorly, with 8.4% of awards going to female students. The only Sector Subject Area which is close to a 50:50 gender split is information and communication technology, where 53.0% of awards have gone to women. However, it should be noted that information and communication technology encompasses practitioner skills, which falls within the engineering footprint, and user skills, which do not.

Table 17.2: N/SVQ awards by Sector Subject Area and gender (2008/09) – UK

	Total Awards	Male	Female	Percentage female
Engineering and manufacturing technologies	142,500	130,700	11,900	8.4%
Construction, planning and the built environment	124,700	123,600	1,100	0.9%
Information and communication technology	35,500	16,700	18,800	53.0%

Source: Data Service

17.2 Vocationally-Related Qualifications (VRQs)

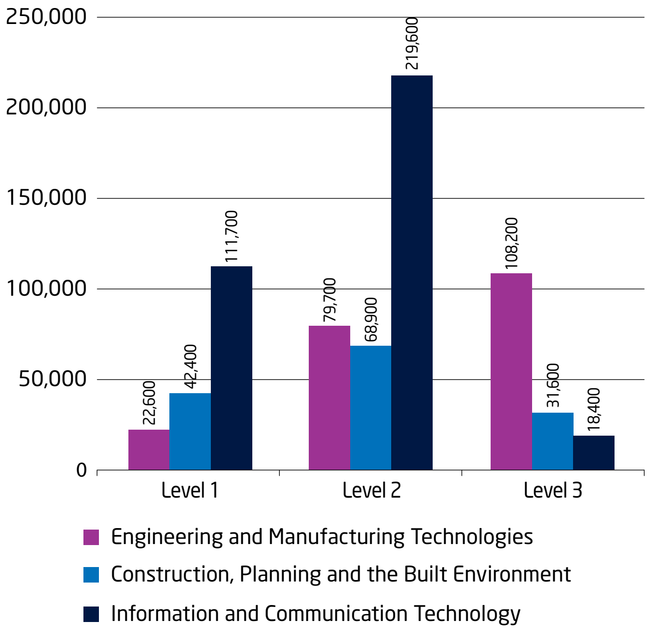
VRQs, such as National Certificates and Diplomas, provide the knowledge and practical skills required for a job through a programme of structured learning. VRQs are usually assessed via assignments, projects and sometimes written tests. As well being a standalone qualification, VRQs are often, but not always, a component of apprenticeships. In 2008/09, 34% of all VRQs were awarded to people over the age of 24.[168]

Figure 17.1 shows the profile of VRQ awards by level for the three engineering-related Sector Subject Areas. The figure quite clearly shows that for engineering and manufacturing technologies, over half (108,200) of the awards are at level 3, while only 22,600 are at level 1.

By comparison, information and communication technology is predominately a level 1 and level 2 qualification: 219,600 awards were at level 2, with a further 111,700 at level 1. This compares to only 18,400 awards at level 3.

Awards in construction, planning and the built environment are more evenly spread across the three qualification levels. Most awards are at level 2 (68,900). However, there are also 42,400 awards at level 1 and 31,600 at level 3.

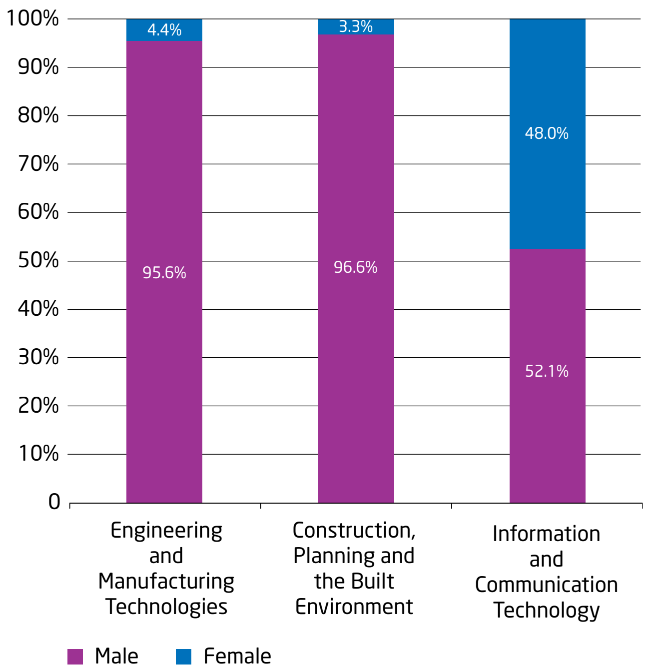
Fig. 17.1: All VRQ awards (as reported by participating awarding bodies)[169] by Sector Subject Area and level (2008/09) – UK



Source: Data Service

Figure 17.2 shows the proportion of awards for each of the three engineering related Sector Subject Areas by gender. The figure clearly shows that only 3.3% of awards in construction, planning and the built environment were to women; for engineering and manufacturing technologies, the comparable figure is 4.4%. More promisingly, 48.0% of awards for information and communication technology were given to females. However, only practitioners fall within the engineering footprint.

Fig. 17.2: All VRQ awards (as reported by participating awarding bodies) by Sector Subject Area and gender (2008/09) – UK



Source: Data Service

168 The Data Service, Statistical First Release June 2010

169 In 2001/02 only three awarding bodies reported their data to the Vocational Qualifications Database. By 2008/09 this had risen to 50 awarding bodies.

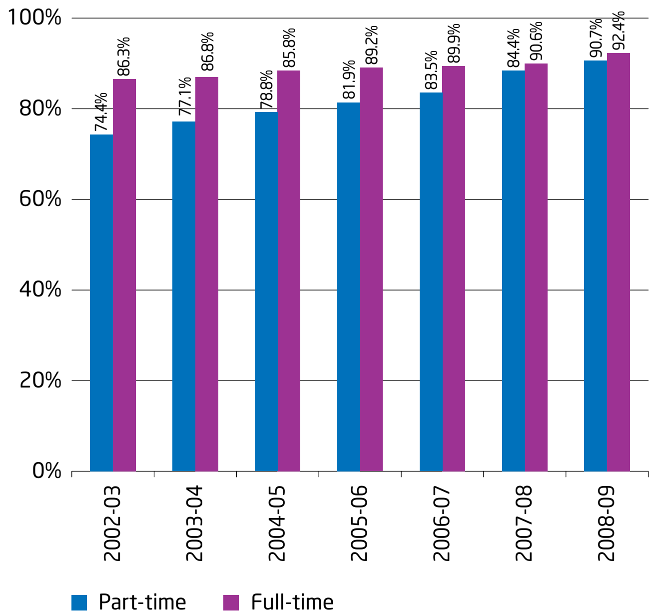
Part 2 Engineering in Education and Training
18.0 Further Education teaching workforce

18.1 Further Education staff

EngineeringUK believes that continuing professional development (CPD) and prior industry experience enables lecturers to build their lessons on real life experience, which enthuses and inspires students into working in STEM careers. Under the STEM framework, set out by the STEM High Level Strategy Group, the National Science Learning Centre has been given lead responsibility for improving the teaching and learning of science teachers through CPD.

In 2002, the Department for Education set out its Success for All strategy. This set a target for all teaching staff in the Further Education sector in England who started teaching on or after the 1st September 2001 to be qualified as a teacher or to be enrolled on an appropriate teaching course by 2010.[170] By 2008/09, 92.4% of full-time staff had either qualified or enrolled on a relevant course – up from 90.6% the previous year. Qualification or enrolment on an appropriate course was lower for part-time staff, with only 90.7% reaching this target in 2008/09.

Fig. 18.0: Percentage of teaching staff, by teaching mode, who are qualified or enrolled (2002/03-2008/09)



Source LLUK

170 The definition of a relevant teaching qualification is different for full-time and part-time staff.

18.2 Subject areas taught

In the Engineering UK Report 2009/10 it was identified that, because FE staff teach across a range of subject areas, it can be very difficult to identify the actual number of staff engaged in teaching engineering in the FE sector. For example, a member of staff teaching an automotive course may need to teach elements of maths and science; this teaching could be delivered by a teacher with industrial automotive skills rather than maths and science skills.

Lifelong Learning UK (LLUK) produces an annual analysis of the Staff Individualised Record (SIR). This also has shortcomings around the accurate identification of the subject area teachers are specialising in. Nevertheless, Table 18.0 shows that, over the three-year period from 2006/07 to 2008/09, each of the three subject areas in the engineering sector have seen growth in the number of FE teachers. Construction had nearly a quarter more teachers (24.4%), engineering and manufacturing technologies has 15.5% more, and information and communication technology 9.1% more. In the last year, the only subject area to show a drop in the number of FE teachers was information and communication technology, down 2.5% to 7,229.

Table 18.0: Subject areas taught by FE teaching staff (2006/7-2008/09) – England

	2006/07	2007/08	2008/09	Percentage change over period	Percentage change over last year
Engineering and manufacturing technologies	6,555	7,079	7,574	15.5%	7.0%
Construction	5,549	6,710	6,903	24.4%	2.9%
Information and communication technology	6,628	7,417	7,229	9.1%	-2.5%
Total	18,732	21,206	21,706	15.9%	2.4%

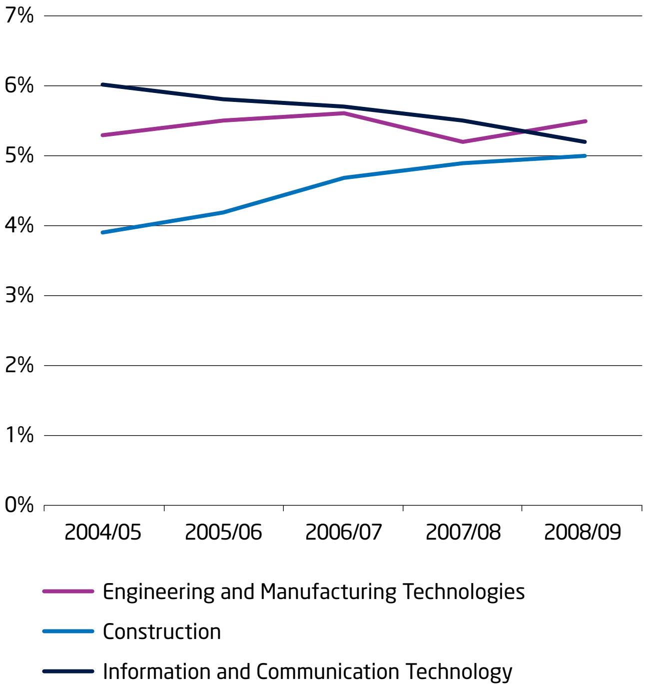
Source: LLUK Further Education Workforce Data 2006/07 – 2008/09

Figure 18.1 and Table 18.1 show the percentage of all teaching staff[171] in the three engineering-related subject areas from 2004/05 to 2008/09. The proportion of construction teaching staff has risen year-on-year from 3.9% in 2004/05 to 5.0% in 2008/09. Engineering and manufacturing technology represented 5.3% of all teaching staff in 2004/05, growing slightly to 5.6% two years later, falling back to 5.2% in 2007/08, then rising again slightly to 5.5% in 2008/09.

There has been an annual decline in the proportion of FE staff teaching information and communications technology, falling from 6.0% in 2004/05 to 5.2% in 2008/09.

171 It should be noted that this data shows both full-time and part-time FE engineering teachers. It is therefore possible that the proportion of part-time FE teachers has risen, decreased or stayed the same and this could affect the amount of contact time with students. In addition, some part-time staff will be teaching for multiple FE providers and will therefore be counted more than once in the figures.

Fig. 18.1: Percentage of FE teaching staff teaching in selected subject areas (2004/05-2008/09) – England



Source: LLUK Further Education College Workforce Data 2008/09

Table 18.1: Percentage of FE teaching staff teaching in selected subject areas (2004/05-2008/09) – England

	2004/05	2005/06	2006/07	2007/08	2008/09
Engineering and manufacturing technologies	5.3%	5.5%	5.6%	5.2%	5.5%
Construction	3.9%	4.2%	4.7%	4.9%	5.0%
Information and communication technology	6.0%	5.8%	5.7%	5.5%	5.2%

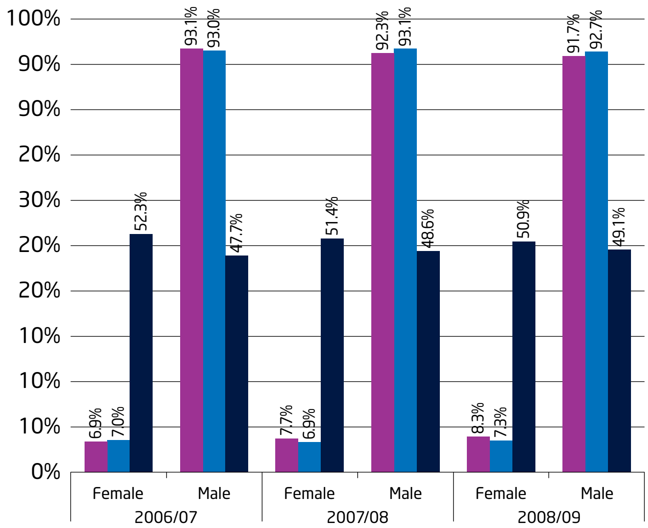
Source: LLUK Further Education College Workforce Data 2008/09

18.3 Gender in engineering subject areas

Figure 18.2 and Table 18.2 show the gender breakdown of FE teachers in the three engineering subject areas over a three-year period. Information and communication technology has a very slight bias towards female teachers, although this has been declining slowly over the period. Conversely, the engineering and manufacturing technologies subject area has a very strong bias towards male lecturers, with over 90% being male. However, the proportion of female teachers who are teaching engineering and manufacturing technologies did increase slightly in both 2007/08 and 2008/09. The picture for construction is similar: over 90% teachers are male, with the proportion of female teachers fluctuating at around 7%.

The construction and engineering and manufacturing technologies figures are in marked contrast to the overall FE teaching workforce, which shows a bias towards female teachers (59.0% were female in 2008/09). However, it should be noted that several subject areas have a strong bias towards female teachers, for instance, foundation programmes, English language and communication, hairdressing and beauty therapy.

Fig. 18.2: Subject area taught by FE teaching staff by gender (2006/07-2008/09) - England



Source: LLUK Further Education Workforce Data 2006/07 – 2008/09

Table 18.2: Subject area taught by FE teaching staff by gender (2006/07-2008/09) – England

	2006/07		2007/08		2008/09	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Engineering and manufacturing technologies	6.9%	93.1%	7.7%	92.3%	8.3%	91.7%
Construction	7.0%	93.0%	6.9%	93.1%	7.3%	92.7%
Information and communication technology	52.3%	47.7%	51.4%	48.6%	50.9%	49.1%
Total	58.9%	41.1%	40.6%	59.4%	59.0%	41.0%

Source: LLUK Further Education Workforce Data 2006/07 – 2008/09

18.4 Salaries in engineering subject areas

LLUK has identified that salary levels are very important when recruiting staff in vocation-related teaching jobs.

"There was an important trend in relation to vocational subjects in which there was a high emphasis on recruiting staff from industry with professional experience – particularly construction, planning and the built environment and engineering and manufacturing technologies and, to a lesser extent, health, public services and care and ICT."

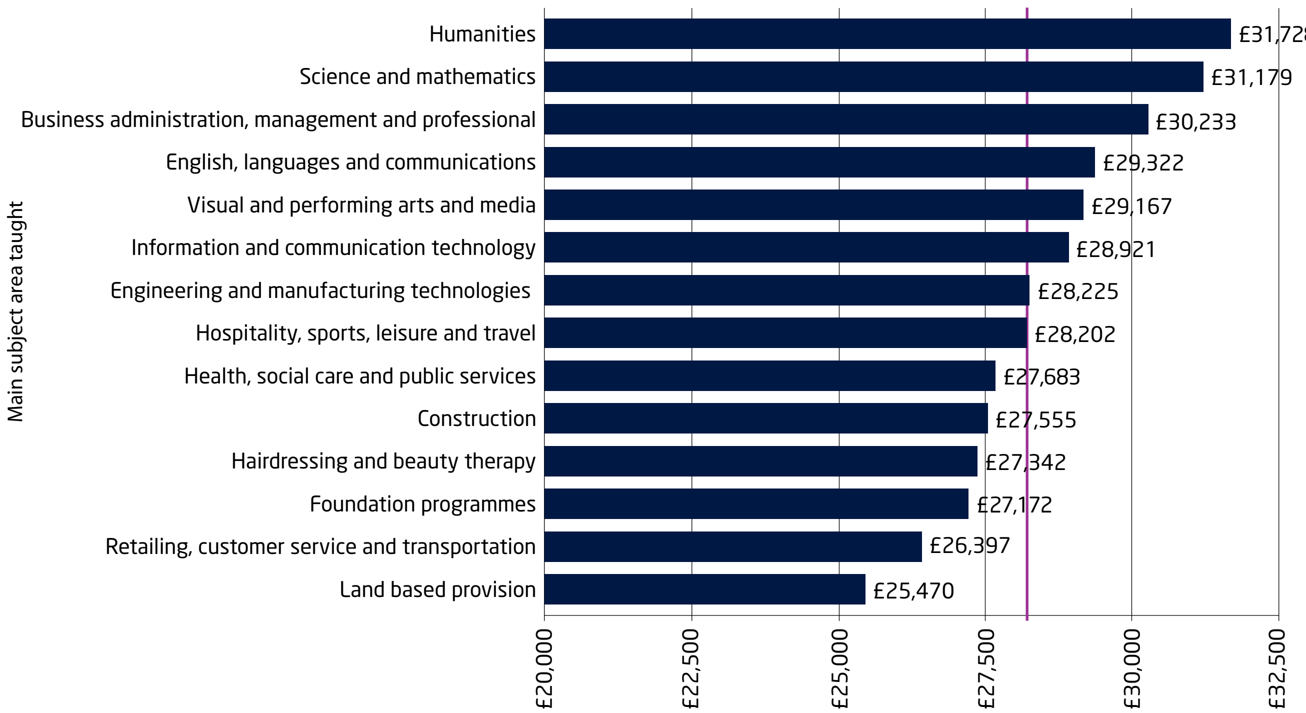
(LLUK, 2009:18).

Figure 18.3 looks at the salary levels for full-time staff in different engineering subject areas.[172 173] Out of the three engineering-related subject areas, staff in information and communication technology earn £28,921; well above the average salary for a teacher. Teachers of engineering and manufacturing technologies earn an average salary £28,225, while those teaching construction earn £27,555 – below the average salary. However, it should be noted that the differential between information and communication technology and construction is only £1,366.

Although not an engineering subject area, it should be noted that those teaching science and mathematics had the second highest average salary at £31,179 – perhaps diverting potential engineering teachers away from teaching engineering.

Section 26 shows the average salaries for people working in different STEM careers. The FE sector will need to monitor salaries in industry if recruitment and retention of STEM lecturers becomes a problem.

Fig. 18.3: Average salaries for full-time FE teaching staff by subject area (2008/09) – England



Source: LLUK Further Education College Workforce Data 2008/09

172 Staff starting work after 5th April 2009 were recorded as earning £0-£1,999 and all salaries in the £0-£1,999 bracket were excluded from the analysis.

173 Data is collected on the salary paid during a tax year. Therefore, for staff starting work during a tax year, their data will be based on their salary in that tax year rather than their actual annual salary.

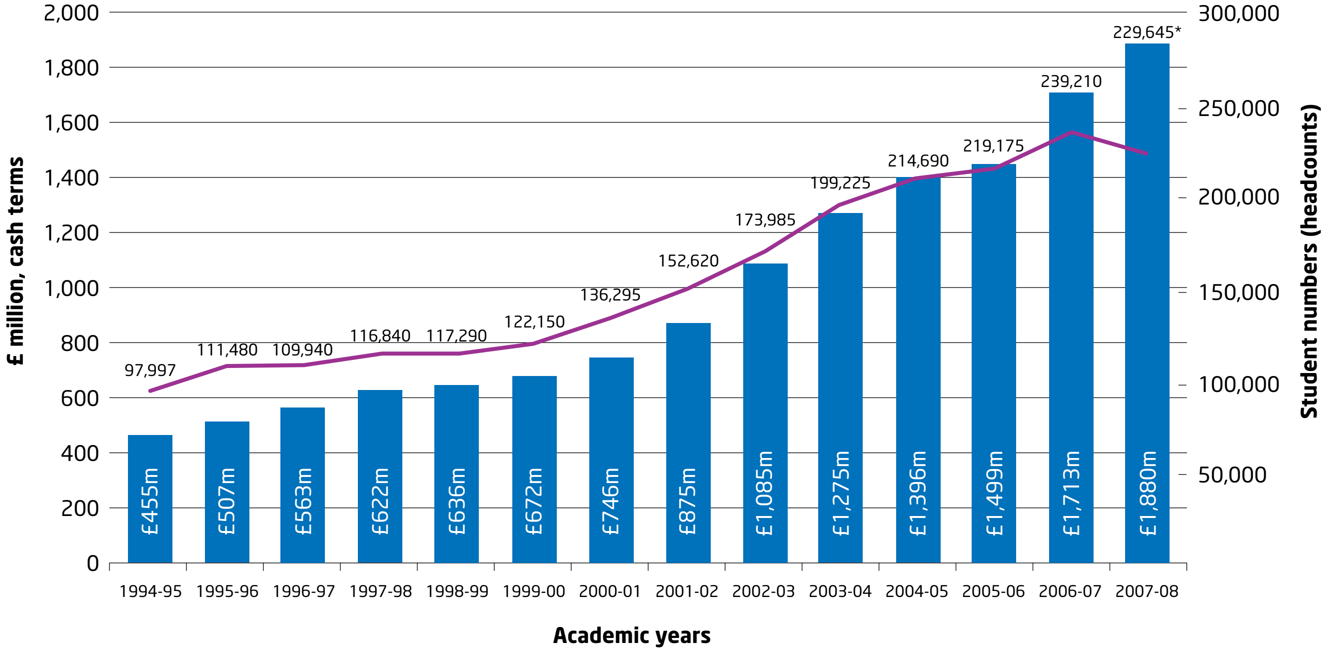
Part 2 Engineering in Education and Training

19.0 Higher Education

Higher Education Institutions (HEIs) have always been critical to the supply of new engineers into the economy. However, after many years of relative stability, the HE sector – like other sectors – is now subject to the vagaries of the coalition government's drive to re-balance the books. As such, it is having to act rapidly in response to budget cuts and education-related government policy decisions.

One particular change which may affect the HE sector is Lord Browne's review of whether the cap for variable fees should rise from the current £3,225 per year for full-time undergraduates. Given the current economic circumstances, raising tuition fees may be seen as an easy way to cut government funding. Another means of increasing university funding would be for universities to increase the number of international students they take (Figure 19.0). In 1994/95, international students paid fees of £455 million. By 2007/08, this had increased to £1,880 million, while the Campaign for Science and Engineering reports that total income derived from international students is £5 billion.

Fig. 19.0: HE income from students (1994/95-2007/08) – all non-EU domiciled[174]



Source: Universities UK

Another measure undertaken by BIS to help reduce its £7.3 billion HE budget, is to cut back its planned increase of 20,000 HE students to 10,000,[175] of which 8,000 would be full-time and 2,000 part-time.

174 From 2007/08 writing up and sabbatical students are no longer included in HESA standard counts of students.

175 http://www.bis.gov.uk/news/topstories/2010/May/BIS-savings

19.1 The UK Higher Education sector

Of the 116 universities in the UK, 91 are in England; Scotland has the second highest number, with 15 (Table 19.0).

Table 19.0: Overview of the HE sector (August 2008) - UK

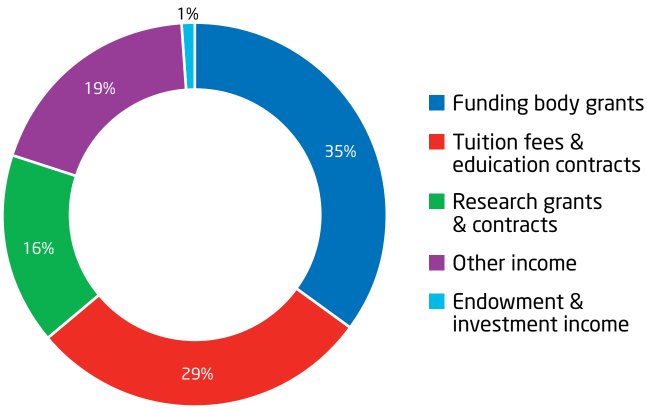
	Universities[176]	Higher Education Institutions[177]
England	91	132
Scotland	15	19
Wales	8	11
Northern Ireland	2	4
United Kingdom	116	166

Source: Universities UK (HESA data)

Overall, HE income in 2008/09 was £25.4 billion, an 8% increase on 2007/09. The largest source of income came from funding body grants (Figure 22.1), which generated 35% of income. The only area of income to show a decline from 2007/08 was endowment and investment income. This can possibly be explained by the decrease in interest rates and falls in the stock market associated with the recession. Tuition fees and education contracts showed the largest percentage increase up 16.2%, on 2007/08. The largest area of expenditure in HE (Figure 19.2) is staffing costs, which accounts for 56.8% of all expenditure. This is a slight decrease on 2007/08. In 2007, universities directly employed over 372,000 full-time and part-time staff (equivalent to approximately 314,600 full-time jobs).[178]

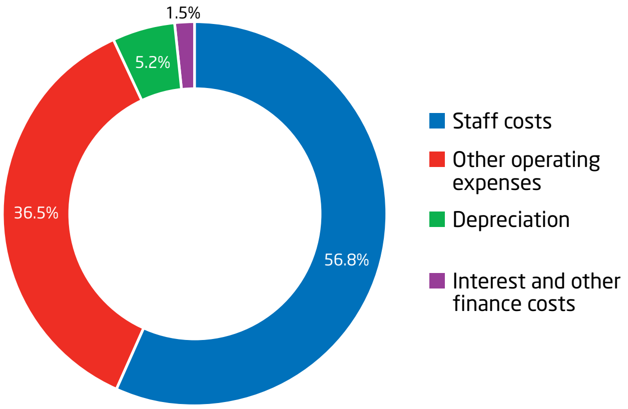
The rising numbers of postgraduate students, many of whom are also international students, has also been financially beneficial to the HE sector. A report for BIS[179] identified that universities generated £1.5 billion in revenue from taught postgraduate provision in 2008/09.

Fig. 19.1: HE income £25.4 billion (2008/09)



Source: HESA

Fig. 19.2: HE expenditure £24.9 billion (2008/09)



Source: HESA

According to the OECD (Table 19.1), the UK spends 1.3% of its GDP on tertiary education, which is a slightly lower proportion than the average for OECD members.

176 Institutions with 'university' or 'university college' title. Federal institutions such as the University of Wales and the University of London are counted as one university.

177 The term Higher Education institutions includes universities, university colleges, specialist Higher Education institutions and other Higher Education colleges.

178 *The impact of universities on the UK economy* by Ursula Kelly, Donald McLellan and Emeritus Professor Iain McNicoll for Universities UK, November 2009

179 *One Step Beyond: Making the most of postgraduate education* by Professor Adrian Smith, Dr Tim Bradshaw, Professor Keith Burnett, Dr David Docherty, Professor Wendy Purcell and Professor Sarah Worthington March 2010

Table 19.1: Tertiary Education spend as a proportion of GDP by OECD and partner countries

	% GDP spend for that year		
Member countries	**2006**	**2000**	**1995**
Australia	1.6	1.5	1.6
Austria	1.3	1.1	1.2
Belgium	1.3	1.3	m
Canada[180 181]	2.7	2.3	2.1
Czech Republic	1.2	0.8	0.9
Denmark[182]	1.7	1.6	1.6
Finland	1.7	1.7	1.9
France	1.3	1.3	1.4
Germany	1.1	1.1	1.1
Greece[183]	m[184]	0.8	0.6
Hungary	1.1	1.1	1.0
Iceland[185]	1.1	1.1	m
Ireland	1.2	1.5	1.3
Italy	0.9	0.9	0.7
Japan[186]	1.5	1.4	1.3
Korea	2.5	2.3	m
Luxembourg[187]	m	m	m
Mexico	1.1	1.0	1.0
Netherlands	1.5	1.4	1.6
New Zealand	1.5	m	m
Norway[188]	1.2	1.2	1.6
Poland	1.3	1.1	0.8
Portugal	1.4	1.0	0.9
Slovak Republic[189]	1.0	0.8	0.7
Spain	1.1	1.1	1.0
Sweden	1.6	1.6	1.5
Switzerland[190]	1.4	1.1	0.9
Turkey[191]	0.8	0.8	0.5
United Kingdom	1.3	1.0	1.1
United States	2.9	2.7	2.3
Partner countries	**2006**	**2000**	**1995**
Brazil[192]	0.8	0.7	0.7
Chile[193]	1.7	2.0	1.7
Estonia[194]	1.1	1.0	1.0
Israel	1.8	1.9	1.8
Russian Federation[195]	0.8	0.5	m
Slovenia	1.3	m	m
OECD average	1.4	~	~

Source: OECD (2009), Education at a Glance 2009: OECD Indicators, p.218, www.oecd.org/edu/eag2009

180 Year of reference 2005 instead of 2006

181 Some levels of education are included with others

182 Some levels of education are included with others

183 Some levels of education are included with others

184 Data not available. In a few cases, data included in other categories.

185 Some levels of education are included with others

186 Some levels of education are included with others

187 Some levels of education are included with others

188 Public expenditure only

189 Some levels of education are included with others

190 Public expenditure only

191 Public expenditure only

192 Public expenditure only

193 2007 instead of 2006

194 Public expenditure only

195 Public expenditure only

19.2 Participation rates

For 2008/09, the provisional HE initial participation rate (HEIPR) for 17- to 30-year-old English-domiciled students was 45%. This was in increase from 43% in 2007/08 and 42% in 2006/07 (Table 19.2). Looking specifically at 2008/09, it is noted that the HEIPR for females was 51%, while for males it was only 40%. Both the female and male HEIPR rates increased by two percentage points from the previous year. The HEIPR percentage for full-time students is 39%, while part-time accounts for a further 6%.

Research commissioned by BIS[196] indicates that more than 55% of all 16- to 17-year-olds in England believed they were likely to apply to university to do a degree. A participation rate of 45% indicates that approximately one in ten students who are considering HE at age 16-17 don't enrol on a course.

Table 19.2: Participation rates for 17- to 30-year-old English-domiciled students at UK Higher Education institutions (2006/07-2008/09)

Academic Year	2006/07	2007/08	2008/09 (Provisional)
HEIPR (male and female) %	42 (42.0)	43 (43.4)	45 (45.5)
Initial entrants (thousands)	285	296	313
HEIPR (male) %	37 (36.5)	38 (37.9)	40 (40.0)
Initial entrants (thousands)	127	133	141
HEIPR (female) %	48 (47.8)	49 (49.1)	51 (51.2)
Initial entrants (thousands)	158	163	172
HEIPR (full-time) %	35 (35.3)	37 (37.0)	39 (39.0)
Initial entrants (thousands)	240	252	268
HEIPR (part-time) %	7 (6.8)	6 (6.4)	6 (6.4)
Initial entrants (thousands)	45	44	45

Source: BIS

Scotland, Wales and Northern Ireland do not produce HEIPR statistics for students from those countries. As a result, it is not possible to provide comparable data for these countries. However, in Scotland[197] in 2007/08, the Age Participation Index was 43.2%, down from 46.1% the previous year. The majority of the fall can be explained by a decline in the number of students entering Higher Education. In Scotland, female participation in Higher Education was 12.9% higher than for males, at 49.8%.[198] The national participation rates for Welsh-domiciled students in 2006/07 was 3.7%, with the figure for women being 4.3% compared with 3.1% for men. These figures have not changed for the last two years. The Higher Education age participation index for Northern Ireland was 49.6% in 2007/08, an increase from 46.1% the previous year.

The postgraduate initial participation rate (PGIPR) for English-domiciled students was 9% in 2008/09, unchanged from 2006/07 (Table 19.3). For women, the PGIPR was 12%, while the comparable figure for men was 8%.

Table 19.3: Postgraduate participation rates for 17- to 30-year-old English-domiciled students at UK Higher Education institutions (2006/07-2008/09)

Academic Year	2006/07	2007/08	2008/09 (Provisional)
PGIPR (male and female) %	9 (8.8)	9 (8.7)	9 (9.4)
Initial entrants (thousands)	59	60	66
PGIPR (male) %	7 (6.8)	7 (6.8)	8 (7.5)
Initial entrants (thousands)	23	24	27
PGIPR (female) %	11 (10.8)	11 (10.7)	12 (11.6)
Initial entrants (thousands)	36	36	40
PGIPR (full-time) %	6 (5.9)	6 (5.7)	6 (6.0)
Initial entrants (thousands)	40	40	42
PGIPR (part-time) %	3 (2.9)	3 (3.0)	3 (3.4)
Initial entrants (thousands)	19	20	24

Source: BIS

196 *Research paper No 3 – Who is heading for HE? Young People's Perceptions of, and Decisions About, Higher Education.* Institute for Employment Studies, September 2009

197 Scottish Funding Council

198 Scottish Funding Council and Higher Education Statistics Agency

19.3 Student and graduate numbers

19.3.1 Applicants[199] to STEM HE courses

Applicant numbers to Higher Education have risen by 38.6% since 2001/02, increasing 8.7% in the last year. In 2001/02, STEM subjects accounted for 22% of all applicants, but by 2008/09 this had dropped to 18%. While this trend may seem to be negative, it could be explained by the fact that the scope of UCAS admissions has been growing. For example, over this time, the Nursing and Midwifery Admissions Service (NMAS), Graduate Teacher Training Registry (GTTR) and the Conservatoires UK Admissions Service (CUKAS) have been included within the over-arching UCAS application system, meaning that true year-on-year comparisons can't be made.

Applicant numbers for all STEM subject groups have increased over the eight-year period and also over the last year (Table 19.4). However, as Figure 19.3 shows, there has not been a steady year-on-year progression for all STEM subject groups. With the exception of physical sciences, which has had year-on-year growth, applicant numbers have fluctuated. But the overall trend has been positive. As universities have internationalised recruitment, the number and percentage of non-UK applicants for all STEM subject groups has increased over the eight-year period.

Applicant numbers for UK students (Table 19.4) has increased for all subject groups except mathematical and computer sciences, which fell from 29,511 in 2001/02 to 24,988 in 2008/09. This however, is due to a fall in computer sciences rather than mathematics (Figure 19.4). Nevertheless, it is worth noting that applicants for mathematical and computer sciences had previously risen significantly, from a low of 22,033 in 2006/07 to 29,362 in 2008/09. Looking at the change in applicants over the last eight years, it can be seen that applicants from the EU have risen 115.7%, while those from the UK and outside the EU have declined, by 15.3% and 29.9% respectively.

Looking specifically at engineering and technology, it can be seen that in 2008/09, nearly a third (31.7%) of applicants were from outside the UK and over a fifth (22.3%) were from outside of the EU (although the proportion of non-UK applicants has declined over the last two years from a peak of 35.4%). Overall, applicants to engineering are up 14.3% over the eight-year period, with UK applications rising by 15.9% and EU applications rising by 18.7%.

Applicant numbers for both biological sciences and physical sciences have increased by 28% over the period. In 2008/09, the number of applicants to biological sciences increased to 40,805, which was the most for any STEM subject. By contrast, physical sciences had the lowest number of applicants amongst the STEM subject, with 17,458. For both these subject groups, the highest rate of growth was from EU students to biological sciences and physical sciences, which increased last year by 19.1% and 21.5% respectively.

The biological sciences subject group had 40,805 applications in 2008/9. Looking at specific subject areas within this group shows that 17,761 were for psychology, while a further 11,894 were for sports science.

199 UCAS applicants are those who apply to full-time, undergraduate Higher Education courses (first degrees, HNC/HNDs etc) offered by universities or colleges who are members of the UCAS scheme. Some international applicants apply directly without going through UCAS.

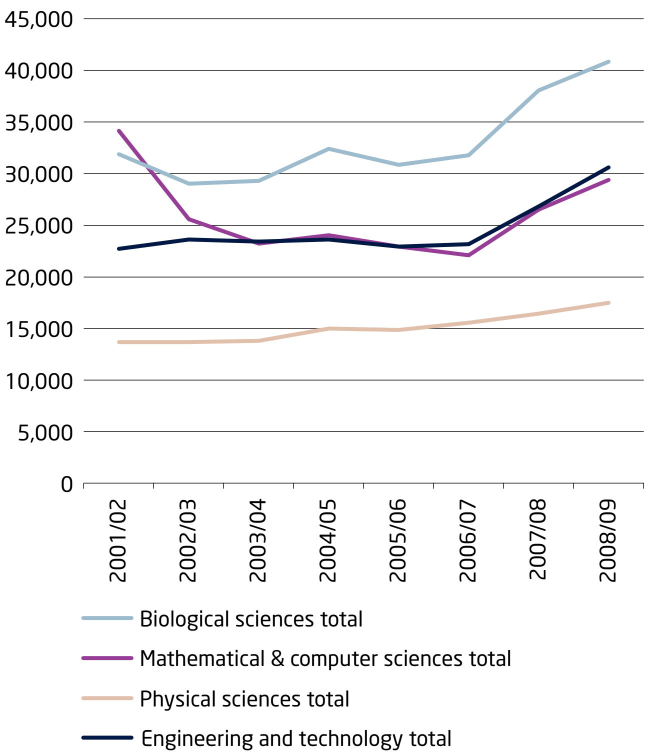
Table 19.4: Applicants to STEM HE courses by domicile (2001/02-2008/09)[200]

		2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	one year change	change over eight year period
Biological sciences	UK	29,788	31,734	30,654	32,537	31,172	32,923	34,903	37,037	6.10%	24.30%
	EU	1,011	1,046	1,355	1,510	1,727	1,784	1,752	2,086	19.10%	106.30%
	Non EU	1,075	1,362	1,492	1,567	1,383	1,421	1,454	1,682	15.70%	56.50%
	Total	31,874	28,982	29,262	32,446	30,916	31,769	38,109	40,805	7.10%	28.00%
	% non UK	6.50%	8.30%	9.70%	9.50%	10.10%	10.10%	8.40%	9.20%	9.50%	41.50%
	% non -EU	3.40%	4.70%	5.10%	4.80%	4.50%	4.50%	3.80%	4.10%	7.90%	20.60%
Physical sciences	UK	12,797	12,642	12,200	13,159	13,246	14,168	14,826	15,637	5.50%	22.20%
	EU	335	416	432	479	561	692	708	860	21.50%	156.70%
	Non EU	503	608	649	746	692	707	880	961	9.20%	91.10%
	Total	13,635	13,666	13,878	14,980	14,927	15,572	16,414	17,458	6.40%	28.00%
	% non UK	6.10%	7.50%	7.80%	8.20%	8.40%	9.00%	9.70%	10.40%	7.20%	70.50%
	% non -EU	3.70%	4.40%	4.70%	5.00%	4.60%	4.50%	5.40%	5.50%	1.90%	48.60%
Mathematical & computer sciences	UK	29,511	26,473	22,107	21,929	21,086	20,967	22,373	24,988	11.70%	-15.30%
	EU	776	752	996	1,093	1,143	1,441	1,444	1,674	15.90%	115.70%
	Non EU	3,849	3,307	3,152	3,228	2,493	2,694	2,683	2,700	0.60%	-29.90%
	Total	34,136	25,597	23,273	23,886	23,031	22,033	26,500	29,362	10.80%	-14.00%
	% non UK	13.50%	15.90%	17.80%	18.10%	15.80%	18.80%	15.60%	14.90%	-4.50%	10.30%
	% non -EU	11.30%	12.90%	13.50%	13.50%	10.80%	12.20%	10.10%	9.20%	-8.90%	-18.60%
Engineering and technology	UK	16,372	15,851	15,812	16,132	15,218	16,250	18,044	20,916	15.90%	27.80%
	EU	1,598	1,552	1,946	2,001	2,180	2,514	2,434	2,889	18.70%	80.80%
	Non EU	4,764	5,414	6,016	6,237	5,370	5,672	6,332	6,837	8.00%	43.50%
	Total	22,734	23,616	23,380	23,653	22,852	23,141	26,810	30,642	14.30%	34.80%
	% non UK	28.00%	29.50%	34.10%	34.80%	33.00%	35.40%	32.70%	31.70%	-3.10%	13.20%
	% non -EU	21.00%	22.90%	25.70%	26.40%	23.50%	24.50%	23.60%	22.30%	-5.50%	6.20%

Source: UCAS

200 Changes in proportion are percentage point increases/decreases

Fig. 19.3: Trends in applicants to STEM HE courses (2001/02-2008/09) – all domiciles

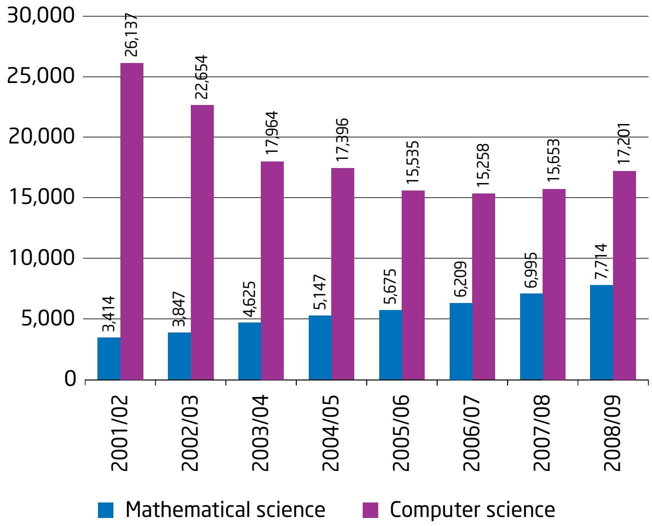


Source: UCAS

Mathematics and computer sciences is the only STEM subject group which has seen an overall decline in applicant numbers over the period, as indicated earlier in this section. A breakdown of the data (Figure 19.4) shows that mathematical science has actually grown year-on-year since 2001/02. By comparison, computer science has declined each year from 2001/02 to 2006/07. More encouragingly, the number of applications has risen for the last two years and applicant numbers to computer sciences are now comparable to 2004/05.

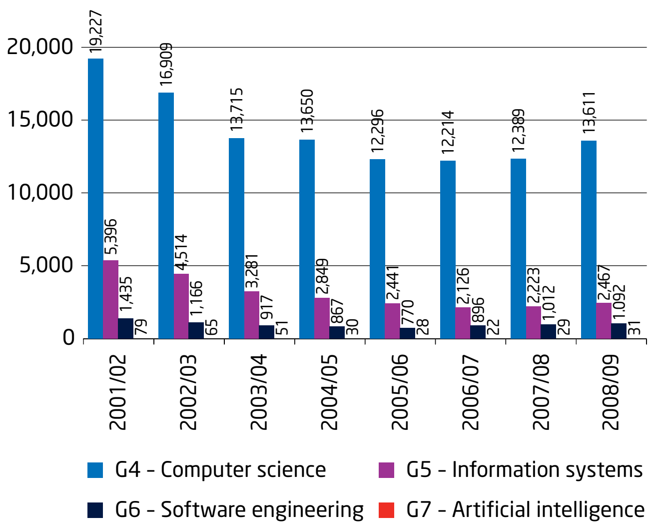
Looking specifically at the computer sciences subject area (Figure 19.5), it can be seen that most applicants were for computer science (the G4 course). Applicant numbers for G4 are down 29% since 2001/02, although they have been rising since 2007/08 (Figure 19.5). The number of applicants for information systems has more than halved over the period, having dropped 54% to 2,467. However, again applicant numbers have been rising over the last two years. Software engineering is down 24% from 2001/02. However, the recovery in applicants to this subject group started slightly earlier in 2006/07. In 2008/09, there were only 31 applicants for artificial intelligence, down from 79 in 2001/02.

Fig. 19.4: Mathematical and computer sciences (2001/02-2008/09) – all domiciles



Source: UCAS

Fig. 19.5: Computer sciences (2001/02-2008/09) – all domiciles



Source: UCAS

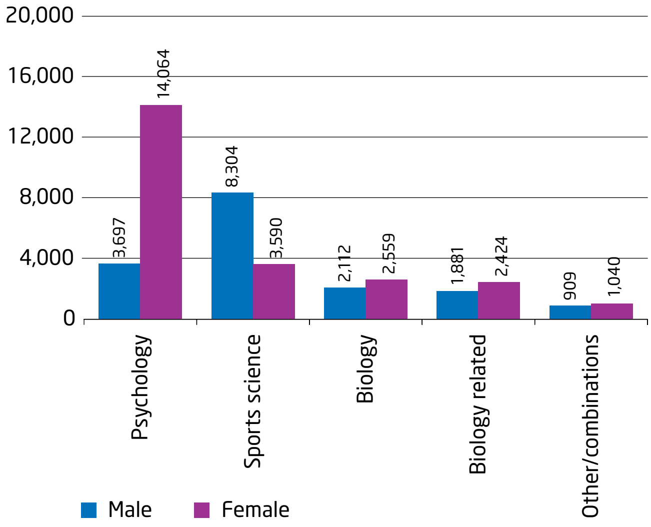
19.3.2 Applicants to STEM by gender

The proportion of women varies greatly between STEM subject groups and also between different STEM subjects. Biological sciences (Figure 19.6) has a large proportion of women. However, this is primarily driven by one subject araea, psychology. Out of the 40,805 students who applied for biological sciences, 34% of them were women applying for psychology. The majority of applicants for biology and biology-related courses were also female. Only sports science was male-dominated, with 70% of applicants.

Within physical sciences (Figure 16.7), physics shows a strong gender imbalance with only one fifth of applicants being female (21%). By comparison, chemistry (48%) and geology (43%) have a more equal proportion of applicants. Within mathematical and computer sciences (Figure 19.8) around 40% of applicants to mathematics are female, compared with only 15% for computer science – a pattern identified in the Engineering UK Report 2009/10.

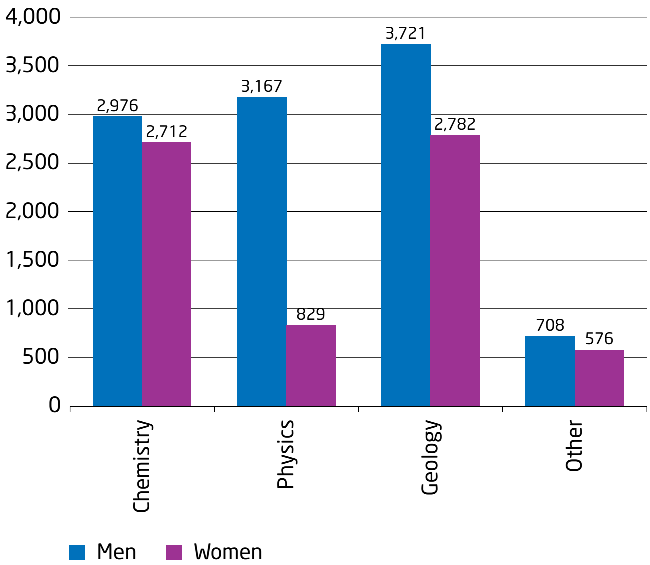
Engineering and technology (Figure 19.9) is the most unrepresentative STEM subject group when it comes to gender. Consistently for the last eight years, the proportion of female applicants to engineering and technology has remained at 12%, although the number of applicants has increased over this time period.

Fig. 19.6: Applicant numbers in biological sciences by subject and gender (2008/09)



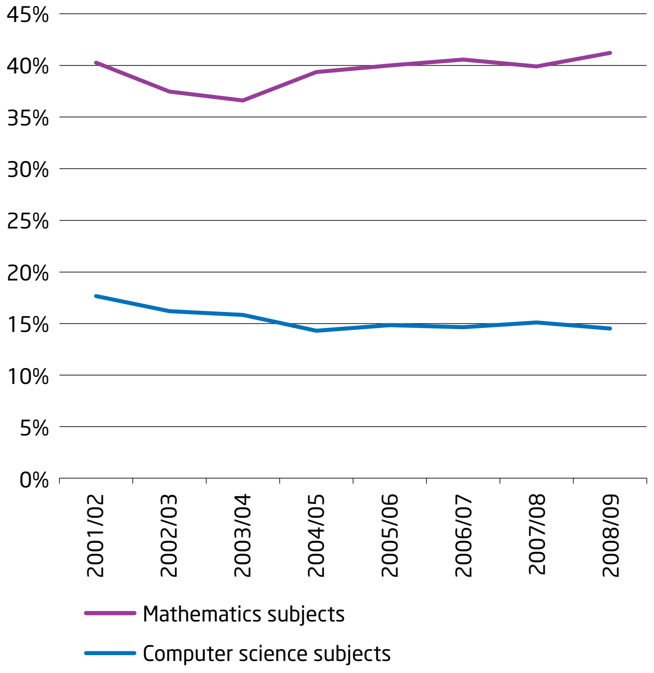
Source: UCAS

Fig. 19.7: Applicant numbers in physical sciences by gender and subject type (2008/09) – all domiciles



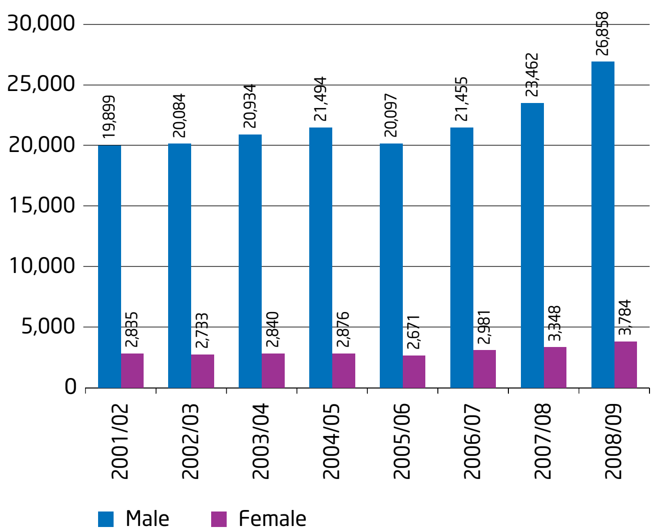
Source: UCAS

Fig. 19.8: Proportion of female applicants in mathematical and computer sciences subjects (2001/02-2008/09) - all domiciles



Source: UCAS

Fig. 19.9: Applicant numbers in engineering and technology by gender (2001/02-2008/09) - all domiciles



Source: UCAS

19.3.3 Applicants to engineering by sub-discipline

In the academic year 2008/09, there was a rise in the number of applicants to all engineering sub-disciplines (Tables 19.5-19.11), with the largest rises being in general engineering (21.5%), aerospace engineering (21.4%) and mechanical engineering (18.7%).

Looking at specific sub-disciplines, the largest rises in applicants to general engineering came from EU applicants and from women. Encouragingly, female applicants rose by nearly a third (31.3%) to reach 273 in 2008/09.

Applicants to civil engineering have risen 117.4% over the eight-year period, with applicant numbers in 2008/09 being 11.1% higher than the previous year. The rise in the number of female applicants has slowed, with 2008/09 being only 3.2% higher than the previous year. This is a sharp decrease compared with 2007/08, when the number of female applicants rose by a third (33.7%).

Mechanical engineering applicant numbers rose 18.7% in the last year, with the number of UK domicile applicants rising by a fifth. In total, there were 7,624 applicants in 2008/09, which is nearly two thirds higher (61.9%) than 2001/02. Female applicants have risen faster than average, with female applicant numbers 79.9% higher in 2008/09 than in 2001/02.

Despite being one of the smaller engineering sub-disciplines, applicants to aerospace engineering rose by over a fifth (21.4%) to 2,911 in 2008/09. The number of female applicants to aerospace rose by only 7.1% and women now comprise only 9.3% of all aerospace applicants.

Applicant numbers to the electronic and electrical engineering sub-discipline have declined by a quarter (25.8%) over the eight-year period, to 4,894 in 2008/09. The largest fall is among UK applicants – down 32.8% over the period (although it did increase by 10.5% in 2008/09). The number of female applicants rose in 2008/09 to 498, the highest number for four years.

Production and manufacturing engineering applicants have fallen by over half (59.2%) in the eight-year period. However, in 2008/09 the sub-discipline had its only increase in applicants, rising by 7.4%. The growth came from non-UK applicants, with a 56.8% rise in non-EU applicants and a 116.7% rise in those from the EU, albeit from a very small base. UK applicant numbers fell 1.9% in 2008/09.

Chemical, process and energy engineering applicants have grown by 140.2% since 2001/02, reaching 2,131 in 2008/09. The highest growth over the eight-year period has been from EU applicants: an increase of 238.7%. Applicant numbers in 2008/09 were 17.5% higher than the previous year, with growth balanced between the different domicile groups.

Table 19.5: Applicants to general engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	783	755	754	853	855	824	1,070	1,299	21.4%	65.9%
EU (excluding UK)	92	103	84	118	183	176	151	200	32.5%	117.4%
Non EU	126	146	147	185	229	215	246	283	15.0%	124.6%
Total non UK	218	249	231	303	412	391	397	483	21.7%	121.6%
Female	131	141	141	164	172	168	208	273	31.3%	108.4%
Total	**1,001**	**1,004**	**985**	**1,156**	**1,267**	**1,215**	**1,467**	**1,782**	**21.5%**	**78.0%**
Percentage of non EU	12.6%	14.5%	14.9%	16.0%	18.1%	17.7%	16.8%	15.9%	-5.4%	26.1%
Percentage of female applicants	13.1%	14.0%	14.3%	14.2%	13.6%	13.8%	14.2%	15.3%	7.7%	16.8%

Source: UCAS

Table 19.6: Applicants to civil engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,744	1,894	2,205	2,557	2,453	2,924	3,479	3,868	11.2%	121.8%
EU (excluding UK)	374	378	607	626	698	831	879	960	9.2%	156.7%
Non EU	549	619	739	714	616	760	863	970	12.4%	76.7%
Total non UK	923	997	1,346	1,340	1,314	1,591	1,742	1,930	10.8%	109.1%
Female	363	416	488	561	514	627	838	865	3.2%	138.3%
Total	**2,667**	**2,891**	**3,551**	**3,897**	**3,767**	**4,515**	**5,221**	**5,798**	**11.1%**	**117.4%**
Percentage of non EU	20.6%	21.4%	20.8%	18.3%	16.4%	16.8%	16.5%	16.7%	1.2%	-18.9%
Percentage of female applicants	13.6%	14.4%	13.7%	14.4%	13.6%	13.9%	16.1%	14.9%	-7.5%	9.6%

Source: UCAS

Table 19.7: Applicants to mechanical engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	3,670	3,700	3,797	3,839	3,560	3,888	4,515	5,417	20.0%	47.6%
EU (excluding UK)	276	283	386	449	412	483	447	588	31.5%	113.0%
Non EU	762	939	1,174	1,265	1,149	1,307	1,460	1,619	10.9%	112.5%
Total non UK	1,038	1,222	1,560	1,714	1,561	1,790	1,907	2,207	15.7%	112.6%
Female	308	338	386	378	339	427	450	554	23.1%	79.9%
Total	**4,708**	**4,922**	**5,357**	**5,553**	**5,121**	**5,678**	**6,422**	**7,624**	**18.7%**	**61.9%**
Percentage of non EU	16.2%	19.1%	21.9%	22.8%	22.4%	23.0%	22.7%	21.2%	-6.6%	30.9%
Percentage of female applicants	6.5%	6.9%	7.2%	6.8%	6.6%	7.5%	7.0%	7.3%	4.3%	-33.8%

Source: UCAS

Table 19.8: Applicants to aerospace engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,523	1,459	1,628	1,673	1,647	1,714	1,760	2,101	19.4%	38.0%
EU (excluding UK)	102	102	112	113	151	146	145	201	38.6%	97.1%
Non EU	264	306	379	472	447	465	493	609	23.5%	130.7%
Total non UK	366	408	491	585	598	611	638	810	27.0%	121.3%
Female	202	162	204	205	170	236	252	270	7.1%	33.7%
Total	**1,889**	**1,867**	**2,119**	**2,258**	**2,245**	**2,325**	**2,398**	**2,911**	**21.4%**	**54.1%**
Percentage of non EU	14.0%	16.4%	17.9%	20.9%	19.9%	20.0%	20.6%	20.9%	1.5%	49.3%
Percentage of female applicants	10.7%	8.7%	9.6%	9.1%	7.6%	10.2%	10.5%	9.3%	-11.4%	-13.1%

Source: UCAS

Table 19.9: Applicants to electronic and electrical engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	4,117	3,729	3,146	2,934	2,462	2,381	2,504	2,766	10.5%	-32.8%
EU (excluding UK)	423	367	376	335	336	397	339	399	17.7%	-5.7%
Non EU	2,052	2,280	2,330	2,190	1,696	1,621	1,773	1,729	-2.5%	-15.7%
Total non UK	2,475	2,647	2,706	2,525	2,032	2,018	2,112	2,128	0.8%	-14.0%
Female	639	670	630	527	424	425	422	498	18.0%	-22.1%
Total	**6,592**	**6,376**	**5,852**	**5,459**	**4,494**	**4,399**	**4,616**	**4,894**	**6.0%**	**-25.8%**
Percentage of non EU	31.1%	35.8%	39.8%	40.1%	37.7%	36.8%	38.4%	35.3%	-8.1%	13.5%
Percentage of female applicants	9.7%	10.5%	10.8%	9.7%	9.4%	9.7%	9.1%	10.2%	12.1%	5.2%

Source: UCAS

Table 19.10: Applicants to production and manufacturing engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,018	904	801	721	467	424	376	369	-1.9%	-63.8%
EU (excluding UK)	29	29	31	29	13	31	12	26	116.7%	-10.3%
Non EU	91	102	91	96	68	65	44	69	56.8%	-24.2%
Total non UK	120	131	122	125	81	96	56	95	69.6%	-20.8%
Female	169	162	125	138	103	121	98	102	4.1%	-39.6%
Total	**1,138**	**1,035**	**923**	**846**	**548**	**520**	**432**	**464**	**7.4%**	**-59.2%**
Percentage of non EU	8.0%	9.9%	9.9%	11.3%	12.4%	12.5%	10.2%	14.9%	46.1%	86.3%
Percentage of female applicants	14.9%	15.7%	13.5%	16.3%	18.8%	23.3%	22.7%	22.0%	-3.1%	47.7%

Source: UCAS

Table 19.11: Applicants to chemical, process and energy engineering (2001/02-2008/09) – all domiciles

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	536	559	561	683	713	877	1,042	1,240	19.0%	131.3%
EU (excluding UK)	31	31	48	51	62	84	91	105	15.4%	238.7%
Non EU	320	338	420	494	493	553	681	786	15.4%	145.6%
Total non UK	351	369	468	545	555	637	772	891	15.4%	153.8%
Female	268	263	267	323	335	388	475	569	19.8%	112.3%
Total	**887**	**928**	**1,029**	**1,228**	**1,268**	**1,514**	**1,814**	**2,131**	**17.5%**	**140.2%**
Percentage of non EU	36.1%	36.4%	40.8%	40.2%	38.9%	36.5%	37.5%	36.9%	-1.6%	2.2%
Percentage of female applicants	30.2%	28.3%	25.9%	26.3%	26.4%	25.6%	26.2%	26.7%	1.9%	11.6%

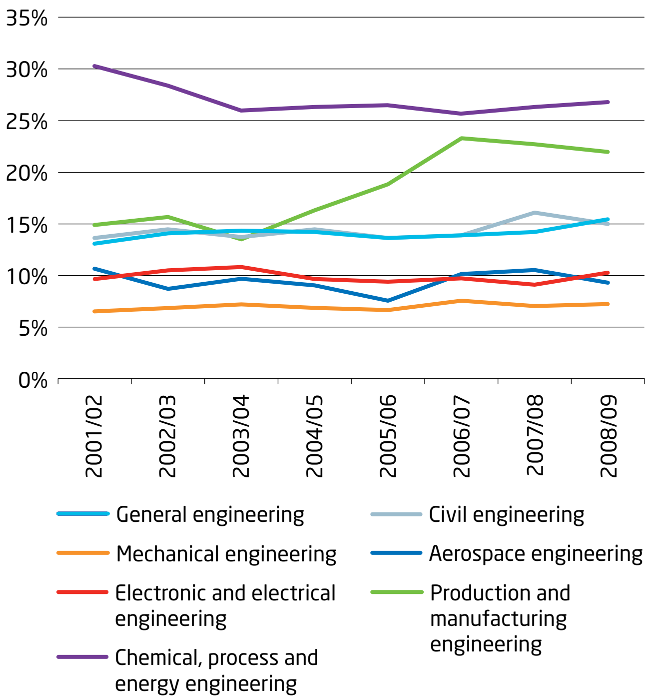
Source: UCAS

19.3.4 Female applicants to engineering subjects

Female participation varies markedly between the different engineering sub-disciplines (Figure 19.10). With two exceptions, most sub-disciplines have had a broadly similar proportion of female applicants since 2001/02, with the number of applicants ranging from 6.5% to 15.3%. The first exception is production and manufacturing engineering: in 2001/02, female applicants formed 14.9% of all applicants, however, by 2008/09, this had increased to 22.0%. The other exception is chemical, process and energy engineering: in 2001/02, nearly a third (30.2%) of applicants were female, however, this fell to 26.7% in 2008/09.

This finding is substantiated by research commissioned by BIS,[201] which shows that women are disproportionately less likely to be interested in STEM subjects than men and more likely to be interested in medicine and allied subjects, and social sciences.

Fig. 19.10: Proportion of female applicants by sub-discipline (2001/02-2008/09) – all disciplines



Source: UCAS

201 *Research paper No 3 – Who is heading for HE? Young People's Perceptions of, and Decisions About, Higher Education.* Institute for Employment Studies, September 2009

19.3.5 Educational backgrounds of applicants to HE engineering undergraduate courses

When looking at the educational background of applicants to HE, there is some variation across the different sub-disciplines (Figure 19.11).

Across all subjects (engineering and non engineering), it can be seen that state schools are the major source of applicants, accounting for 39.1% of all applicants. Nearly a fifth (19.5%) are from FE colleges, 16.8% from sixth form colleges, 8.0% from independent schools and 5.2% from grammar schools.

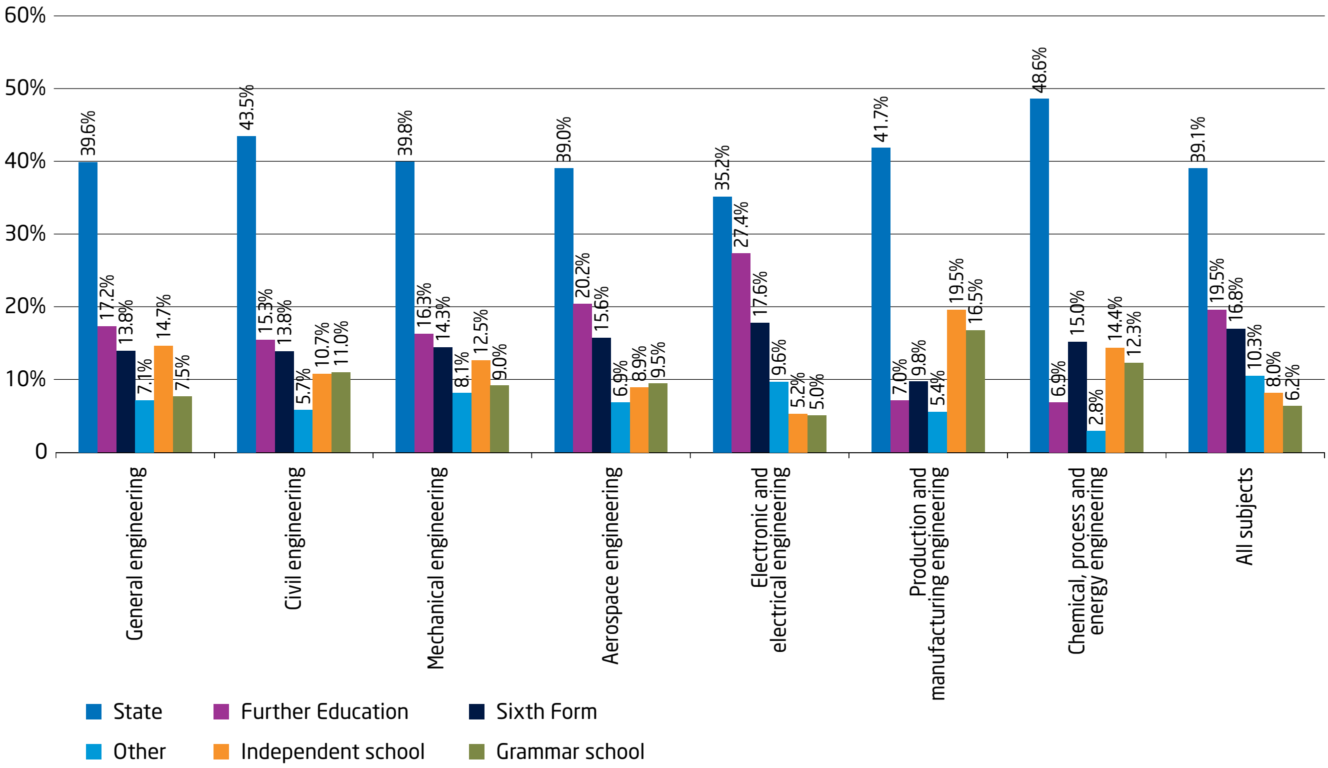
State schools appear to account for a disproportionately large number of applicants to chemical, process and energy engineering (48.6%), when compared to the overall average of 39.1%. Against an average of 19.5%, applicants from FE institutions are more likely to apply for electronic and electrical engineering courses (27.4%) and less likely to apply for production and manufacturing engineering (7.0%) and chemical, process and energy engineering (6.9%).

Sixth form colleges are under-represented as a source of applicants to the production and manufacturing engineering sub-discipline. On average, 16.8% of all applicants are from sixth form colleges, whereas only 9.8% of those applying for production and manufacturing engineering are.

Independent schools make up 8.0% of all applicants. However, independent schools are heavily over-represented in three engineering sub-disciplines: production and manufacturing engineering (19.5%); general engineering (14.7%); and chemical, process and energy engineering (14.4%). Conversely, they only comprise 5.2% of all applicants to electronic and electrical engineering.

Only 6.2% of all applicants come from grammar schools. However, for production and manufacturing engineering, this proportion is more than double (16.5%). Chemical, process and energy engineering also have nearly double the average proportion of applicants from grammar schools at 12.3%.

Fig. 19.11: Educational background of applicants to engineering undergraduate level HE courses by sub-discipline (2008/09) – UK domiciled



Source: UCAS

19.3.6 Ethnicity of applicants

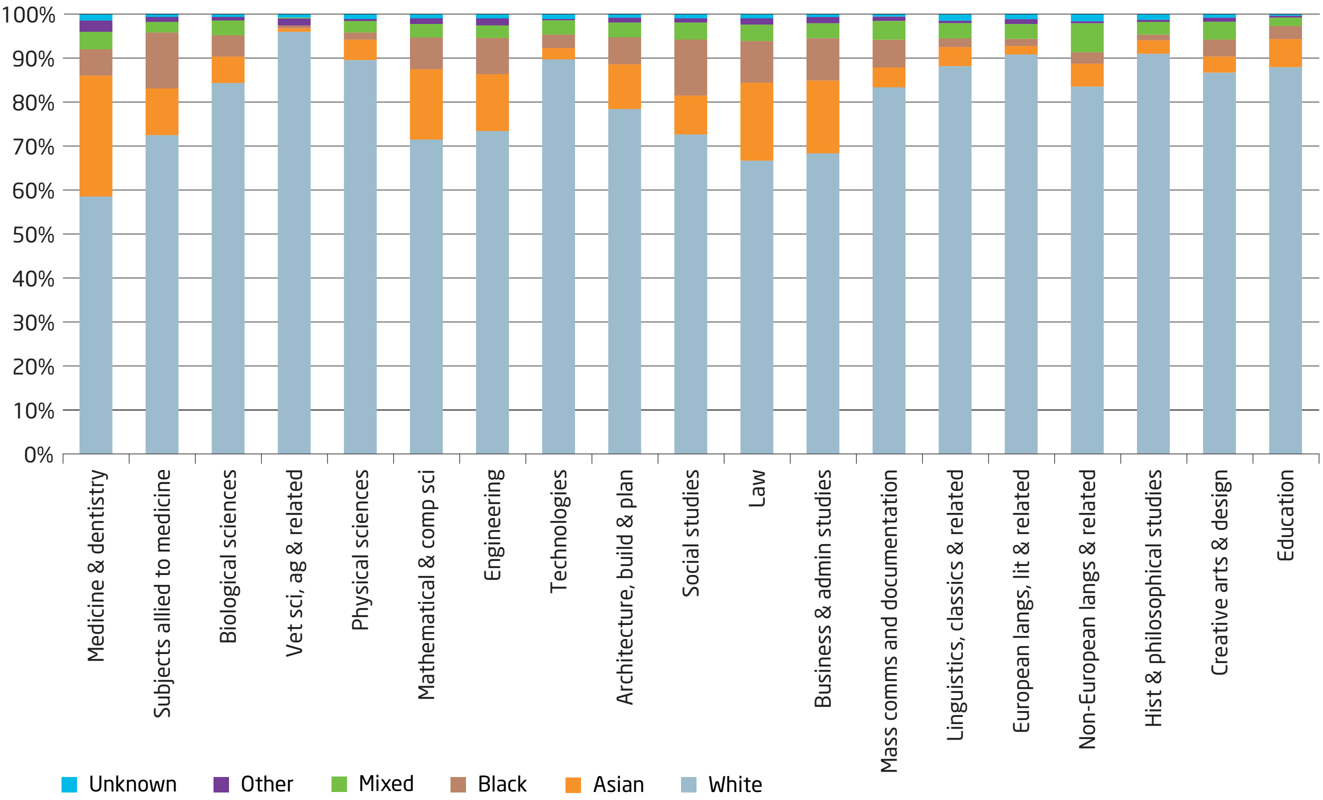
Figure 19.12 shows the breakdown of ethnicity across different subject areas. It is clear that the proportion of applicants from black and minority ethnic (BME) groups varies quite significantly between different subject areas. The subject area with the lowest proportion of BME applicants is veterinary science, agriculture and related subjects, where 96% of applicants are white. The other two subject areas with at least 90% white applicants are history and philosophical studies (91.0%) and European languages, literature and related subjects.

The subject area with the lowest proportion of white applicants was medicine, at only 58.7%. This data broadly supports research commissioned by BIS,[202] which identified that young people from black and minority ethnic backgrounds, and those from less advantaged backgrounds, were more interested in vocational subjects and less interested in non-vocational subjects than white individuals and those from higher socio-economic groups.

For comparative purposes, Table 19.12 shows the estimated population breakdown by ethnicity of 15- to 24-year-olds for 2007.

202 *Research paper No 3 – Who is heading for HE? Young People's Perceptions of, and Decisions About, Higher Education.* Institute for Employment Studies, September 2009

Fig. 19.12: Breakdown by ethnicity of applicants across HE subject areas (2008/09) – UK domiciled



Source: UCAS

Table 19.12: Estimated 15- to 24-year-old population estimates by ethnic group – experimental (mid 2007)

	Estimated populations (thousands)	Estimated proportion
Asian	683.0	10%
Black	236.8	3%
Mixed	271.8	4%
White	5,707.4	83%

Source: Office for National Statistics (ONS)

Ethnicity of applicants to engineering

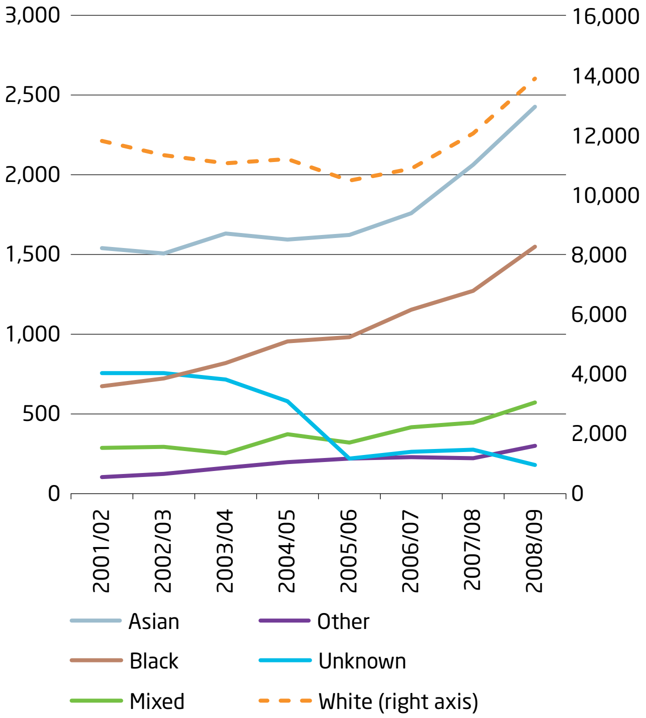
Figure 19.13 shows that the number of engineering applicants for all ethnic groups has been positive over the eight-year period studied. The only marked decline is among applicants of unknown ethnicity. Asian applicant numbers are up the most, rising 57% from 1,540 in 2001/02 to 2,430 by 2008/09.

There has been a positive increase in the number of both male and female applicants in the each of the ethnic groups (Figure 19.14–19.15 and Tables 19.13 -19.15). However, the number of Asians and mixed race females applying has been quite volatile, with some large year-on-year increases but also some large decreases.

It should be noted that the proportion of female applicants for all ethnic groups is still small when compared to all applicants. However, the proportion of female applicants from ethnic minorities tends to mirror the proportion of male applicants from the same groups; the engineering sector needs to increase the number of female applicants from all ethnic groups.

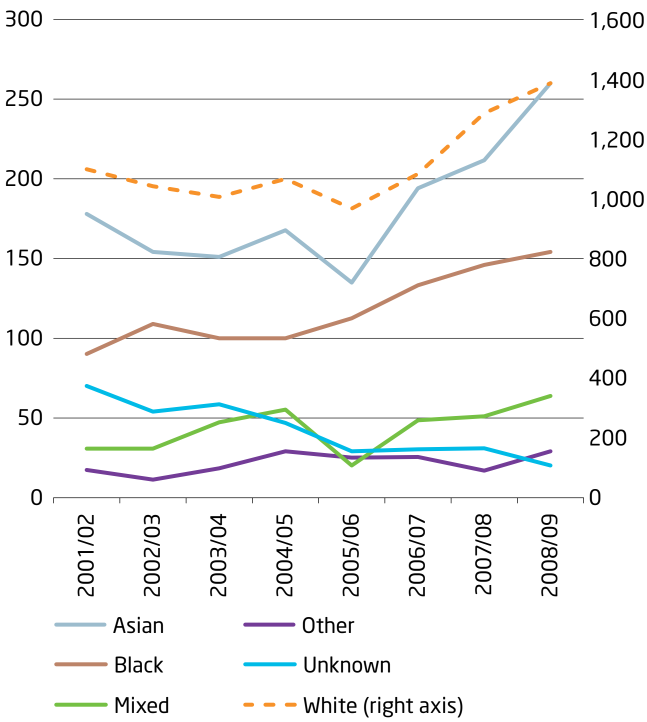
Comparing the numbers in Tables 19.13-19.15 to Table 19.12 (an estimate of 15- to 24-year-olds in England in 2007), it would appear that engineering is dominated by white applicants. But this is a crude comparison; in fact, engineering succeeds in appealing to students from different ethnic backgrounds.

Fig. 19.13: Applicants to engineering by ethnic group (2001/02-2008/09) – UK domiciled



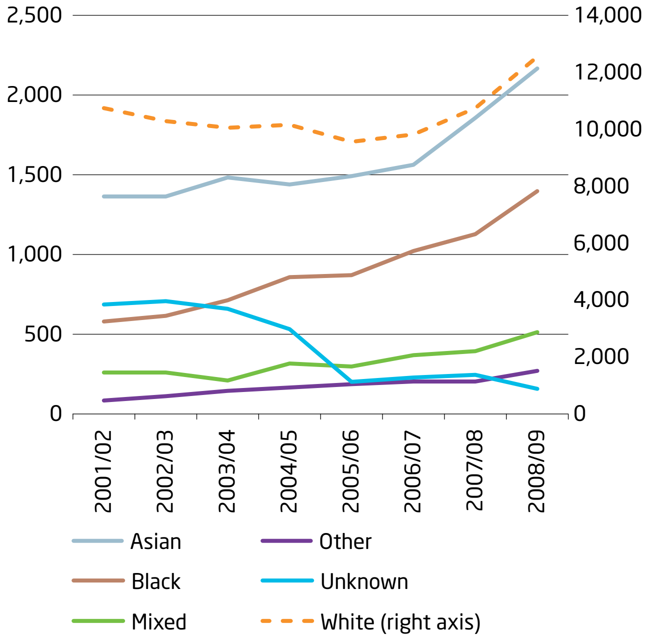
Source: UCAS

Fig. 19.14: Female applicants to engineering by ethnic group (2001/02-2008/09) – UK domiciled



Source: UCAS

Fig. 19.15: Male applicants to engineering by ethnic group (2001/02-2008/09) – UK domiciled



Source: UCAS

Table 19.13: Percentage split of engineering applicants by ethnic group (2001/02-2007/08) – UK domiciled

	2001/01	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Asian	10.2%	10.3%	11.2%	10.7%	11.7%	12.0%	12.7%	12.9%
Black	4.4%	4.9%	5.6%	6.4%	7.1%	7.8%	7.8%	8.2%
Mixed	1.9%	2.0%	1.7%	2.5%	2.3%	2.8%	2.7%	3.0%
Other	0.6%	0.8%	1.1%	1.3%	1.5%	1.5%	1.3%	1.5%
Unknown	5.0%	5.1%	4.9%	3.9%	1.6%	1.8%	1.7%	0.9%
White	78.0%	76.9%	75.6%	75.2%	75.8%	74.1%	73.8%	73.5%

Source: UCAS

Table 19.14: Percentage split of female engineering applicants by ethnic group (2001/02-2008/09) – UK domiciled

	2001/01	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Asian	12.0%	11.0%	10.9%	11.5%	10.5%	12.8%	12.2%	13.6%
Black	6.1%	7.8%	7.3%	6.8%	8.7%	8.8%	8.4%	8.1%
Mixed	2.1%	2.1%	3.4%	3.8%	1.6%	3.2%	2.9%	3.3%
Other	1.1%	0.8%	1.3%	2.0%	1.9%	1.7%	1.0%	1.5%
Unknown	4.7%	3.9%	4.2%	3.2%	2.2%	2.0%	1.8%	1.0%
White	74.0%	74.4%	72.9%	72.8%	75.0%	71.6%	73.8%	72.4%

Source: UCAS

Table 19.15: Percentage split of male engineering applicants by ethnic group (2001/02-2008/09) – UK domiciled

	2001/01	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Asian	10.0%	10.2%	11.2%	10.7%	11.8%	11.9%	12.7%	12.8%
Black	4.2%	4.6%	5.4%	6.4%	6.9%	7.7%	7.7%	8.2%
Mixed	1.9%	2.0%	1.6%	2.3%	2.3%	2.8%	2.7%	3.0%
Other	0.6%	0.8%	1.1%	1.2%	1.5%	1.5%	1.4%	1.6%
Unknown	5.0%	5.3%	5.0%	3.9%	1.5%	1.7%	1.7%	0.9%
White	78.4%	77.2%	75.8%	75.5%	75.9%	74.4%	73.8%	73.6%

Source: UCAS

19.3.7 POLAR2 groupings of applicants to engineering

POLAR2 is based on a measure of HE participation by ward for those aged 18 or 19 in academic years 2000/01-2005/06. The POLAR2 data is broken into five quintiles – each representing approximately 20% of young people.[203] In quintile 1, fewer than one in five young people enter Higher Education, compared with over half in quintile 5 (the group representing those wards where young people are most likely to participate in Higher Education). Figure 19.16 shows that in 2008/09, 27.4% of all applicants came from quintile 5. Conversely, only 12.4% of applicants came from quintile 1.

Comparing the different subject areas shows that European languages, literature and related subjects attracted the highest percentage of quintile 5 applicants (40.7%), while medicine and dentistry attracted the second-highest number (39.5%). Conversely, subjects allied to medicine had the highest proportion of applicants in quintile 1 (17.4%).

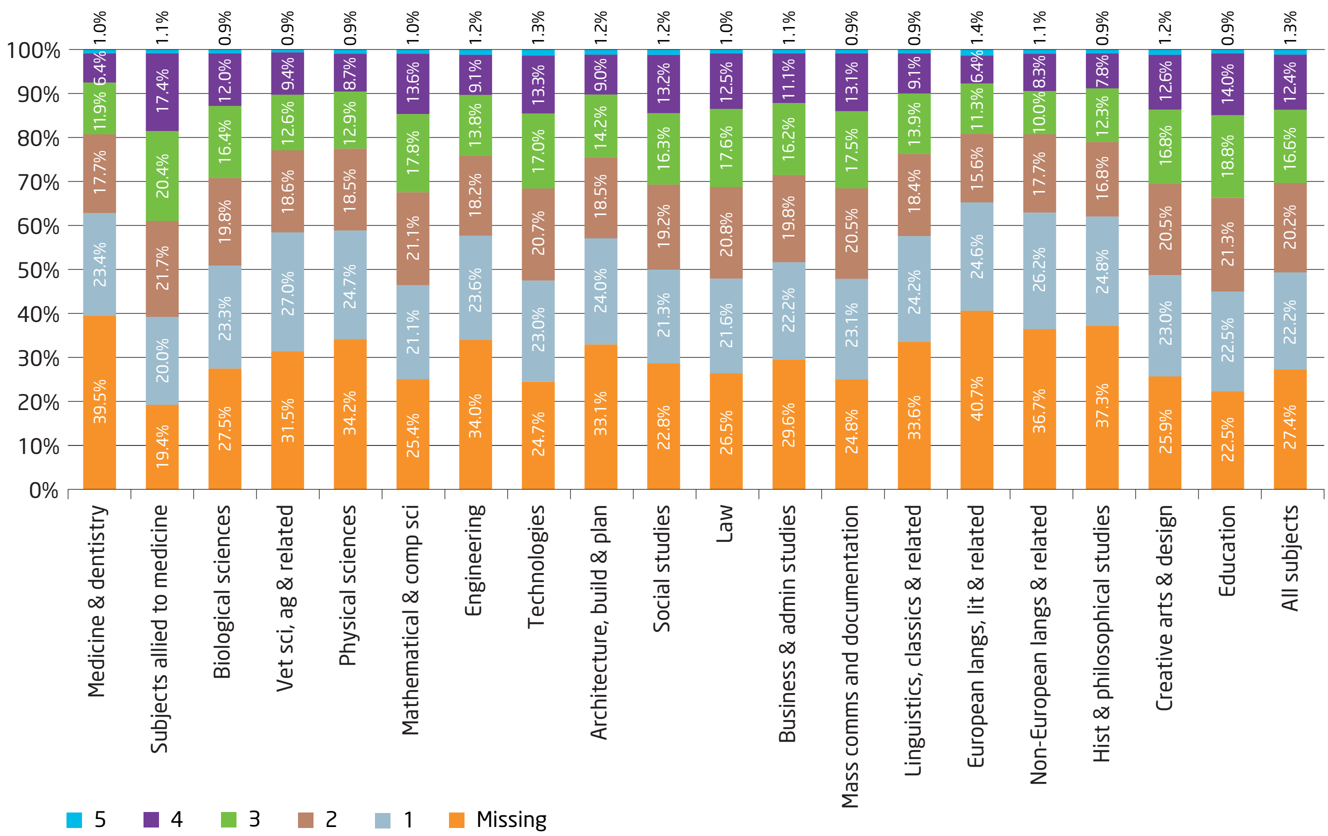
Table 19.16 shows the proportion of applicants to engineering by POLAR2 for an eight-year period. Encouragingly, this table shows that the proportion of applicants from quintile 1 has been slowly increasing, from 7.4% in 2001/02 to 9.1% in 2008/09 (23% increase). In 2008/09, there were more females than males in quintile 5 (Figure 16.17), whereas there was a lower proportion of females to males in quintiles 1-4, indicating that females who apply for engineering are more likely than males to come from high participation areas. This contrasts poorly with the results of analysis by HEFCE,[204] which showed that women were 25% more likely than men to enter HE overall and 44% more likely in the most disadvantaged areas.

Figure 19.18 shows participation in HE among students eligible for free school meals. This chart shows that 14% of students who are eligible for free school meals go on to Higher Education, compared with 33% overall. This suggests that potential HE students from hard-to-reach backgrounds are not enrolling in HE and points to a possible talent pool of students that the engineering sector could target.

203 A quintile divides a population into five equally-sized population groups.

204 Trends in young participation in Higher Education: core results for England

Fig. 19.16: POLAR2 grouping of applicants (2008/09) – UK domiciled



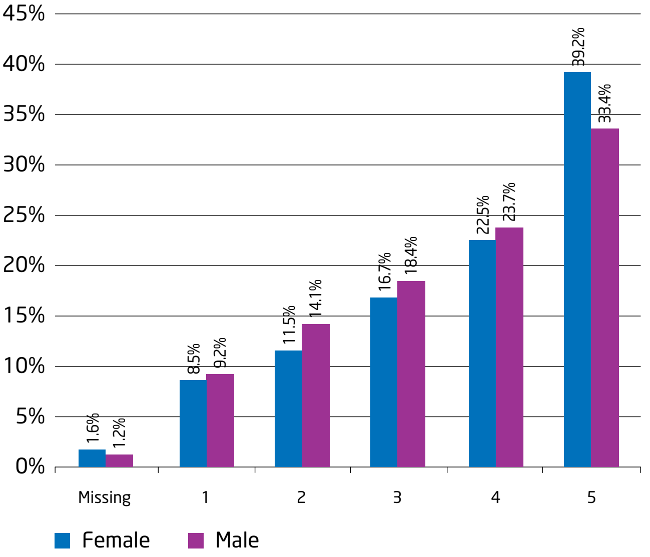
Source: UCAS

Table 19.16: Proportion of applicants to engineering by POLAR2 grouping (2001/02-2008/09) – UK domiciled

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Missing	1.1%	0.9%	1.0%	0.8%	1.4%	1.0%	2.1%	1.2%
1	7.4%	7.4%	7.7%	8.1%	8.0%	8.5%	8.4%	9.1%
2	13.5%	13.4%	13.4%	13.2%	13.7%	13.4%	13.9%	13.8%
3	18.0%	18.7%	18.3%	18.3%	18.2%	19.0%	18.0%	18.2%
4	24.9%	24.4%	25.0%	24.9%	24.4%	23.5%	23.3%	23.6%
5	35.1%	35.1%	34.6%	34.7%	34.4%	34.5%	34.4%	34.0%

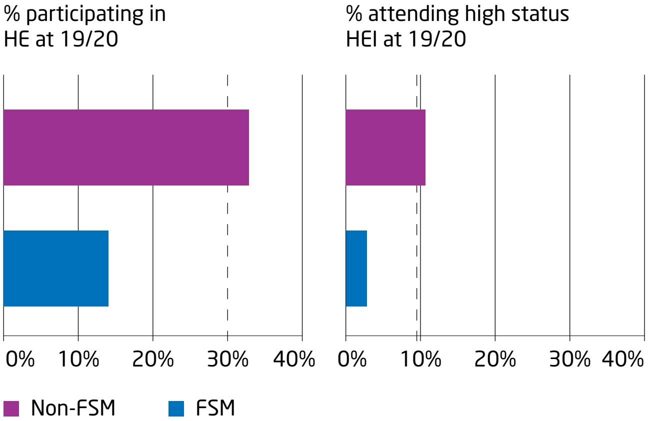
Source: UCAS

Fig. 19.17: Proportion of applicants to engineering by POLAR2 and gender (2008/09) – UK domiciled



Source: UCAS

Fig. 19.18: Raw socio-economic gap in HE participation rates amongst state school students at age 19/20



Source: IFS Working Paper W10/04, May 2010[205]

205 Widening Participation in Higher Education: Analysis using Linked Administrative Data

19.3.8 Accepted applicants to STEM degrees

Data on accepted applicants is the closest indication we have on who actual starts in STEM degrees. Table 19.17 shows the number of accepted applicants to STEM subject groups. As with applicants, each of the different STEM subject groups has seen an increase in the number of accepted applicants. However, the level of growth has not been even: both within the last year and over the last eight years, the number of EU accepted applicants has grown faster than the groups from all other domiciles. Furthermore, whilst biological sciences, physical sciences and mathematical and computer sciences have seen more than 100% growth in accepted applicants from the EU for this same period, engineering and technology has only grown by 53.6%. The number of non-UK and non-EU applicants accepted onto STEM degrees from 2007/08 to 2008/09 has also fallen.

The only group to have seen a fall in accepted applicants over the eight-year period was non-EU applicants for mathematical and computer sciences – although overall numbers have been rising steadily since 2005/06.

Table 19.17: Number of accepted applicants to STEM degrees by subject area and domicile 2001/02-2008/09)

		2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	one year change	change over eight year period
Biological sciences	UK	26,112	27,179	27,133	30,155	28,654	29,451	32,726	33,862	3.5%	29.7%
	EU	759	822	1,089	1,178	1,292	1,354	1,370	1,586	15.8%	109.0%
	Non EU	786	981	1,040	1,113	970	964	1,031	1,133	9.9%	44.1%
	Total	**27,657**	**28,982**	**29,262**	**32,446**	**30,916**	**31,769**	**35,127**	**36,581**	**4.1%**	**32.3%**
	% non UK	5.6%	6.2%	7.3%	7.1%	7.3%	7.3%	6.8%	7.4%	8.2%	32.1%
	% non -EU	2.8%	3.4%	3.6%	3.4%	3.1%	3.0%	2.9%	3.1%	6.9%	10.7%
Physical sciences	UK	13,414	13,336	12,933	13,973	13,849	14,356	15,075	15,692	4.1%	17.0%
	EU	303	381	376	405	461	608	601	719	19.6%	137.3%
	Non EU	428	588	569	602	617	608	736	804	9.2%	87.9%
	Total	**14,145**	**14,305**	**13,878**	**14,980**	**14,927**	**15,572**	**16,412**	**17,215**	**4.9%**	**21.7%**
	% non UK	5.2%	6.8%	6.8%	6.7%	7.2%	7.8%	8.1%	8.8%	8.6%	69.2%
	% non -EU	3.0%	4.1%	4.1%	4.0%	4.1%	3.9%	4.5%	4.7%	4.4%	56.7%
Mathematical & computer sciences	UK	23,709	22,167	19,984	20,542	19,963	18,786	22,042	23,940	8.6%	1.0%
	EU	642	674	848	913	990	1,106	1,185	1,370	15.6%	113.4%
	Non EU	2,627	2,756	2,441	2,431	2,078	2,141	2,193	2,214	1.0%	-15.7%
	Total	**26,978**	**25,597**	**23,273**	**23,886**	**23,031**	**22,033**	**25,420**	**27,524**	**8.3%**	**2.0%**
	% non UK	12.1%	13.4%	14.1%	14.0%	13.3%	14.7%	13.3%	13.0%	-2.3%	7.4%
	% non -EU	9.7%	10.8%	10.5%	10.2%	9.0%	9.7%	8.6%	8.0%	-7.0%	-17.5%
Engineering and technology	UK	17,566	16,995	16,622	17,240	16,387	16,156	18,648	20,302	8.9%	15.6%
	EU	1,451	1,423	1,713	1,698	1,959	2,159	2,034	2,229	9.6%	53.6%
	Non EU	4,013	4,431	5,045	4,715	4,506	4,826	5,017	5,265	4.9%	31.2%
	Total	**23,030**	**22,849**	**23,380**	**23,653**	**22,852**	**23,141**	**25,699**	**27,796**	**8.2%**	**20.7%**
	% non UK	23.7%	25.6%	28.9%	27.1%	28.3%	30.2%	27.4%	27.0%	-1.5%	13.9%
	% non -EU	17.4%	19.4%	21.6%	19.9%	19.7%	20.9%	19.5%	18.9%	-3.1%	8.6%

Source: UCAS

19.3.9 Accepted applicants by engineering discipline

Tables 19.18-19.24 show the number of accepted applicants to various engineering sub-disciplines, broken down by domicile status. They also show the number of female accepted applicants. Over the eight-year period, only two sub-disciplines have seen a decline in the number of accepted applicants. The first is electronic and electrical engineering, which saw a steep decline in the number of accepted applicants between 2001/02 and 2005/06; since 2005/06, the numbers have been fluctuating around 4,600. The second is production and manufacturing engineering, which has declined each year since 2002/03, with the number of UK accepted applicants falling by 59.2% over the period.

Conversely, the other sub-disciplines have all shown growth of at least 50%. Two sub-disciplines have shown growth of more than 100% among non-EU accepted applicants: aerospace engineering; and chemical, process and energy engineering. The largest increase in accepted applicants among UK-domiciled students was for civil engineering, which increased by 94.1% over the eight-year period.

Table 19.18: Accepted applicants onto first degrees in general engineering (2001/02-2007/08)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,996	2,056	2,016	2,245	2,176	2,269	2,553	2,682	5.1%	34.4%
EU (excluding UK)	139	130	169	186	249	272	211	232	10.0%	66.9%
Non EU	279	375	432	456	438	438	440	379	-13.9%	35.8%
Total Non UK	418	505	601	642	687	710	651	611	-6.1%	46.2%
Female	330	356	395	397	363	389	437	425	-2.7%	28.8%
Total	**2,414**	**2,561**	**2,617**	**2,887**	**2,863**	**2,979**	**3,204**	**3,293**	**2.8%**	**36.4%**
Percentage of Non EU	11.6%	14.6%	16.5%	15.8%	15.3%	14.7%	13.7%	11.5%	-16.1%	-0.9%
Proportion of female students	13.7%	13.9%	15.1%	13.8%	12.7%	13.1%	13.6%	12.9%	-5.1%	-5.8%

Source: UCAS

Table 19.19: Accepted applicants onto first degrees in civil engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,690	1,871	2,267	2,469	2,458	2,607	3,151	3,281	4.1%	94.1%
EU (excluding UK)	311	294	426	423	494	583	685	681	-0.6%	119.0%
Non EU	451	507	619	563	502	564	601	633	5.3%	40.4%
Total Non UK	762	801	1,045	986	996	1,147	1,286	1,314	2.2%	72.4%
Female students	343	382	447	518	500	563	707	704	-0.4%	105.2%
Total	2,452	2,672	3,312	3,455	3,454	3,754	4,437	4,595	3.6%	87.4%
Percentage of Non EU	18.4%	19.0%	18.7%	16.3%	14.5%	15.0%	13.5%	13.8%	2.2%	-25.0%
Proportion of female students	14.0%	14.3%	13.5%	15.0%	14.5%	15.0%	15.9%	15.3%	-3.8%	9.3%

Source: UCAS

Table 19.20: Accepted applicants onto first degrees in mechanical engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	3,028	3,157	3,387	3,515	3,311	3,193	4,032	4,553	12.9%	50.4%
EU (excluding UK)	241	283	314	334	365	383	360	440	22.2%	82.6%
Non EU	611	716	846	885	874	1,016	1,020	1,151	12.8%	88.4%
Total Non UK	852	999	1,160	1,219	1,239	1,399	1,380	1,591	15.3%	86.7%
Female students	290	297	326	318	292	359	377	458	21.5%	57.9%
Total	3,880	4,156	4,547	4,734	4,550	4,592	5,412	6,144	13.5%	58.4%
Percentage of Non EU	15.7%	17.2%	18.6%	18.7%	19.2%	22.1%	18.8%	18.7%	-0.5%	19.1%
Proportion of female students	7.5%	7.1%	7.2%	6.7%	6.4%	7.8%	7.0%	7.5%	7.1%	0.0%

Source: UCAS

Table 19.21: Accepted applicants onto first degrees in aerospace engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,326	1,397	1,412	1,522	1,483	1,289	1,489	1,346	-9.6%	1.5%
EU (excluding UK)	60	71	87	80	120	99	95	138	45.3%	130.0%
Non EU	185	232	256	300	302	273	325	402	23.7%	117.3%
Total Non UK	245	303	343	380	422	372	420	540	28.6%	120.4%
Female students	165	146	166	176	162	193	202	217	7.4%	31.5%
Total	**1,571**	**1,700**	**1,755**	**1,902**	**1,905**	**1,661**	**1,909**	**1,886**	**-1.2%**	**20.1%**
Percentage of Non EU	11.8%	13.6%	14.6%	15.8%	15.9%	16.4%	17.0%	21.3%	25.3%	80.5%
Proportion of female students	10.5%	8.6%	9.5%	9.3%	8.5%	11.6%	10.6%	11.5%	8.5%	9.5%

Source: UCAS

Table 19.22: Accepted applicants onto first degrees in electronic and electrical engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	5,110	4,272	3,469	3,336	2,824	2,699	2,689	2,990	11.2%	-41.5%
EU (excluding UK)	403	333	329	325	311	389	304	348	14.5%	-13.6%
Non EU	1,587	1,770	1,969	1,620	1,495	1,549	1,538	1,457	-5.3%	-8.2%
Total Non UK	1,990	2,103	2,298	1,945	1,806	1,938	1,842	1,805	-2.0%	-9.3%
Female students	807	760	742	588	521	532	498	553	11.0%	-31.5%
Total	**7,100**	**6,375**	**5,767**	**5,281**	**4,630**	**4,637**	**4,531**	**4,795**	**5.8%**	**-32.5%**
Percentage of Non EU	22.4%	27.8%	34.1%	30.7%	32.3%	33.4%	33.9%	30.4%	-10.3%	35.7%
Proportion of female students	11.4%	11.9%	12.9%	11.1%	11.3%	11.5%	11.0%	11.5%	4.5%	0.9%

Source: UCAS

Table 19.23: Accepted applicants onto first degrees in production and manufacturing engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	1,355	1,177	980	899	677	618	603	553	-8.3%	-59.2%
EU (excluding UK)	46	48	44	37	36	49	44	41	-6.8%	-10.9%
Non EU	120	122	114	106	109	103	101	93	-7.9%	-22.5%
Total Non UK	166	170	158	143	145	152	145	134	-7.6%	-19.3%
Female students	268	246	204	201	165	189	175	143	-18.3%	-46.6%
Total	**1,521**	**1,347**	**1,138**	**1,042**	**822**	**770**	**748**	**687**	**-8.2%**	**-54.8%**
Percentage of Non EU	7.9%	9.1%	10.0%	10.2%	13.3%	13.4%	13.5%	13.5%	0.0%	70.9%
Proportion of female students	17.6%	18.3%	17.9%	19.3%	20.1%	24.5%	23.4%	20.8%	-11.1%	18.2%

Source: UCAS

Table 19.24: Accepted applicants onto first degrees in chemical, process and energy engineering (2001/02-2008/09)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Percentage change over eight years
UK	681	676	689	768	855	953	1,084	1,192	10.0%	75.0%
EU (excluding UK)	36	42	47	46	58	80	62	75	21.0%	108.3%
Non EU	262	282	362	389	393	422	494	549	11.1%	109.5%
Total Non UK	298	324	409	435	451	502	556	624	12.2%	109.4%
Female students	272	272	275	311	356	368	428	489	14.3%	79.8%
Total	**979**	**1,000**	**1,098**	**1,203**	**1,306**	**1,455**	**1,640**	**1,816**	**10.7%**	**85.5%**
Percentage of Non EU	26.8%	28.2%	33.0%	32.3%	30.1%	29.0%	30.1%	30.2%	0.3%	12.9%
Proportion of female students	27.8%	27.2%	25.0%	25.9%	27.3%	25.3%	26.1%	26.9%	3.1%	-3.2%

Source: UCAS

19.3.10 Gender of accepted applicants to engineering degrees

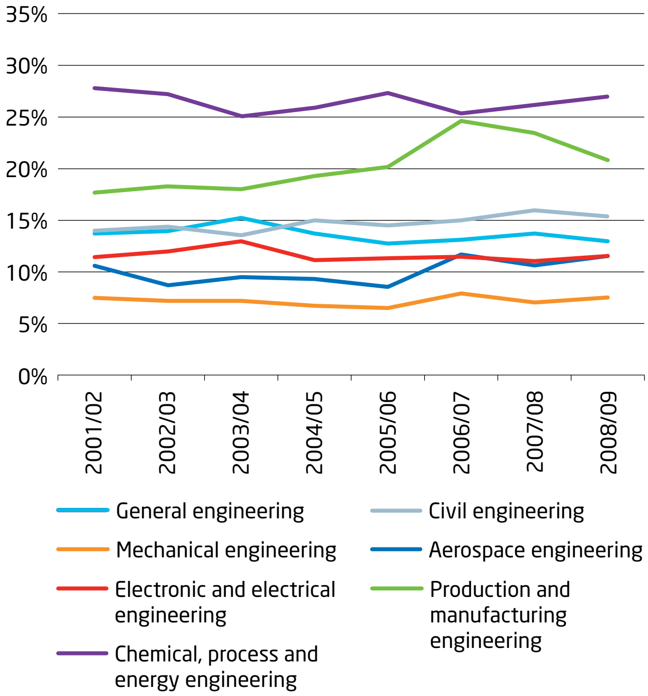
Figure 19.19 shows the proportion of female accepted applicants by engineering sub-discipline. The highest is for chemical, process and energy engineering, where consistently, at least 25% of accepted applicants are female. The largest rise is evident in production and manufacturing engineering, where the number of female applicants accepted has risen from 17.6% in 2001/02 to 20.8% in 2008/09, despite falling back from its peak of 24.5% in 2006/07.

Civil engineering has seen a slight increase in the proportion of female accepted applicants, up from 14.0% in 2001/02 to 15.3% in 2008/09. Whilst slight, this rise has been achieved during a period of large increases (84.7%) in the overall number of accepted applicants.

There has been a small decrease in the number of females accepted onto general engineering degrees over the eight-year period. In 2008/09, it was down to 12.9% from its peak of 15.1% in 2003/04. Aerospace engineering has increased its female application acceptances from a low point of 8.6% in 2002/03 to 11.5% in 2008/09.

Of all the sub-disciplines, the lowest number of female acceptances is consistently for mechanical engineering. The number stood at 7.5% in both 2001/02 and 2008/09, with only a slight fluctuation in the intervening years.

Fig. 19.19: Proportion of female accepted applicants to degree courses by engineering discipline (2001/02-2008/09) – all domiciles



Source: UCAS

19.4 Qualifications achieved

Previous analyses in this section have examined important trends which, by their very nature, contain an inherent three- or four-year time lag. However, the analysis most often used by commentators is the numbers of graduates who actually graduate and go on to employment or further study.

HESA collects data from all public-funded universities on HE students. Table 19.25 shows the growth or decline over seven years in the number of first degrees achieved for different STEM subjects, as well as all subjects. Throughout the seven-year period, STEM degrees have accounted for at least a quarter of all first degrees achieved in each academic year. However, the number of students achieving a STEM first degree is declining as a proportion of all first degrees, from a high point of 28.5% in 2003/04 through to just 25.5% in 2008/09.

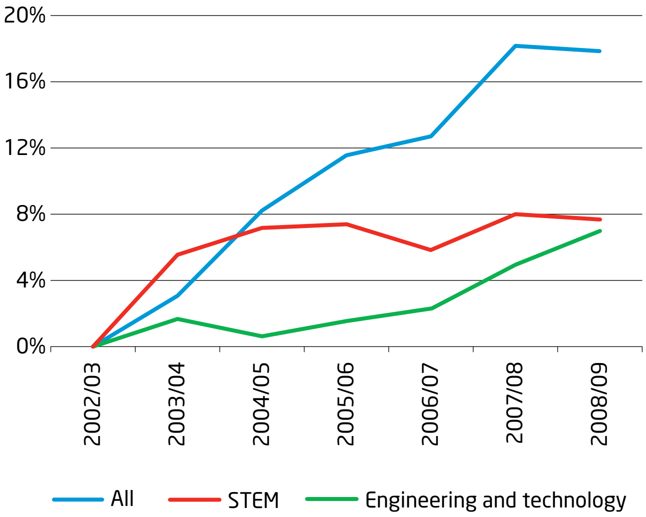
Figure 19.20 shows the compound growth in all subjects, all STEM subjects, and engineering and technology since 2002/03. The chart shows that graduate numbers in all subjects have grown by 17.8% over the period, while all STEM subjects and engineering and technology have underperformed, growing by 6.9%. and 7.7% respectively.

Table 19.25: Number of first degrees achieved in STEM (2002/03-2008/09) – UK domiciled

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	One year change	Change over seven year period
Biological sciences	23,725	25,955	27,200	27,840	29,095	31,185	30,720	-1.5%	29.5%
Physical sciences	12,480	11,995	12,530	12,900	12,480	13,015	13,510	3.8%	8.3%
Mathematical sciences	5,100	5,395	5,270	5,500	5,645	5,815	5,980	2.8%	17.3%
Computer science	18,240	20,205	20,095	18,840	16,445	14,915	14,035	-5.9%	-23.1%
Engineering & technology	19,455	19,780	19,575	19,765	19,900	20,420	20,805	1.9%	6.9%
Total STEM	79,000	83,330	84,670	84,845	83,565	85,350	85,050	-0.4%	7.7%
All subjects	283,280	292,090	306,365	315,985	319,260	334,890	333,720	-0.3%	17.8%
STEM proportion of all degrees	27.9%	28.5%	27.6%	26.9%	26.2%	25.5%	25.5%	0%	-8.60%

Source: HESA

Fig. 19.20: Percentage growth in first degrees achieved – UK domiciled



Source: HESA

At this juncture, we would also draw attention to our concern over the fall in the number of engineering and technology students undertaking sandwich courses. This fall was identified in the Universities UK and the CBI report Future Fit,[206] which showed that over the last 12 years, there has been a decline in the proportion and absolute number of sandwich courses. In 1994/05, 10.5% of all undergraduate students were studying on a sandwich course, but by 2006/07 this had fallen to 6.5%. The largest decline was in engineering and technology, where the number of sandwich students declined by 33% over this 12-year period. The same report reveals that employers want students who have work experience.

19.4.1 Degrees achieved in engineering sub-disciplines

In Table 19.25 we showed that the overall number of students graduating in engineering and technology has increased. However, when we examine the number of qualifiers by different engineering sub-discipline, a different pattern becomes apparent. Table 19.26 details the changes in the number of first degree by gender of graduates for the last year and over a six-year period. Across all the sub-disciplines selected, there was a 1% increase in the number of qualifiers in 2008/09 compared with the previous year. However, across the six-year period the number of qualifiers decreased by 5%.

Three subject areas have experienced declining numbers of students graduating over the six-year period, as well as between 2007/08 and 2008/09. These are:

- General engineering
- Electronic and electrical engineering
- Production and manufacturing engineering

For general engineering and electronic and electrical engineering, the number of female qualifiers has fallen at a faster rate than male qualifiers.

The sub-discipline with the largest decline in the number of graduates was production and manufacturing engineering, which fell 40% over the six-year period. Male graduates fell 43% while female graduates fell 19%. It should be noted that in 2008/09 the number of female graduates increased by 15%.

Of all the engineering sub-disciplines, civil engineering showed the largest growth in qualifiers, up 62% over the six-year period and 13% in the last year. The growth in qualifiers has been strongest amongst male students, who increased by 65% over six years, compared with 47% for females.

Mechanical engineering, chemical, process and energy engineering and aerospace engineering also showed growth over the six-year period, but at a much lower rate than civil engineering. For each of these three sub-disciplines, numbers of male graduates have grown at a faster rate than female graduates over the six years. Indeed, in mechanical engineering and aerospace engineering, male graduate numbers have grown while female graduates have declined.

206 http://www.cbi.org.uk/pdf/20090326-CBI-FutureFit-Preparing-graduates-for-the-world-of-work.pdf

Table 19.26: Number of first degrees achieved in engineering subjects (2003/04-2008/09) – UK domiciled

		2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
General engineering	Female	284	226	261	244	229	204	-11%	-28%
	Male	1,431	1,454	1,421	1,500	1,235	1,219	-1%	-15%
	Total male and female	1,714	1,679	1,682	1,743	1,464	1,423	-3%	-17%
Civil engineering	Female	241	235	223	277	310	353	14%	47%
	Male	1,311	1,502	1,382	1,622	1,918	2,161	13%	65%
	Total male and female	1,551	1,737	1,604	1,898	2,228	2,514	13%	62%
Mechanical engineering	Female	236	204	206	211	225	215	-4%	-9%
	Male	2,402	2,431	2,445	2,554	2,572	2,681	4%	12%
	Total male and female	2,638	2,635	2,651	2,765	2,796	2,896	4%	10%
Aerospace engineering	Female	109	93	105	107	89	106	18%	-3%
	Male	903	944	926	895	877	942	7%	4%
	Total male and female	1,012	1,037	1,032	1,002	966	1,048	8%	4%
Electronic & electrical engineering	Female	431	358	310	283	317	254	-20%	-41%
	Male	3,510	3,209	2,913	2,777	2,654	2,513	-5%	-28%
	Total male and female	3,941	3,567	3,223	3,060	2,970	2,768	-7%	-30%
Production & manufacturing engineering	Female	162	154	139	144	115	132	15%	-19%
	Male	1089	953	869	730	692	623	-10%	-43%
	Total male and female	1,252	1,107	1,008	874	807	755	-6%	-40%
Chemical, process & energy engineering	Female	128	126	139	119	141	131	-7%	3%
	Male	411	407	383	382	428	450	5%	9%
	Total male and female	539	533	523	501	569	581	2%	8%
All males and females for selected sub-disciplines		12,646	12,295	11,722	11,843	11,801	14,321	1%	-5%

Source: HESA

Table 19.27 explores the number of postgraduate degrees by gender for selected engineering sub-disciplines. Over the six-year period, the number of postgraduates gaining a qualification increased by 9%, with a rise of 4% occurring in the last year. However, not all sub-disciplines grew at the same rate or even grew at all.

The number of production and manufacturing engineering postgraduates to qualify fell by 40% over the period and by 10% in the last year. The decline was most marked among male students, with the number qualifying down by 42%. The number of females to qualify fell by 27%.

Electronic and electrical engineering also showed a decline, with the number of postgraduate qualifiers down by nearly a quarter (24%). However, this subject area did see growth of 5% in 2008/09. Here, the decline was steepest amongst female postgraduates, with 43% fewer qualifiers, compared with 20% fewer males.

The most successful sub-discipline was civil engineering, which saw 63% growth in postgraduate qualifiers over the six years – 19% in the last year. This mirrors the subject's success in first degrees. There was growth in both the numbers of male (up 71% overall and 22% in 2008/09) and female (43% overall and 11% in 2008/09) postgraduates.

Aerospace engineering grew 37% over six years and 15% in the last year. However, its growth has not been even. In fact, the number of male postgraduates has grown 55% in six years and 11% last year, compared with the number of female postgraduates, which has fallen 39% in six years (albeit from a very small base).

General engineering has increased its number of postgraduate qualifiers by 30% in the last six years. However, numbers fell back 5% in 2008/09. Interestingly, female numbers actually grew by 6% in 2008/09, while males dropped by 7%. Given that numbers of first degree graduates have fallen by 17% over the same period, it is unlikely that general engineering postgraduate numbers will return to growth in 2009/10.

Mechanical engineering postgraduate numbers grew slightly over the six-year period – up 5%. However, this masks a decline of 18% in 2008/09, which included a 47% fall in the number of female postgraduates. Nevertheless, overall postgraduate numbers are still above those achieved in 2006/07.

Table 19.27: Number of postgraduate degrees (excluding doctorates and PGCE) achieved in engineering subjects (2003/04-2008/09) – UK domiciled

		2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
General engineering	Female	61	112	108	86	79	84	6%	38%
	Male	362	624	612	535	498	464	-7%	28%
	Total male and female	**422**	**736**	**720**	**622**	**577**	**548**	**-5%**	**30%**
Civil engineering	Female	160	162	143	198	206	229	11%	43%
	Male	388	389	413	472	546	665	22%	71%
	Total male and female	**548**	**551**	**556**	**670**	**752**	**894**	**19%**	**63%**
Mechanical engineering	Female	34	33	26	22	69	36	-47%	7%
	Male	263	266	227	234	311	274	-12%	4%
	Total male and female	**296**	**299**	**253**	**255**	**380**	**310**	**-18%**	**5%**
Aerospace engineering	Female	22	21	22	18	7	13	91%	-39%
	Male	83	105	114	92	116	129	11%	55%
	Total male and female	**104**	**125**	**136**	**110**	**124**	**142**	**15%**	**37%**
Electronic and electrical engineering	Female	131	148	107	100	81	75	-7%	-43%
	Male	591	553	527	507	443	474	7%	-20%
	Total male and female	**721**	**702**	**634**	**607**	**524**	**549**	**5%**	**-24%**
Production and manufacturing engineering	Female	43	50	52	33	47	32	-33%	-27%
	Male	307	251	230	219	185	177	-4%	-42%
	Total male and female	**350**	**301**	**282**	**252**	**232**	**208**	**-10%**	**-40%**
Chemical, process and energy engineering	Female	58	61	62	38	30	50	67%	-14%
	Male	114	128	126	123	113	136	20%	19%
	Total male and female	172	189	187	162	143	186	30%	8%
All males and females for selected sub-disciplines		2,614	2,902	2,766	2,678	2,731	2,837	4%	9%

Source: HESA

Table 19.28 shows the number of doctoral awards for selected engineering sub-disciplines over the six-year period. Due to the small number of students graduating in certain sub-disciplines, there is a lot of variation in the data when comparing graduate numbers year-on-year. However, it can be said that graduate numbers for the selected sub-disciplines have increased by 2% over the period and by 13% in 2008/09. It is also notable that, despite achieving a 63% increase in postgraduate numbers over the six years, civil engineering saw a 14% decrease in the number of doctorates over the same period. Despite the absolute numbers being relatively low, the importance and value of engineering researchers (and indeed STEM researchers per se) to the future of the UK economy cannot be understated and has been described in some detail in section 4 of this report.

Table 19.28: Number of doctorates achieved in engineering subjects (2003/04-2008/09) – UK domiciled

		2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
General engineering	Female	33	26	38	27	19	30	60%	-8%
	Male	157	142	136	148	125	136	9%	-13%
	Total male and female	190	168	174	174	145	167	15%	-12%
Civil engineering	Female	20	25	27	31	28	29	4%	45%
	Male	74	70	77	73	63	52	-17%	-30%
	Total male and female	94	95	104	104	92	81	-12%	-14%
Mechanical engineering	Female	25	17	20	27	16	22	36%	-13%
	Male	114	109	114	152	90	105	17%	-8%
	Total male and female	139	126	133	179	106	127	20%	-9%
Aerospace engineering	Female	3	5	2	10	7	8	10%	156%
	Male	20	21	24	39	23	38	66%	91%
	Total male and female	23	26	26	49	29	46	58%	100%
Electronic and electrical engineering	Female	27	26	30	32	25	41	63%	51%
	Male	161	176	144	205	164	187	14%	16%
	Total male and female	188	201	174	236	189	228	20%	21%
Production and manufacturing engineering	Female	9	14	16	7	11	9	-18%	0%
	Male	34	24	29	22	33	29	-14%	-16%
	Total male and female	43	37	44	29	44	38	-15%	-13%
Chemical, process and energy engineering	Female	30	21	24	21	28	17	-38%	-42%
	Male	60	59	64	54	58	75	29%	25%
	Total male and female	89	80	88	74	85	92	8%	4%
All males and females for selected sub-disciplines		764	732	743	844	689	779	13%	2%

Source: HESA

19.4.2 Ethnicity of engineering graduates

Table 19.29 shows a 9.4% decline in the number of white graduates, down from 11,195 in 2003/04 to 9,268 in 2008/09. The number of white qualifiers also fell by 0.4% in 2008/09, when the overall number of qualifiers rose by 1.1%.

The largest percentage decline over six years was for graduates from other Black backgrounds (down 62.7%); however, this was from a very small base of only 51 in 2003/04.

The number of Asian or British Asian – Indian qualifiers fell by 11.1% in 2008/09 and by 18.9% over the six years. Qualifiers with Chinese ethnicity have fallen by 6.1% over the six-year period. Encouragingly, however, these numbers rose by 12.0% in 2008/09.

The largest growth over the six-year period was among Black or Black British – African graduates, up three-quarters overall (76.0%) and by 5.6% in 2008/09. The number of graduates from the other (including mixed) ethnicity category also grew significantly, up 57.8% over six years and up by a very impressive 24.4% in 2008/09. Graduates from other Asian backgrounds also grew in number by a half (49.7%) over the six years.

Table 19.29: First degrees achieved in engineering by ethnic origin (2003/04-2008/09) – UK domiciled	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Change over one year	Change over six years
White	10,195	9,837	9,238	9,421	9,268	9,234	-0.4%	-9.4%
Black or Black British – Caribbean	83	77	86	85	76	76	0.1%	-8.6%
Black or Black British – African	292	306	376	358	487	514	5.6%	76.0%
Other Black background	51	24	41	37	26	19	-26.4%	-62.7%
Asian or Asian British – Indian	566	483	508	452	516	459	-11.1%	-18.9%
Asian or Asian British – Pakistani	265	264	269	242	264	301	14.0%	13.5%
Asian or Asian British - Bangladeshi	99	88	77	69	90	92	1.4%	-7.8%
Chinese	276	241	217	252	231	259	12.0%	-6.1%
Other Asian background	189	190	231	213	233	283	21.8%	49.7%
Other (including mixed) ethnicity	286	278	296	360	363	452	24.4%	57.8%
Unknown	611	651	563	504	400	399	-0.2%	-34.7%
Total	12,913	12,437	11,901	11,992	11,954	12,087	1.1%	-6.4%

Source: HESA

In Table 19.30 we show the ethnic breakdown of qualifiers for selected undergraduate engineering sub-disciplines. General engineering had the largest proportion of white qualifiers in 2008/09, at 83.6%, closely followed by production and manufacturing engineering, where 83.3% of qualifiers where white. The other two sub-disciplines where approximately four out of five qualifiers were white were civil engineering (80.5%) and mechanical engineering (79.8%).

The three sub-disciplines with the lowest proportion of white qualifiers were chemical, process and energy engineering (63.4%), electronic and electrical engineering (68.7%), and aerospace engineering (68.9%). In each case, Asian or Asian British – Indian qualifiers formed the second largest ethnic group, with approximately one in every twenty qualifiers having this ethnicity.

Table 19.30: Percentage breakdown of first degrees achieved by ethnic origin in engineering subjects (2008/09) – UK domiciled

	White	Black or Black British - Caribbean	Black or Black British - African	Other Black back-ground	Asian or Asian British - Indian	Asian or Asian British - Pakistani	Asian or Asian British - Bangla-deshi	Chinese	Other Asian back-ground	Other (including mixed) ethnicity	Unknown
General engineering	83.6%	0.4%	2.0%	0.2%	2.4%	1.1%	0.4%	1.7%	1.4%	2.5%	4.3%
Civil engineering	80.5%	0.7%	3.3%	0.1%	2.7%	1.7%	0.6%	1.8%	2.2%	3.5%	3.0%
Mechanical engineering	79.8%	0.5%	2.9%	0.1%	3.7%	2.1%	0.4%	2.1%	2.0%	4.1%	2.4%
Aerospace engineering	68.9%	0.6%	4.7%	0.5%	5.3%	4.4%	0.7%	2.4%	3.7%	5.1%	3.9%
Electronic & electrical engineering	68.7%	1.0%	6.9%	0.2%	5.0%	3.6%	1.6%	2.1%	2.9%	3.9%	4.0%
Production & manufacturing engineering	83.3%	0.9%	0.6%	0.1%	2.5%	2.1%	0.4%	2.3%	1.6%	2.7%	3.5%
Chemical, process & energy engineering	63.4%	0.0%	12.2%	0.0%	6.3%	3.1%	0.4%	4.3%	3.1%	4.8%	2.4%

Source: HESA

Table 19.31 shows the breakdown of ethnicity for selected undergraduate engineering sub-disciplines, by gender. This shows up some quite interesting gender differences. Looking specifically at white qualifiers, there is a higher proportion of male qualifiers to females for six of the seven sub-disciplines. (The exception to this rule is aerospace engineering.)

The sub-discipline with the lowest proportion of white female qualifiers was chemical, process and energy engineering, where two thirds of male qualifiers were white (66.5%) but only 52.8% of females. Nearly a fifth (18.3%) of female qualifiers in chemical, process and energy engineering were Black or Black British – African, and a further 6.9% were Chinese.

In electronic and electrical engineering, 70.1% of male qualifiers are white and 55.2% of female qualifiers are white. It is notable that amongst female qualifiers, 8.6% were Asian or Asian British – Indian and 8.0% were Black or Black British – Caribbean.

Table 19.31: Percentage breakdown by gender of first degrees achieved by ethnic origin in engineering subjects (2008/09) – UK domiciled

		White	Black or Black British - Caribbean	Black or Black British - African	Other Black back-ground	Asian or Asian British - Indian	Asian or Asian British - Pakistani	Asian or Asian British - Bangla-deshi	Chinese	Other Asian back-ground	Other (including mixed) ethnicity	Unknown
General engineering	Female	83.2%	1.0%	1.5%	0.0%	2.3%	0.7%	0.5%	0.9%	1.0%	3.9%	5.0%
	Male	83.7%	0.3%	2.1%	0.3%	2.4%	1.1%	0.4%	1.8%	1.5%	2.2%	4.2%
Civil engineering	Female	77.0%	1.3%	3.0%	0.0%	3.7%	0.3%	0.3%	3.1%	2.8%	5.2%	3.3%
	Male	81.0%	0.6%	3.4%	0.1%	2.5%	2.0%	0.7%	1.6%	2.1%	3.2%	2.9%
Mechanical engineering	Female	72.4%	0.5%	3.6%	0.5%	2.7%	2.3%	0.5%	4.0%	5.0%	4.2%	4.5%
	Male	80.4%	0.5%	2.9%	0.0%	3.7%	2.0%	0.4%	1.9%	1.7%	4.1%	2.3%
Aerospace engineering	Female	74.6%	1.4%	5.0%	0.9%	4.7%	0.9%	0.0%	1.9%	4.7%	5.7%	0.0%
	Male	68.2%	0.5%	4.7%	0.4%	5.3%	4.8%	0.8%	2.4%	3.6%	5.0%	4.3%
Electronic & electrical engineering	Female	55.2%	2.9%	8.0%	0.0%	8.6%	4.0%	3.5%	2.9%	3.3%	6.4%	5.0%
	Male	70.1%	0.8%	6.8%	0.2%	4.7%	3.6%	1.4%	2.0%	2.9%	3.6%	3.8%
Production & manufacturing engineering	Female	75.2%	0.0%	0.0%	0.0%	3.0%	2.3%	0.8%	7.2%	1.5%	5.7%	4.4%
	Male	85.0%	1.0%	0.7%	0.1%	2.4%	2.1%	0.4%	1.3%	1.6%	2.0%	3.3%
Chemical, process & energy engineering	Female	52.8%	0.0%	18.3%	0.0%	6.1%	0.0%	0.8%	6.9%	3.8%	9.9%	1.5%
	Male	66.5%	0.0%	10.4%	0.0%	6.4%	4.0%	0.3%	3.6%	2.9%	3.3%	2.7%

Source: HESA

In Table 19.32, we look at the ethnic breakdown of higher degree qualifiers to selected engineering sub-disciplines. When compared with first degree qualifiers (Table 19.30) for the same engineering sub-disciplines, it is noted that the proportion of white qualifiers is lower. For instance at undergraduate level, 68.7% of first degree qualifiers in electronic and electrical engineering are white, but at higher degree level this falls to just over half (52.8%). The second largest ethnic grouping is Black or Black British – African, which accounts for at least 4.3% of all qualifiers in each of the selected sub-disciplines.

Table 19.32: Percentage breakdown by ethnic origin of higher degrees achieved in engineering subjects (2008/09) – UK domiciled

	White	Black or Black British - Caribbean	Black or Black British - African	Other Black back-ground	Asian or Asian British - Indian	Asian or Asian British - Pakistani	Asian or Asian British - Bangla-deshi	Chinese	Other Asian back-ground	Other (including mixed) ethnicity	Unknown
General engineering	67.8%	0.5%	6.0%	0.8%	4.0%	1.2%	0.8%	2.7%	2.1%	3.6%	10.6%
Civil engineering	69.4%	0.2%	5.1%	0.7%	1.7%	1.7%	0.2%	2.5%	3.2%	2.9%	12.4%
Mechanical engineering	64.9%	0.6%	4.3%	0.0%	4.5%	1.8%	0.5%	3.2%	2.6%	2.4%	15.2%
Aerospace engineering	66.8%	0.5%	4.8%	0.0%	2.1%	1.1%	0.5%	0.7%	5.2%	5.4%	12.8%
Electronic & electrical engineering	52.8%	0.6%	6.4%	0.1%	5.0%	4.8%	1.5%	4.3%	4.6%	3.6%	16.3%
Production & manufacturing engineering	66.7%	0.0%	8.3%	0.0%	4.3%	1.9%	0.4%	2.2%	3.3%	5.2%	7.7%
Chemical, process & energy engineering	57.1%	0.4%	6.8%	0.0%	4.3%	2.9%	0.0%	1.8%	1.8%	4.7%	20.3%

Source: HESA

19.4.3 Socio-economic group of engineering graduates

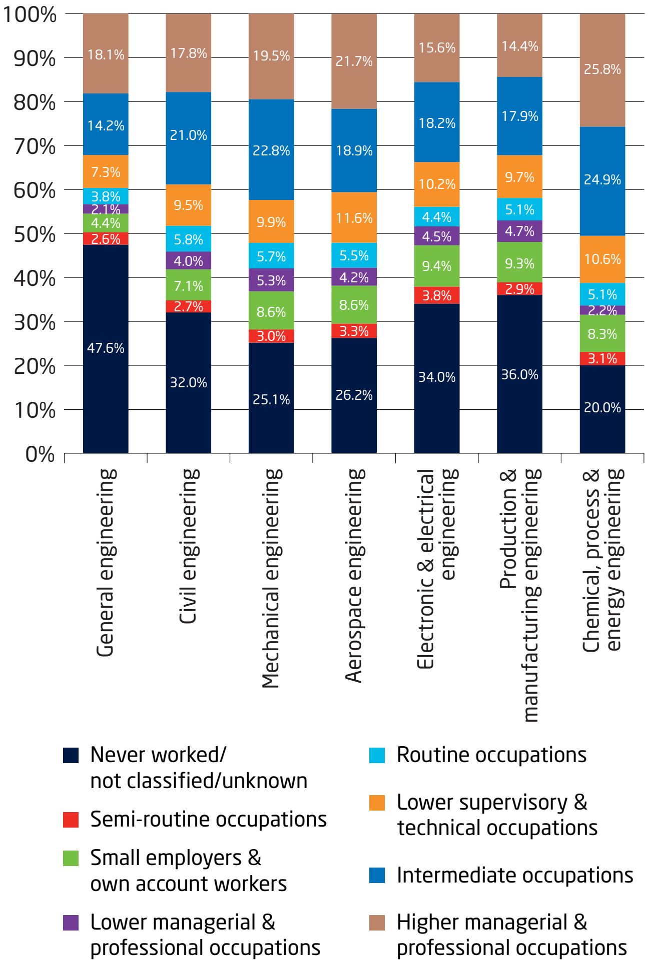
The largest socio-economic group[207] for all selected engineering sub-disciplines, with the exception of chemical, process and energy engineering, was never worked/not classified/unknown.[208] The two next most significant socio-economic groups are lower managerial and professional occupations, and higher managerial and professional occupations.

When looking at socio-economic groups by engineering sub-disciplines, it can be seen that over half (50.7%) of qualifiers in chemical, process and energy engineering were in the higher managerial and professional occupations or the lower managerial and professional occupations groups. By comparison, only a third of qualifiers in production and manufacturing engineering (32.3%), general engineering (32.3%), and electronic and electrical engineering (33.8%) were in these two socio-economic groups.

207 The socio-economic classification of a qualifier is based on the job of the main income earner in the household. If the qualifier is under the age of 25, this is based on the parent or guardian's occupation. If they are over the age of 25, then it is based on their occupation.

208 The vast majority of never worked/not classified/unknown will be people whose socio-economic class is either not classified or unknown. Only a very small proportion come from households recorded as never having worked.

Fig. 19.21: Percentage breakdown by socio-economic group of first degrees achieved in engineering subjects (2008/09) - UK domiciled



Source: HESA

19.5 BTEC Higher National Certificate (HNC) and Higher National Diploma (HND)

HNCs[209] and HNDs[210] are highly flexible and can be studied part-time, full-time, as a sandwich course or through distance learning. They are assessed through projects and practical tasks rather than formal written exams and all involve work-related experience. They provide a recognised route to related degree courses; HNC/D holders may move on to the second or third year of a related degree course. Table 19.32 shows the number of HNC/HND completions over a four-year period for selected engineering subjects.

The table shows that the number of completions for selected HNCs has grown 15% to 2,325 over four years, while the number of HNDs has risen 29% to 620. Among HNCs, the fastest-growing subject was operations engineering which grew 192% over the four-year period and 8% in the last year. Civil engineering (NQF) grew by 91% over four years and 14% in the last year. By comparison, the civil engineering HNC declined 96% over four years and 85% in the last year, with just six completions in 2009/10. Similarly, numbers entering mechanical engineering courses declined by 83% in four years and 53% in the last year.

Looking at the selected HNDs, it was noticed that electrical/electronic engineering (NQF) grew by 106% over four years, and by 6% in the last year, to 243 completions in 2009/10. Mechanical engineering (NQF) has grown by 80% since 2006/07.

Among the selected HNDs, engineering showed the largest percentage decline over four years, falling 38% to just 61 in 2009/10.

209 An HNC is a work-related vocational qualification at level 4 on the National Qualifications Framework. If studied full-time it takes one year to complete.

210 An HND is a work-related vocational qualification at level 5 on the National Qualifications Framework. If studied full-time it takes two years to complete.

Table 19.33: Total number of completions for selected[211] engineering HNC/HNDs achieved (2006/07-2009/10)

Award Title	Size	2006/07	2007/08	2008/09	2009/10	Change over one year	Change over four years
Building services engineering (NQF)	HNC	163	209	278	237	-15%	45%
Civil engineering	HNC	158	89	40	6	-85%	-96%
Civil engineering (NQF)	HNC	204	298	342	390	14%	91%
Electrical/electronic engineering	HNC	225	125	83	74	-11%	-67%
Electrical/electronic engineering (NQF)	HNC	549	597	584	623	7%	13%
Electrical/electronic engineering (NQF)	HND	118	196	230	243	6%	106%
Engineering	HND	99	103	41	61	49%	-38%
Manufacturing engineering (NQF)	HNC	174	260	255	334	31%	92%
Manufacturing engineering (NQF)	HND	79	104	92	76	-17%	-4%
Marine engineering (NQF)	HND	102	55	80	92	15%	-10%
Mechanical engineering	HNC	168	73	60	28	-53%	-83%
Mechanical engineering (NQF)	HNC	331	401	422	481	14%	45%
Mechanical engineering (NQF)	HND	82	116	204	148	-27%	80%
Operations engineering (NQF)	HNC	52	104	141	152	8%	192%
All selected engineering HNCs		2,024	2,156	2,205	2,325	5%	15%
All selected engineering HNDs		480	574	647	620	-4%	29%

Source: Edexcel

211 Engineering HNC/HNDs with at least 100 completions in one or more academic years

19.6 Foundation degrees

This section has been authored by Dr Esther Lockley, Research and Information Manager, and Charles Pickford, Director of Employer Partnerships (Private Sector), fdf.

19.6.1 Student profile

The number of students enrolled on engineering and technology Foundation degrees continues to grow annually, with 3,315 new entrants to programmes in 2008-09 (Table 19.34). While around a third (32%) of all undergraduates in the UK study Higher Education part-time, engineering and technology Foundation degrees attract an even greater proportion of part-time students.[212] In 2008-09, 41% of entrants to engineering and technology Foundation degrees enrolled on part-time programmes.

Table 19.34: Entrants to engineering and technology Foundation degrees, by year[213]

Academic year	Entrants to full-time programmes	Entrants to part-time programmes	Total entrants
2006/07	1,170	1,035	2,205
2007/08	1,455	1,110	2,565
2008/09	1,945	1,370	3,315

Source: Higher Education Funding Council for England

Just under 12% of entrants to engineering and technology Foundation degrees are female (Table 19.35). This is slightly less than for undergraduate engineering and technology programmes in general. UCAS data[214] indicates that in 2009 13% of accepted applicants to all undergraduate engineering and technology programmes were female. Table 19.34 also shows that a quarter of engineering and technology Foundation degree students are aged 30 or over and 69% are aged 20 or over on entry. Individuals who are aged over 50 account for 2% of entrants.

212 HESA *Press release 144 – Students in Higher Education Institutions 2008-09* Available at: www.hesa.ac.uk/index.php/content/view/1668/161

213 All data rounded to the nearest five

214 www.ucas.ac.uk/about_us/stat_services/stats_online

Table 19.35: Full- and part-time entrants to engineering and technology Foundation degrees by age and gender (2008/09)

		Full-time		Part-time	
Gender	**Age on entry**	**Number**	**Proportion**	**Number**	**Proportion**
Female	16 to 19	75	4%	30	2%
	20 to 29	95	5%	70	5%
	30 to 39	30	1%	45	3%
	40 to 49	10	0%	35	2%
	50 to 59	0	0%	10	1%
	60 plus	0	0%	5	0%
	Subtotal: female	205	11%	190	14%
Male	16 to 19	710	37%	220	16%
	20 to 29	760	39%	555	40%
	30 to 39	215	11%	225	17%
	40 to 49	50	2%	125	9%
	50 to 59	10	0%	50	4%
	60 plus	0	0%	5	1%
	Subtotal: male	1,740	89%	1,180	86%
Total		1,945	100%	1,370	100%

Source: Higher Education Funding Council for England

Around a quarter (23%) of entrants to engineering and technology Foundation degrees already hold a Higher Education qualification (Table 19.36). A levels or NVQ 3 are the highest qualification held by 36% of entrants. A BTec level 3 award is the highest qualification of 11% of entrants. Fewer than 1% of entrants list their highest qualification as an Advanced Modern Apprenticeship or an Access to HE programme.

Table 19.36: Full- and part-time entrants to engineering and technology Foundation degrees by highest qualifications held on entry (2008/09)

Qualifications on entry		Full-time		Part-time	
		Number	Proportion	Number	Proportion
HE level	Postgraduate (excluding PGCE)	40	2%	15	1%
	First degree (including PGCE)	75	4%	50	4%
	HND/HNC	100	5%	155	11%
	Foundation degree	20	1%	20	1%
	Graduate equivalent qualifications (including higher NVQ)	10	1%	10	1%
	Other HE qualification of less than degree standard (including institutional credits)[215]	170	9%	105	8%
	Subtotal	**415**	**21%**	**355**	**26%**
FE level or below	A levels, VCE and equivalents [216]	860	44%	330	24%
	BTEC level 3	210	11%	145	11%
	Other FE level qualifications[217]	25	1%	5	0%
	GCSEs and equivalents[218]	75	4%	75	5%
	Other non-advanced qualifications [219]	75	4%	85	6%
	Accreditation of Prior Experiential Learning	5	0%	10	1%
	No formal qualification	20	1%	25	2%
	Subtotal	**1,270**	**65%**	**670**	**49%**
Unknown		260	13%	345	25%
Total		**1,945**	**100%**	**1,370**	**100%**

Source: Higher Education Funding Council for England

Higher education institutions teach 22% of Foundation degree students (Table 19.37). Just under 14% of students are subject to joint teaching arrangements involving a Further Education college and a Higher Education institution. However, the majority (64%) of students on engineering and technology Foundation degrees are taught by Further Education colleges.

215 'Other HE qualification of less than degree standard (including institutional credits)' includes: Certificates and Diplomas of HE; GNVQs and NVQs at level 4 and professional qualifications.

216 'A levels, VCE and equivalents' includes: GNVQs and NVQs at level 3; AVCEs and VCEs; and their Scottish equivalents.

217 'Other FE level qualifications' includes: Access to HE course; and Advanced Modern Apprenticeships

218 'GCSEs and equivalents' includes: O levels and Scottish equivalents.

219 'Other non-advanced qualifications' includes: NVQs at level 2

Table 19.37: Full- and part-time entrants to engineering and technology Foundation degrees by institution type (2006/07)

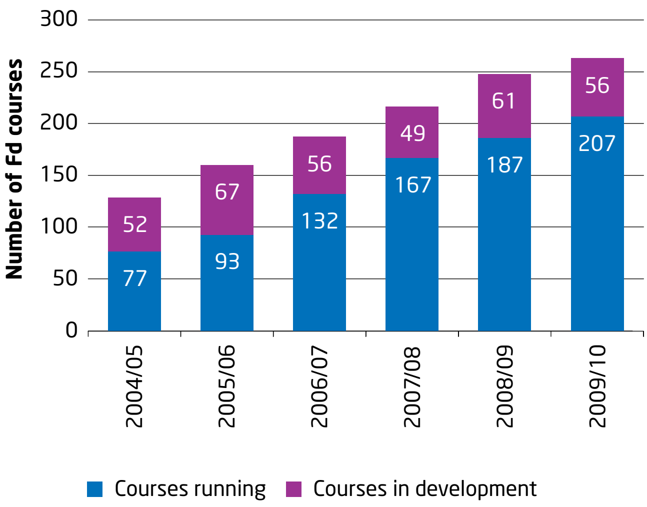
Institution type		**Full-time**		**Part-time**		**FT + PT**	
Registering	**Teaching**	**Number**	**Proportion**	**Number**	**Proportion**	**Number**	**Proportion**
Higher Education Institution	Higher Education Institution	315	27%	165	16%	480	22%
Higher Education Institution	Higher Education Institution and Further Education College	225	19%	80	8%	305	14%
Higher Education Institution	Further Education College	405	35%	475	46%	880	40%
Further Education College	Further Education College	225	19%	310	30%	535	24%
Total		1,170	100%	1,035	100%	2,205	100%

Source: Higher Education Funding Council for England

19.6.2 Course profile

The number of engineering and technology Foundation degree courses available in England has grown steadily since the introduction of the qualification in 2001/02. The number of courses offered by universities and colleges has more than doubled in the period from 2004/05 to 2009/10 (Figure 19.22). In 2009/10 there were 207 courses running (ie with students enrolled) and a further 56 courses in development.

Fig. 19.22: Growth in engineering and technology Foundation degree courses

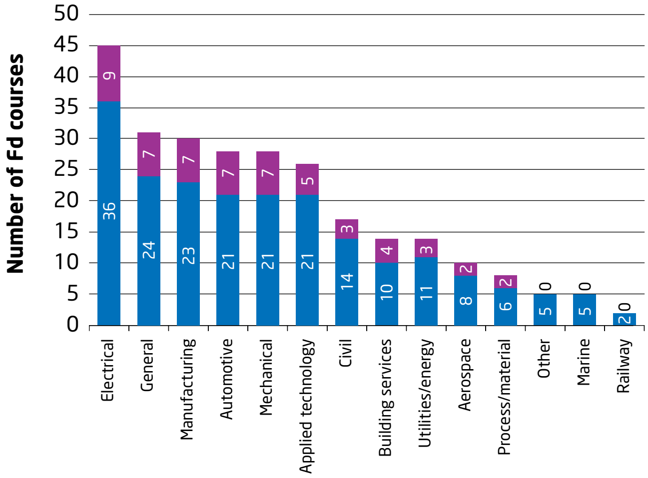


Source: fdf course database

Foundation degrees can either be general programmes covering a broad subject base or very specific programmes developed to suit the needs of a particular industry or company. General programmes are likely to offer a route into initial employment within the sector, whereas specific programmes are more likely to be aimed at up-skilling the existing workforce. Figure 19.23 shows a subject profile for the engineering and technology Foundation degrees that were available in 2009/10. Courses in electrical, manufacturing and automotive engineering, as well as general programmes, dominate the profile and account for just under 40% of provision. Specialist programmes in aerospace, process, marine and railway engineering account for just 8% of provision.

The majority of engineering and technology Foundation degrees are delivered by Further Education colleges (72%); 23% of courses are delivered by universities; and 5% are delivered by other organisations such as private training providers or employers.

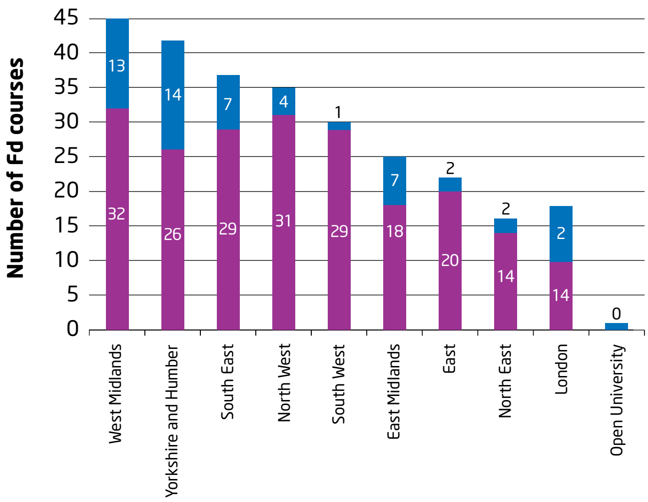
Fig. 19.23: Subject focus of Foundation degrees in engineering and technology (2009/10)



Source: fdf course database

The distribution of programmes is uneven in terms of the number of courses offered within each of the English regions (Figure 19.24). More courses are available in the West Midlands than in any other region, followed by Yorkshire and Humberside. In contrast, only 5% of provision is located in London.

Fig. 19.24: Location of engineering and technology Foundation degrees (2009/10)



Source: fdf course database

Part 3 Engineering in Employment
20.0 Graduate destinations

One of EngineeringUK's objectives is 'to increase the supply of engineers'; this section provides a valuable insight into this aim through the analysis of graduate destinations data.

The HESA Destinations of Leavers from Higher Education Survey (DLHE)[220] is administered[221] approximately six months after graduation. In 2008/09, there was a total of 285,070 valid responses from a possible total of 371,250, giving an overall response rate of 76.8%.

The analysis of the DLHE data for 2008/09 shows the direct effects of the recession on various graduating degree disciplines. In particular, engineering and technology graduates (across different qualification outcomes) have found it more difficult to find jobs which directly relate to the degree they qualified in. It also shows that graduate employment rates for engineering and technology graduates (across different qualification outcomes) are slightly below the average for all students, while the unemployment rate is above average.

Of those first degree graduates who did go into employment, the largest number found jobs in manufacturing (Figure 20.7).

220 Post-doctoral students are excluded from the DLHE survey

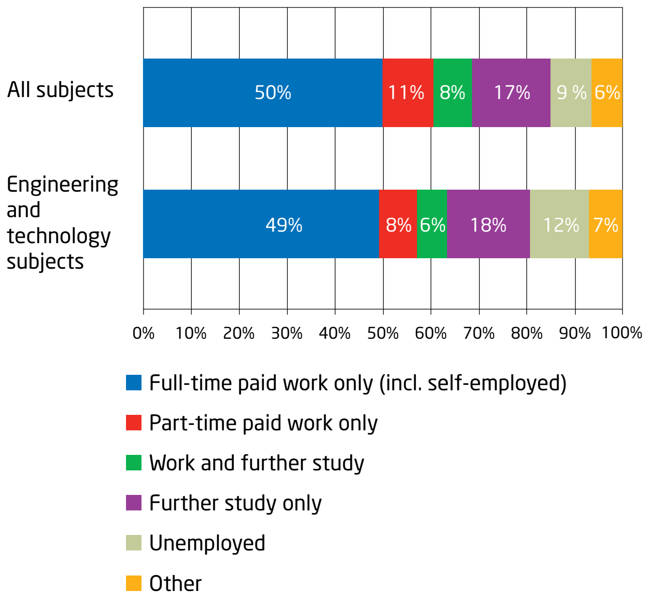
221 Data collection is undertaken by individual HEIs using a questionnaire and procedure set by HESA, with the data collected returned to HESA for analysis. Returned DLHE data is linked to earlier student returns submitted by HEIs.

20.1 Destinations after full-time study

Overall, 50% of all full-time graduates were in full-time employment six months after graduation. The comparable figure for engineering and technology is slightly lower at 49% (Figure 20.0). This is a reversal of last year, when 59% of engineering and technology graduates went into full-time employment, but only 55% of all graduates went into employment. It is possible that this could be an effect of the recession; since subject areas like medicine, dentistry and education traditionally have high employment rates and are not likely to be affected by the recession, they can depress the employment figures for those subject areas which aren't immune to recession, such as engineering.

In another reversal from 2007/08, engineering and technology graduates are now more likely than average to go on to further study six months after graduating. In 2008/09 18% of engineering and technology graduates went on to further study, compared with 17% of all students. Unemployment for engineering and technology students was higher in 2008/09 than it was for all graduates (12% compared with 9%).

Fig. 20.0: Destinations of leavers of HE (all qualifications) in all subjects and engineering and technology, who obtained qualifications by full-time study (2008/09) – UK domiciled

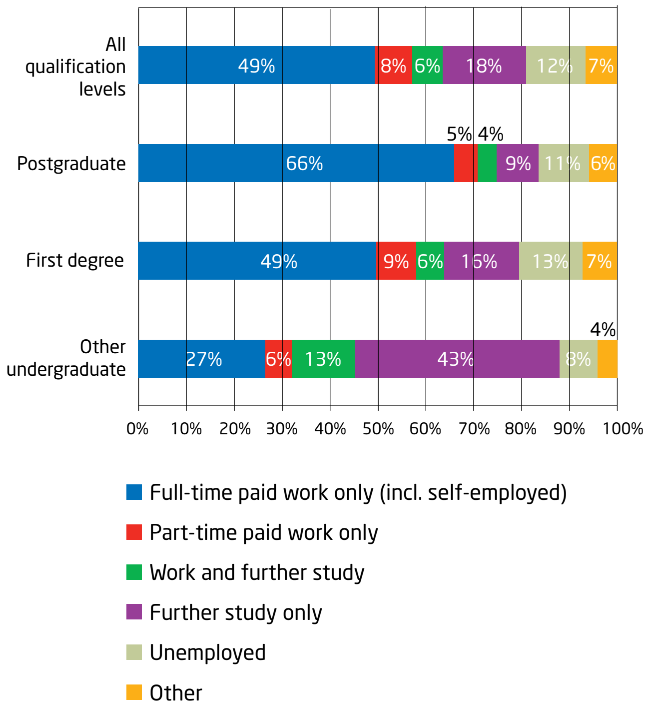


Source: HESA/Destinations of leavers from Higher Education institutions

Figure 20.1 shows the destination of full-time engineering and technology graduates by their qualification obtained. Previously, we had identified that 49% of all engineering and technology graduates had gone into full-time employment. However, this figure was not consistent across the different qualification levels. Amongst those with a postgraduate qualification, two thirds (66%) went into full-time employment, while 49% of first degree graduates did the same. The other undergraduates category had the lowest percentage going into full-time employment, at only 27%. Conversely, this same undergraduate category was much more likely to go into further study only (43%) than either first degree graduates (16%) or, unsurprisingly, postgraduates (9%).

Unemployment was highest among those with a first degree (13%), followed by postgraduates (11%). However, those with other undergraduate qualifications had the lowest unemployment rate (8%).

Fig. 20.1: Destinations of engineering and technology graduates who obtained qualifications through full-time study (2008/09) – UK domiciled



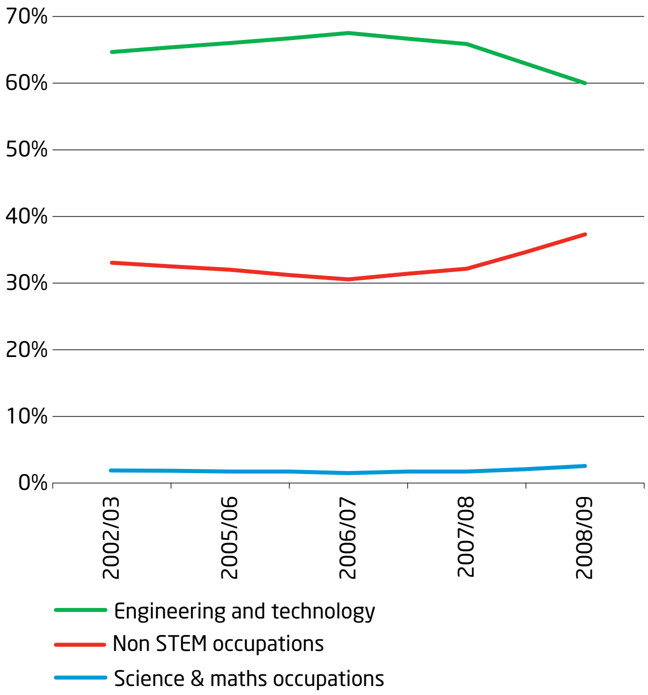
Source: HESA/Destinations of leavers from Higher Education institutions

20.2 Occupation of engineering and technology graduates

The DLHE data provided by HESA provides a breakdown of type of occupation[222] for full-time first degree graduates who have entered employment. Figure 20.2 shows the trends for those entering employment over a five-year period. The chart clearly shows that, as the recession started and engineering-related graduate employment opportunities became harder to find, engineering and technology graduates had to look outside of STEM careers in order to find employment. In this regard, it appears that engineering graduates were successful in finding employment in non-STEM occupations and serves to reinforce the opinion of the generic usefulness of an engineering degree. In 2007/08, 66% of those entering employment got a job in an engineering and technology occupation. The following year this had fallen to 60%. Conversely, those getting a job which was not STEM related rose from 32% in 2007/08 to 37% in 2008/09.

Prior to 2008/09, the percentage of graduates entering engineering and technology occupations, science and maths occupations, and non-STEM occupations was broadly consistent, with only limited year-on-year fluctuations.

Fig. 20.2: Destinations of engineering and technology graduates who obtained first degrees through full-time study (2004/05-2008/09) – UK domiciled

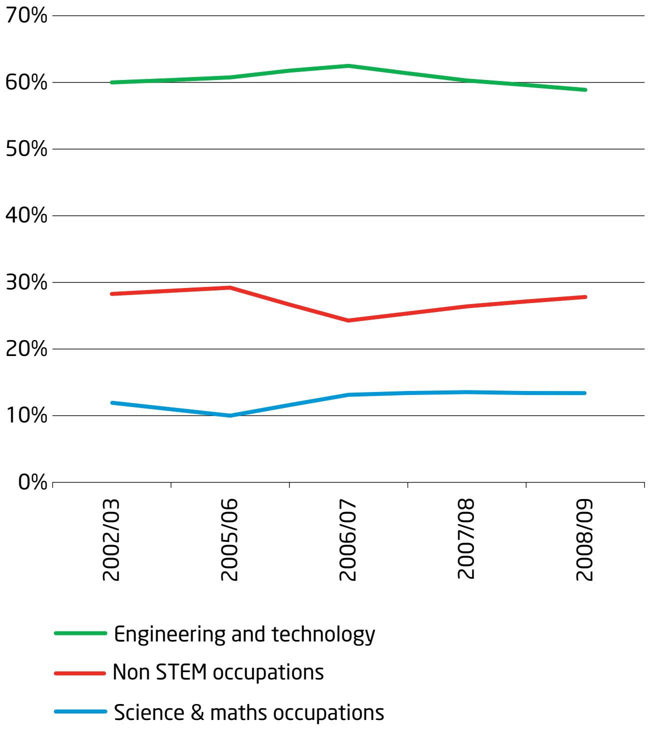


Source: HESA/Destinations of leavers from Higher Education institutions

Figure 20.3 shows the destinations of full-time postgraduates who entered employment. There has been little variation in the percentage of postgraduates entering engineering and technology occupations. There was a slight increase in 2006/07 to 63%, but it fell back to 60% the following year. In 2008/09 it was only slightly lower at 59%. Nearly a third of postgraduates who went into an engineering and technology occupation went to work as engineering professionals.

It is noticeable when comparing Figures 20.2 and 20.3, that the percentage of first degree engineering and technology graduates entering an engineering and technology occupation is higher in each year than the corresponding percentage of postgraduates.

Fig. 20.3: Destinations of engineering and technology graduates who obtained postgraduate degree through full time study (2004/05-2008/09) – UK domiciled



Source: HESA/Destinations of leavers from Higher Education institutions

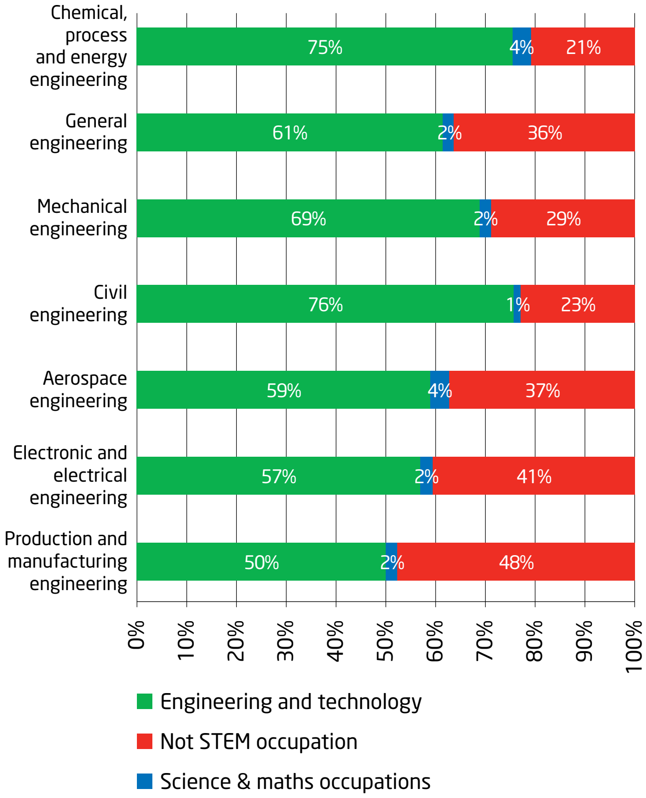
222 By Standard Occupational Classification (SOC) code - see annex 28.3

20.3 Occupations by sub-discipline

The percentage of first degree engineering and technology graduates who enter an engineering and technology occupation does vary significantly by sub-discipline (Figure 20.4). Those who studied a degree in civil engineering were most likely to get a career in engineering and technology (76%), followed by three quarters for chemical, process and energy engineering.

Conversely, only half of those who graduated from production and manufacturing engineering went into a career in engineering and technology, while nearly half (48%) went into a career which was not in a STEM occupation, along with 41% of those who graduated in electronic and electrical engineering.

Fig. 20.4: Occupation type of qualifiers who obtained first degrees in engineering by sub-discipline (2008/09) – UK domiciled



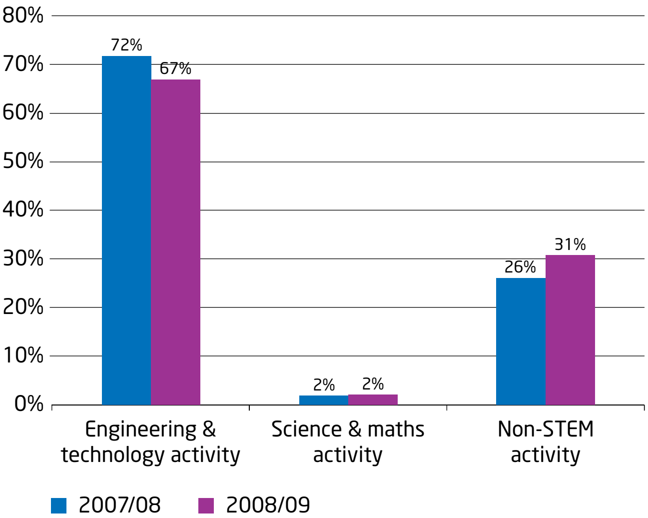
Source: HESA/Destinations of leavers from Higher Education institutions

20.4 Types of industry

It is also possible to explore the destination of graduates by Standard Industrial Classification (SIC) code.[223] The SIC code reflects the primary activity of the employing company. However, it should be noted that an individual employee's role can be quite different from this primary activity. HESA changed the SIC code used for industrial destinations in 2007/08; as a result, it is only possible to look at the trends over two years.

Two thirds (67%) of those who graduated with a first degree in engineering and technology went to work for an employer whose primary activity was engineering and technology-related (Figure 20.5). This is down from the previous year's figure of 72%. Conversely, in 2007/08 a quarter (26%) of those who graduated went to work for an employer whose primary activity was not STEM-related – the following year, this figure increased to 31%.

Fig. 20.5: Employer destinations for engineering and technology subject area leavers who obtained first degree and entered employment, by primary activity of employer (2007/08) – UK domiciled

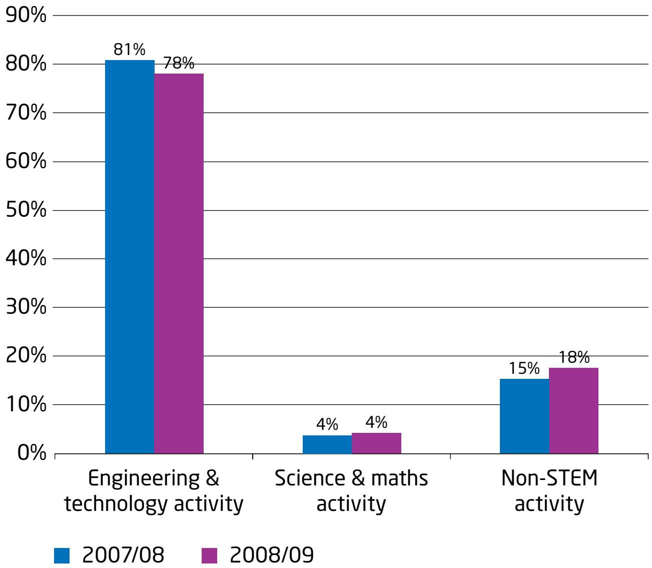


Source: HESA/Destinations of leavers from Higher Education institutions

223 Standard Industrial Classification 2007 Code

Figure 20.6 shows that the recession has also had a negative impact on postgraduates going to work for employers whose primary activity is engineering and technology: numbers have fallen from 81% in 2007/08 to 78% the following year. Similarly, the percentage of postgraduates who went to work for employers whose primary activity was not STEM-related rose from 15% in 2007/08 to 18% one year later.

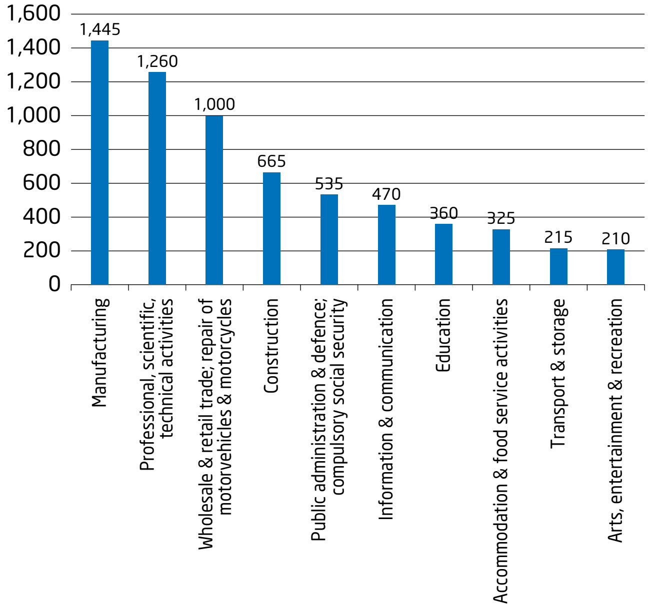
Fig. 20.6: Employer destinations for engineering and technology subject area leavers who obtained postgraduate degree and entered employment, by primary activity of employer (2007/08) – UK domiciled



Source: HESA/Destinations of leavers from Higher Education institutions

Figure 20.7 shows the top ten employer destinations for those graduating with a first degree, by SIC sections. Most graduates (1,445) went to work in manufacturing. Professional, scientific and technical activities companies recruited 1,260 graduates. The third-most prolific employment area was in the wholesale and retail trade and the repair of motor vehicles and motorcycles, where 1,000 graduates found work. It should be noted that 535 graduates went into public administration and defence, and compulsory social security, while 360 got jobs in education.

Fig. 20.7: Top ten employer destinations for engineering and technology leavers who obtained first degree qualifications, by SIC sections (2008/09) – UK domiciled



Source: HESA/Destinations of leavers from Higher Education institutions

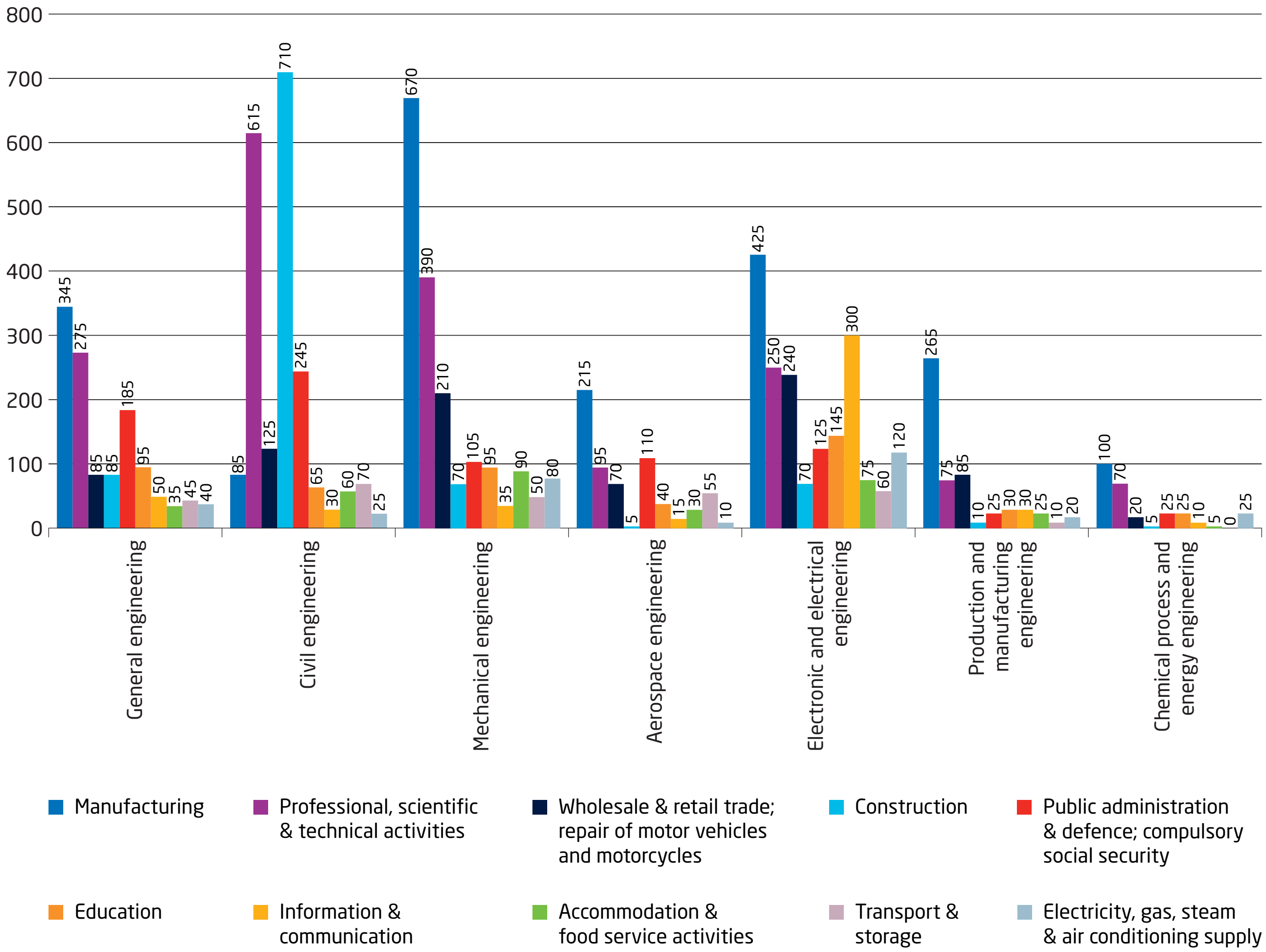
20.5 Industry type by engineering sub-disciple

The industrial sector which engineering and technology graduates go into varies considerably by sub-discipline (Figure 20.8). For instance, 710 civil engineering graduates went to work for companies whose primary activity is construction. However, 615 went to work for companies who were involved in professional, scientific and technical activities, and 245 went into public administration and defence; compulsory social security.

In each of the other selected engineering sub-disciplines, the bulk of employers were primarily involved in manufacturing. Professional, scientific and technical activities companies were the second largest employer of graduates from general engineering, mechanical engineering and chemical, process and energy engineering.

Graduates from the electronic and electrical engineering sub-discipline went to work for a wide range of employers. Although 425 went to work in manufacturing, 300 went into information and communication, 250 went into professional, scientific and technical activities, and 240 were employed by companies in the wholesale and retail trade, and the repair of motor vehicles and motorcycles.

Fig. 20.8: Top ten employer types that engineering and technology graduates (all levels) go into, by SIC sector (2008/09) – UK domiciled



Source: HESA/Destinations of leavers from Higher Education institutions

20.6 Graduate destinations for international students studying in the UK

This section was authored by Michael Peak, Education Market Research and Intelligence Manager, British Council.

The British Council traditionally collects and analyses a wealth of data from our own study of prospective international students, *Student Decision Making study*, which is currently based on responses from well over 100,000 students, alongside various other studies conducted with existing international students in the UK in order to understand and benchmark their experiences.

However, we also wanted to learn more about what international graduates go on to do after their UK education experience. To fill this gap, we developed a research project to determine the employability rates and prospects of UK international graduates when entering the employment market. Specifically, we quantified graduates' prospects by their country and city of origin, the educational institution they attended, the subject they studied and their level of study (or the qualification they obtained).

In March 2009, we held a series of focus groups with recent international graduates and used our findings to build an online survey. From June to October 2009, we piloted this with UK graduates who had remained in contact with the British Council alumni network. The results of this pilot are discussed in this article.

With the cooperation of UK institutions, we plan to run this online survey each year, and generate time-series data which will allow users to track the employability of specific qualifications from their specific institution, benchmarked against a UK average.

20.6.1 Overview of data collected

In total, 3,766 UK graduates completed the survey – a 64% response rate. However, for the purpose of this research we concentrated on the 2,872 who told us they were not currently in education, as we wanted to focus on those who had left education to find work.

Of the respondents, 48% were female and 52% male. They came from 50 different countries, with Malaysia, Thailand, Brazil, Mexico and China being the most represented nations. Most (92%) had recently studied at university, (the others having studied in a UK college, school, or English language school).

The study included 122 UK HE institutions. Graduates who had studied at a university told us the level of study they achieved: 48% obtained an MA or MSc, 10% an MBA, 12% a PhD, 13% undergraduate qualifications, and 3% professional qualifications (including PGCE and ACCA).

We surveyed respondents who had graduated over a long time range: over 30% graduated prior to 2000, although more than half had graduated since 2003.

A separate British Council study (the S*tudent Decision Making* survey) tells us that, increasingly, students considering international education are motivated by the drive to obtain better career prospects.

We found in our study of UK graduates that 46% had studied a course which lasted less than 12 months, highlighting the popularity of one-year masters programmes in the UK. These are much shorter and more intense than masters programmes in other countries, allowing graduates to enter (or re-enter) the world of work much sooner.

20.6.2 Overview of engineering graduates

The study captured data from graduates from various courses: 396 of which were, engineering and technology graduates. Of these, the majority were male (77%), with 98% having studied at a Higher Education institution.

These respondents came from 24 countries, with the majority coming from Malaysia (102), followed by Thailand (55), Mexico (48), Brazil (27) and South Korea (26).

Eighty-nine (22%) of these engineering graduates studied in the UK for a PhD, 180 (45%) for an MSc and 86 for an undergraduate qualification.

The majority of the respondents undertook full-time study in the UK, but 3% studied via distance learning or at a UK campus outside of the UK. This goes some way to reflecting the large number of UK qualifications provided via trans-national education (TNE).[224] For comparison, figures from HESA analysed by the British Council show that over 380,000 students were studying for a UK qualification outside of the UK in 2008-09 and that, in over 60 countries, more students study for a UK qualification in their home country than travel to the UK for their study experience.

After completing their UK qualification, 92% found employment or returned to their previous employment (if they had come to the UK as part of a sabbatical or sponsored leave); 5% said that they were unemployed after completing their UK qualification; and the remaining few took a gap year, or spent time with their family.

Respondents were also asked where they went after completing their qualification: 84% went back to their country of origin, 10% stayed in the UK, and 6% went on to another country – 10 countries were listed in total, with Singapore, UAE and USA proving the most popular.

About 12% told us that, while it took them over six months to find a job after graduating, most found a job within the first year. More than 20% found employment whilst still studying and more than 60% found a job in the first six months.

224 Trans-national education is the provision of education from one country offered in another. Trans-national education includes a wide variety of delivery modes, including distance and e-learning; validation and franchising arrangements; twinning and other collaborative provision.

We went on to ask the graduates about the type of job that they obtained, their initial role after graduating and the type of organisation that they initially worked for. A total of 330 engineering graduates were asked and responded to these questions. The vast majority took up full-time, permanent roles (91%), with the remainder mainly taking up full-time temporary positions (8%).

When we asked about the industry sector that the graduates started work in, perhaps not surprisingly, the majority (34%) responded that they worked in the engineering and manufacturing sector (along with a number of physical science and computer science graduates). Other engineering graduates started work in teaching and education (15%), IT and information systems (9%) and energy and utilities (8%).

Around two thirds started work with a large organisation (over 500 employees) and 60% said they worked for a private or commercial company (compared with 29% who worked in the public sector, and a sprinkling who were self-employed or worked for NGOs).

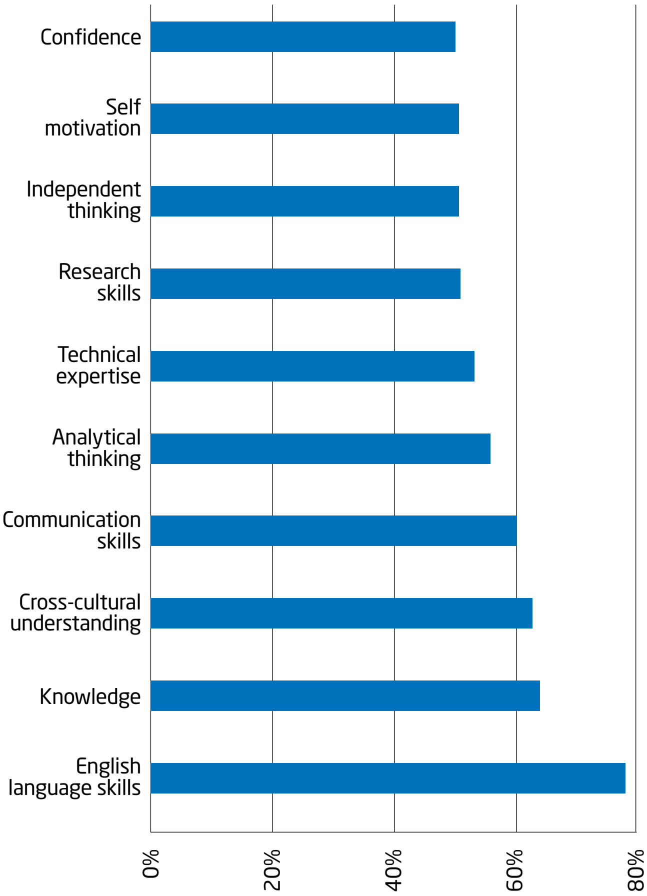
Perhaps as a consequence of the international experience that these graduates gained from studying in the UK, a significant number (40%) started work with an international company. 28% worked for national organisations, 12% for regional companies and 20% for local companies (based in one town/city).

31% of the graduates took up technical or professional roles in their first job, 23% went into research and development, 20% went into junior management and 10% into middle management.

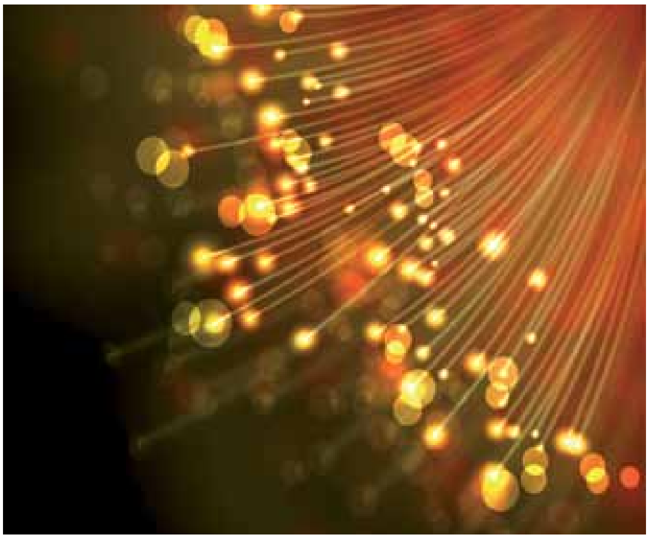
We presented respondents with a list of 21 skills and asked them to identify all of those that they perceived themselves to have developed during their UK education experience. All 396 engineering graduates responded to this question 78% identified that they had improved their English language skils.

Other skills developed include knowledge, cross-cultural understanding, communication skills, analytical thinking, technical expertise, research skills, independent thinking, self-motivation and confidence (Figure 20.9).

Fig. 20.9: Skills developed by international engineering graduates with a UK education



396 engineering graduates were asked the following question: Which of the following skills did you enhance or further develop as part of your study and life in the UK? – Respondents presented with a list of 21 different skills.



Compared with many other subject areas (in particular subjects including creative arts, English language, and media studies) the engineering graduates appear to consider that they have developed their research skills, technical expertise, analytical thinking and independent thinking in particular.

The British Council's *Student Decision Making* study tells us that career prospects are a major driver behind decisions to study overseas, also that word of mouth from current and past students is a major source of high quality, reliable information. With this in mind, we asked the graduates about any further support mechanisms from their UK universities that would benefit them after graduation. The service most frequently mentioned (by 47% of respondents) was for internships and other schemes aimed at international graduates.

The British Council has collected a wealth of valuable information and, with support from UK institutions and their alumni offices, will be able to continue this research, which should prove very valuable to UK education providers.

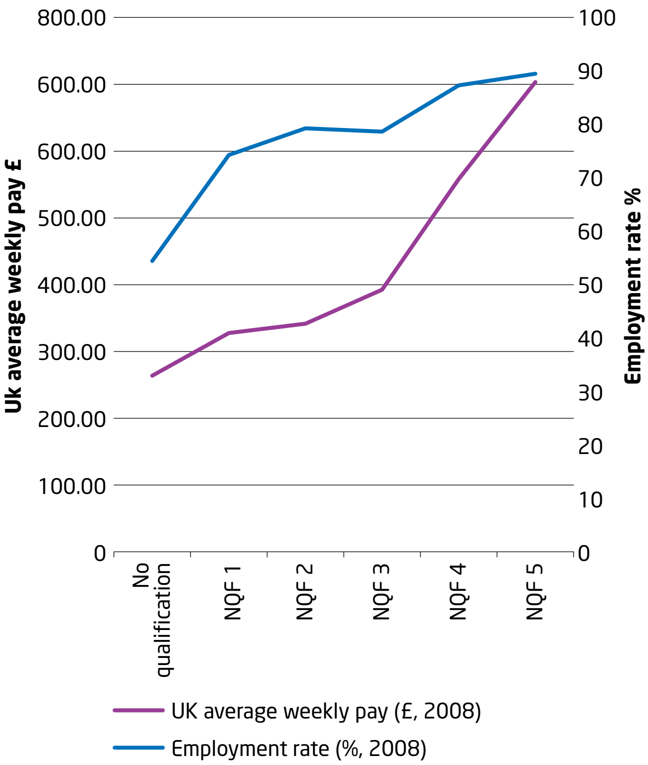
Part 3 Engineering in Employment
21.0 Skills shortage vacancies

The 2009 National Employer Skills Survey (NESS) was conducted by interviewing over 79,000 employers[225 226] between March and July 2009.[227] It represents the largest and most comprehensive source of data on skills, or lack thereof, in England.

21.1 The importance of skills

UKCES identified in its report *World Class Skills and Jobs for the UK* that there are currently 4.6 million people in the UK with no qualifications: one in eight adults of working age. The UKCES also showed in its 2009 Almanac (Figure 21.0) that the average weekly salary for an employee depended on how highly qualified they were, with unskilled workers earning just under £300 per week and those at level 5 earning just over £700 per week. The analysis also showed that just over 50% of those with no qualifications were employed but that almost 90% of those qualified to level 5 were employed.

Fig. 21.0: Average weekly pay and employment rate by qualification level



Source: LFS (2008) in UK Employment and skills almanac 2009 (UK Commission for Employment and Skills, 2009)

225 Employers were defined as establishments, at unit level, with at least two employees, meaning that theoretically multiple sites for the sample employer could be interviewed.

226 The survey interviews a representative sample of UK employers

227 *National Employer Skills Survey for England 2009: Key findings report*, UKCES, March 2010

The report also identified that, if all other factors stay consistent, a 1% rise in productivity would increases GDP by around £11 billion. Similarly, a 1% increase in the employment rate will add £8-11 billion to GDP. Qualifications do not capture all aspects of skills development, nor can skills only be obtained via qualifications. Qualifications are, however, a very important source of skills acquisition and provide a platform for further skills progression. *The Leitch Review* estimated that the improvement in qualifications over the last ten years raised GDP by between £30 billion and £50 billion over the period; this was achieved through greater productivity per worker and the provision of approximately 200,000 extra jobs.

Table 21.0 shows the percentage of the workforce in England who are qualified to different national qualification framework (NQF) levels. The table shows that three quarters (75.6%) of the workforce in England are qualified to at least level 2 and a third (35.3%) are qualified to at least level 4.

Table 21.0: Percentage of workforce by level of qualification (quarter 4 2009) – England

Level of qualification	Percentage
Qualified to at least level 2	75.6%
Qualified to at least level 3	55.9%
Qualified to at least level 4	35.3%

Source: The Data Service Statistical First Release June 2010

21.2 SET-based technician skills

The Engineering UK 2009/10 report highlighted the clear requirement for SET technicians and their contribution to the UK economy. This remains a key requirement if we are to meet the challenge of achieving a low carbon economy.

Tables 21.1 and 21.2 show the qualification level of SET technicians working in jobs which were identified as level 3 or level 4. The two tables show that for each identified SET technician career at levels 3 or 4, at least 10% are qualified to below level 2 or have no formal qualifications – even though the job requires level 3 or level 4 skills. In some instances, this could represent staff who have received on-the-job training but not undergone formal assessment of their skills. However, it could also represent a lack of skilled workers with level 3 and level 4 skills, which could present opportunities for their employers to improve the performance of their employees and their business by up-skilling staff.

Table 21.1: Level 3 SET-based technicians levels of qualification

	NQF first degree & above plus teaching qualifications	Other NQF Levels 4 and 5	NQF Levels 2 and 3	Other lower or no qualifications
Pharmaceutical dispensers	8.4	6.8	68.2	16.6
Electrical/electronics technicians	13.8	17.3	55.1	13.8
Engineering technicians	14.5	18.1	55.8	11.6
Precision instrument makers and repairers	5.7	17.9	57.2	19.3
Telecommunications engineers	6.2	12.9	55.8	25.1
Lines repairers and cable jointers	0.4	2.8	67.9	28.8
Sheet metal workers	1.1	3.4	66.2	29.3
Welding trades	0.9	3.1	64.8	31.3
Pipe fitters	3.3	7.0	68.3	21.4
Metal machine setter and setter operator	0.5	5.4	63.0	31.1
Tool-makers, tool-fitters and markers-out	0.6	7.5	78.8	13.0
Electricians and electrical fitters	3.1	8.1	78.2	10.6
Electrical and electronic engineer n.e.c.	8.2	15.8	56.2	19.9
Plumbing, heating and ventilating engineers	2.2	4.5	77.0	16.4

Source: IES analysis of the 2007 to 2009 Labour Force Survey

Table 21.2: Level 4 SET-based technicians levels of qualification

	NQF first degree & above plus teaching qualifications	Other NQF Levels 4 and 5	NQF Levels 2 and 3	Other lower or no qualifications
Laboratory technicians	33.3	15.7	37.2	13.8
Building and civil engineering technicians	24.1	28.5	37.1	10.3
Quaility assurance technicians	25.4	16.2	38.6	19.8
Science and engineering technicians n.e.c	24.7	14.3	41.6	19.4
IT operations technicians	35.9	13.5	34.2	16.5
IT user support technicians	29.3	13.8	41.9	15.1
Medical and dental technicians	29.6	16.9	42.7	10.7
Computer engineers, installation and maintenance	21.1	13.6	44.9	20.3

Source: IES analysis of the 2007 to 2009 Labour Force Survey

21.3 National Employer Skills Survey

To get a picture of how engineering fits into the national picture on skills shortages, we have applied the EngineeringUK footprint, as defined by Standard Industrial Classification 2003 (SIC)[228] to the National Employer Skills Survey (NESS) 2009. This allows us to compare engineering establishments to the average of all establishments in England.

Examination of the number of establishments which either have a vacancy, have at least one hard-to-fill vacancy, or have at least one skills shortage vacancy[229] indicates that the engineering sector is performing well in comparison to all establishments in England. The occurrence of vacancies in engineering establishments is only 8%, compared with 12% for all establishments. Skills shortage vacancies are also slightly lower at 2%, compared with 3% for all establishments (Table 21.3).

Table 21.3: Number of establishments with at least one vacancy, hard-to-fill vacancy and skills shortage vacancy (2009) – England

	All establishments	All engineering establishments
Have at least one vacancy	12%	8%
Have at least one vacancy that is hard to fill	3%	3%
Have a skills shortage vacancy	3%	2%

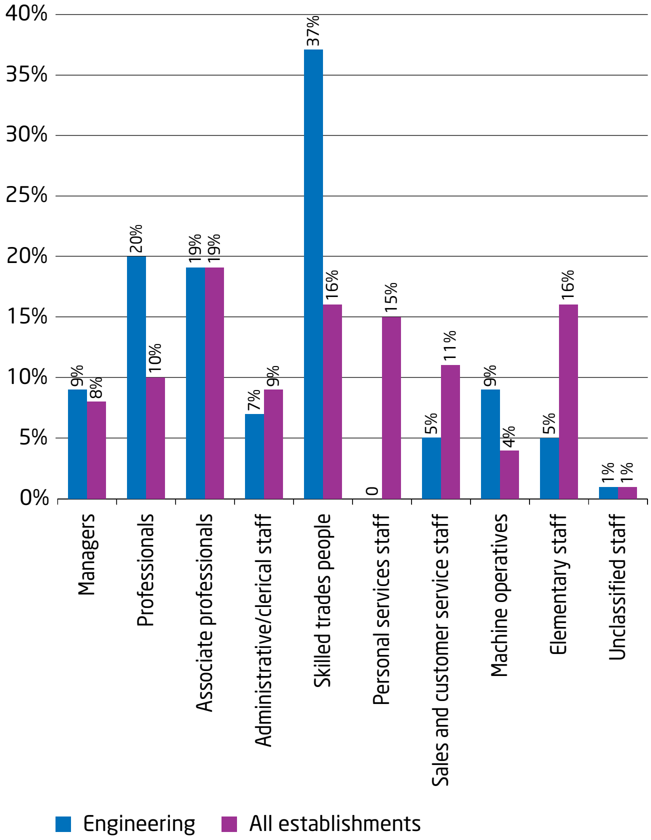
Source: NESS 2009

Examining hard-to-fill vacancies and skills shortage vacancies by occupation (Figures 21.1 and 21.2) shows that there is a disproportionately large percentage of vacancies (compared with all establishments) for professionals and skilled trades people. In each case, the proportion of vacancies is double the average for all establishments.

Skilled trades people come from the ranks of level 3 and level 4 SET technicians and it is these people who should be meeting these hard-to-fill or skills shortages gaps. This issue is further compounded by our earlier analysis of Tables 21.1 and 21.2, which identified that at least 10% of level 3 and level 4 SET technicians in the selected careers have a qualification level below level 2, ie they do not hold the appropriate qualification for their roles.

It is also worrying (though perhaps not surprising due to the nature of engineering roles) that shortages of professionals were also double the overall average.

Fig. 21.1: Incidence of hard-to-fill vacancies by occupation and all employers with a hard-to-fill vacancy (2009) – England

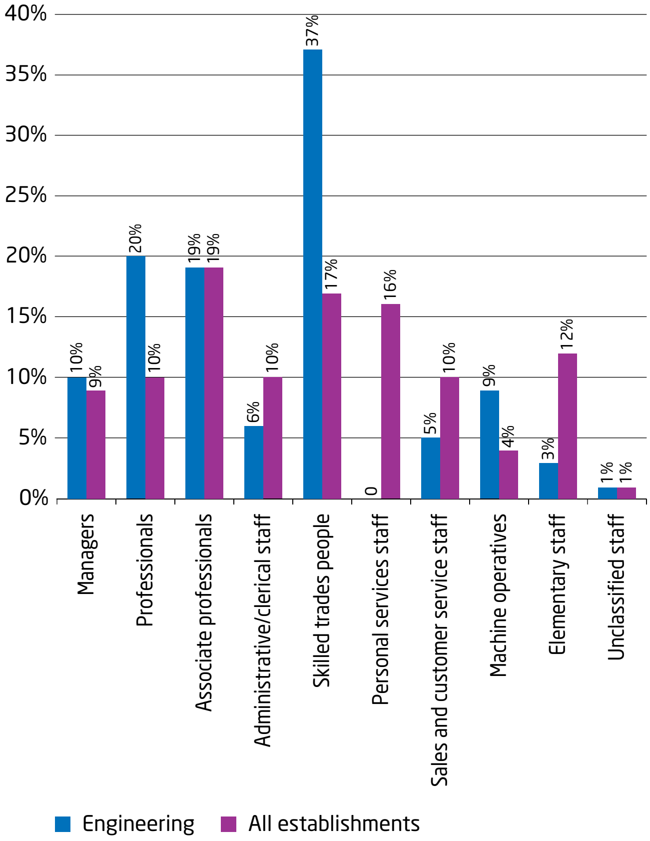


Source: NESS 2009 (employer base)

228 See appendix 28.3 for more details

229 Hard-to-fill vacancies are reported as such by respondents. Skills Shortage vacancies are a subset of hard-to-fill vacancies where the reason given for the difficulty filling the position is a low number of applicants with the required skills, work experience or qualifications.

Fig. 21.2: Incidence of skills shortage vacancies by occupation and all employers with a skills shortage vacancy (2009) – England



Source: NESS 2009 (employer base)

21.4 Hard-to-fill vacancies

Using the NESS 2009 data, it is possible to explore the main causes of hard-to-fill vacancies by occupation. Overall, 61% of hard-to-fill vacancies earned that label because of a low number of appropriately skilled applicants (Table 21.4). This was the reason given by 64% of respondents for vacancies in both the professional and associate professional occupation groups, an above average figure in both cases.

Over a third (36%) of hard-to-fill vacancies were caused by a lack of necessary work experience. Among managers and senior officials this rose to 59%. Vacancies at manager and senior official level were also more likely than average to be attributable to a lack of qualifications demanded by the hiring company (29% against an average of 19%), and a low number of applicants with the required attitude, motivation or personality (20% against 14%).

Unclassified occupations were the most likely to have hard-to-fill vacancies as a result of the post's poor terms and conditions (for instance, pay). However, caution should be exercised with this result due to the low base.

In Table 21.5, we find that the skills most difficult to find were technical, practical or job specific (73%). This skills shortage was the most important for the majority of occupations, including sales and customer service staff (80%), skilled trades people (77%), managers and senior officials (72%), professionals (71%), associate professionals (71%) and machine operatives (69%).

Management skills were seen as an important skills shortage amongst managers and senior officials (61%), when compared with the overall average of 34%. It was also an important skill shortage amongst those in associate professional occupations (40%).

Among machine operatives, nearly half (49%) of employers who reported a skills shortage said that a lack of team working skills was a problem. This compares unfavourably to the overall average of 29%.

Table 21.4: Main causes of hard-to-fill vacancies by all with a hard-to-fill vacancy and occupation (2009) – England[230]

	Total	Managers and senior officials	Pro-fessionals	Associate pro-fessionals	Administra-tive staff	Skilled trades people	Sales and customer service staff	Machine operatives	Elementary staff	Unclassified staff[231]
Weighted base	8,331	717	1,656	1,598	563	3,055	444	759	392	99
Low number of applicants with the required skills	61%	60%	64%	64%	55%	61%	53%	60%	19%	9%
Lack of work experience the company demands	36%	59%	28%	35%	32%	35%	33%	29%	33%	29%
Lack of qualifications the company demands	19%	29%	18%	13%	23%	23%	8%	16%	5%	0%
Low number of applicants with the required attitude, motivation or personality	14%	20%	4%	12%	13%	16%	13%	17%	2%	10%
Not enough people interested in doing this type of job	13%	3%	13%	5%	18%	14%	16%	9%	30%	8%
Low number of applicants generally	11%	7%	6%	12%	17%	13%	11%	2%	6%	0%
Poor terms and conditions (eg pay) offered by post	8%	4%	7%	11%	20%	4%	12%	1%	9%	53%
Other	5%	8%	1%	6%	11%	5%	2%	0%	19%	0%

Source: NESS 2009 (employer base)

230 All answers below 5% have been excluded from this table

231 Caution should be exercised when looking at unclassified staff due to the small base size

Table 21.5: Skills found difficult to obtain from applicants by all with a skills shortage vacancy and occupation (2009) – England[232]

	Total	Managers and senior officials	Pro-fessionals	Associate pro-fessionals	Administra-tive staff	Skilled trades people	Sales and customer service staff	Machine operatives	Elementary staff	Unclassified staff[233]
Weighted base	6,902	702	1,394	1,333	385	2,545	318	604	183	37
Technical, practical or job-specific skills	73%	72%	71%	71%	42%	77%	80%	69%	67%	100%
Customer handling skills	36%	31%	21%	37%	54%	35%	67%	44%	50%	20%
Problem solving skills	35%	38%	24%	34%	42%	37%	28%	38%	56%	0%
Management skills	34%	61%	21%	40%	41%	33%	39%	17%	22%	20%
Written communication skills	33%	23%	24%	38%	49%	32%	13%	35%	58%	0%
Team working skills	29%	28%	13%	20%	43%	33%	43%	49%	46%	0%
Oral communication skills	29%	23%	20%	35%	31%	26%	40%	40%	58%	0%
Literacy skills	28%	28%	17%	23%	50%	29%	23%	36%	53%	0%
Numeracy skills	25%	17%	17%	20%	37%	28%	21%	28%	44%	23%
IT professional skills	19%	11%	16%	19%	28%	21%	42%	5%	9%	0%
General IT user skills	18%	20%	6%	13%	31%	20%	36%	20%	9%	0%
Office admin skills	17%	5%	11%	15%	33%	19%	25%	12%	9%	0%
Foreign language skills	13%	6%	9%	13%	6%	16%	17%	4%	13%	57%
No particular skills difficulties	5%	2%	11%	1%	5%	3%	0%	15%	17%	0%
Don't know	5%	6%	7%	8%	2%	5%	3%	1%	0%	0%

Source: NESS 2009 (employer base)

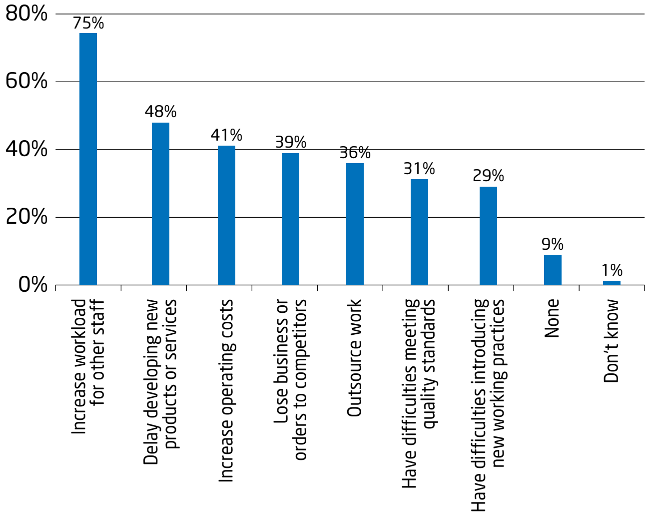
232 All answers below 5% have been excluded from this table

233 Caution should be exercised when looking at unclassified staff due to the small base size

Three quarters of employers who had hard-to-fill vacancies said that they increased the workload on other staff (Figure 21.3). More worryingly, nearly half (48%) said it delayed them developing new products or services, while 41% said it increased operating costs. 39% of employers with hard-to-fill vacancies also reported that they had lost orders as a result.

These results show that hard-to-fill vacancies have a real and significant impact on the profitability and success of engineering businesses in England.

Fig. 21.3: Implication of hard-to-fill vacancies by employers with a hard-to-fill vacancy (2009) – England

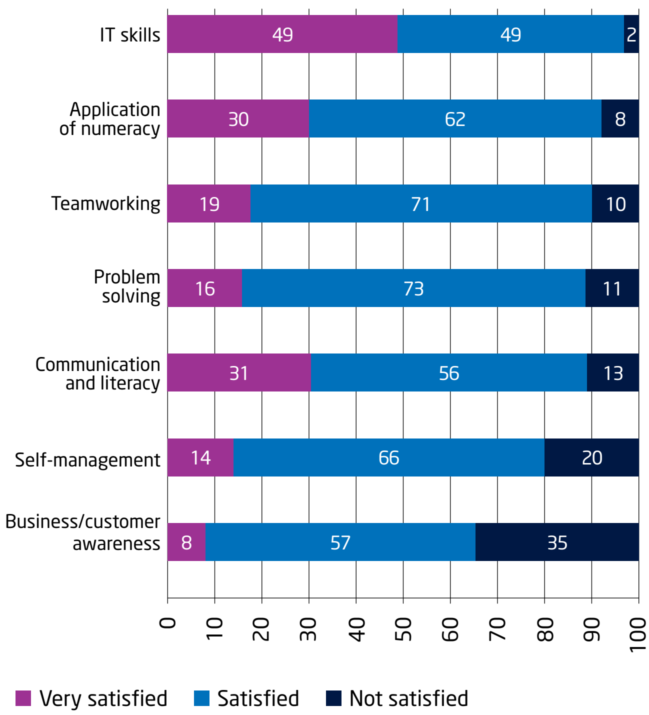


Source: NESS 2009 (employer base)

21.5 Employability Skills

In its research report *Future Fit: Preparing graduates for the world of work,*[234] Universities UK and the CBI identified the extent to which employers believe that graduates are equipped with employability skills (Figure 21.4). The largest perceived area of weakness was business and customer service awareness, with 35% of respondents not being satisfied with graduate skills in this area. Self management skills were also perceived to be a weakness amongst a fifth of respondents.

Fig.21.4: The level to which graduates are equipped with employability skills



Source: Universities UK and the CBI

234 http://www.cbi.org.uk/pdf/20090326-CBI-FutureFit-Preparing-graduates-for-the-world-of-work.pdf

Part 3 Engineering in Employment
22.0 Graduate recruitment and salaries

22.1 Graduate recruitment – uncertain predictions

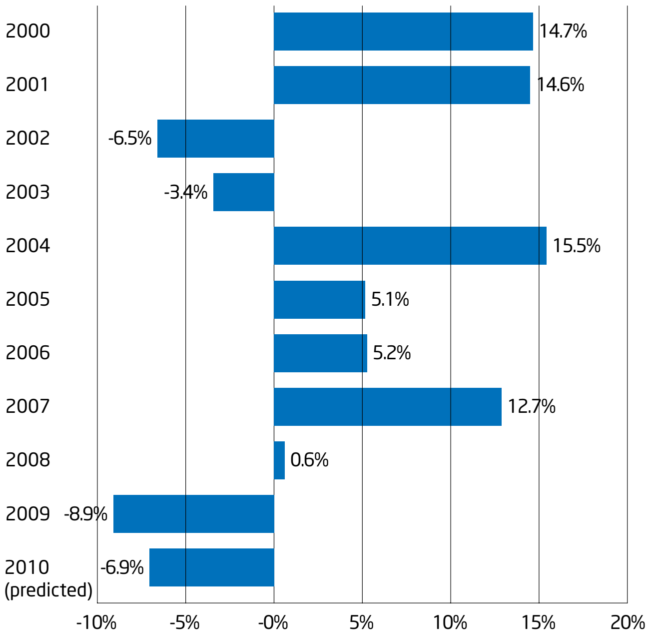
The Association of Graduate Recruiters (AGR) conducts a review of employees of its member organisations twice a year to ascertain the 'health' of the graduate recruitment market. The 2010 summer review shows that the recession in 2008 and 2009 has had a major effect on graduate recruitment. Figure 22.0 shows the year-on-year percentage change in the number of graduate vacancies at AGR members. This shows that in 2009, the number of graduate vacancies fell 8.9% and it is predicted to fall another 6.9% in 2010.

In June 2010, High Fliers undertook an end-of-year update to its Graduate Market in 2010 report with employers in the Times Top 100 Graduate Employers list. This update gave a much more positive picture and showed that surveyed employers have recruited 17.9% more graduates in 2010 than were recruited in 2009 and that the pace of graduate recruitment is higher than expected. When asked in January 2010 how many graduates they would recruit, companies expected vacancies to increase by an average of 11.8%.

Table 22.0 shows the expected percentage changes in graduate vacancies in 2010 compared with 2009, according to AGR. This table shows that graduate vacancies in engineering or industrial companies were expected to fall by 21.4%, while vacancies in IT/telecommunication companies were predicted to fall by 31.4%. More encouragingly, vacancies in construction companies or consultancy are showing a projected rise of 44.7%. The highest level of potential growth in the number of graduate vacancies is in banking or financial services, which is projected to rise by 72.0%.

The High Fliers research, however, shows a slightly different picture, with vacancies in engineering and industrial up 9.5% and vacancies in IT and telecommunications up by a huge 78.5%.

Fig. 22.0: Percentage year-on-year change in the number of graduate vacancies at AGR employers (2000-2010)



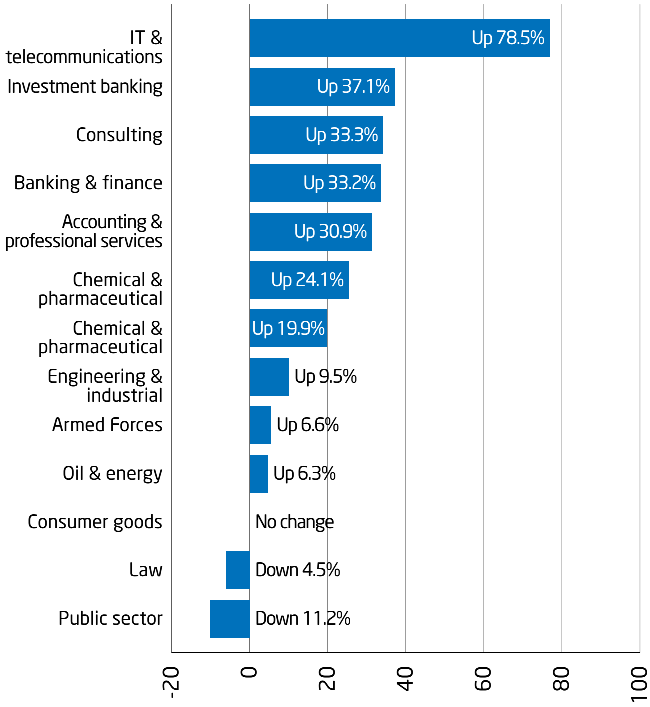
Source: AGR Summer Survey 2010

Table 22.0: Expected percentage change in vacancies from 2009 to 2010 by sector[235]

Banking or financial services	+72.0%
Insurance company	+53.3%
Consulting or business services firm	+52.3%
Construction company or consultancy	+44.7%
Accountancy or professional services firm	+17.1%
Investment bank or fund managers	-9.3%
Public sector	-9.7%
Law firm	-11.8%
Engineering or industrial company	-21.4%
Retail	-31.4%
IT / telecommunications company	-31.4%
FMCG company	-45.4%

Source: AGR Summer Survey 2010

Fig. 22.1: How graduate vacancies have changed by sector or industry (2009-2010)



Percentage change in graduate vacancies between 2009 and 2010

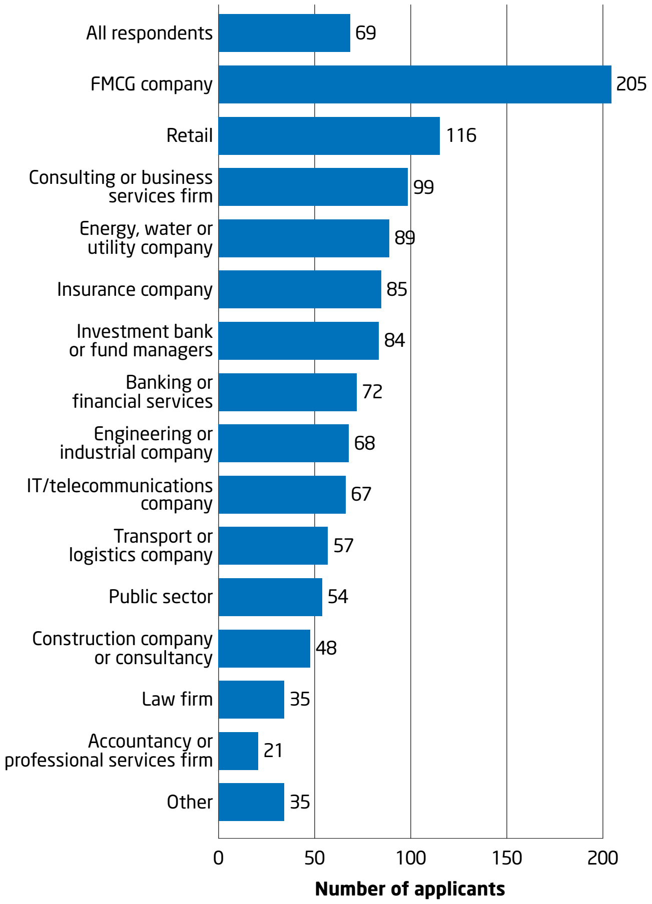
Source: High Fliers the Graduate Market in 2010-07-29

235 The sector classifications are reflective of AGR membership

22.1.1 Number of applications per place

The AGR Summer Survey shows that, on average, there were 69 applicants for each vacancy in 2010. Applications for vacancies in engineering or industrial companies and IT/telecommunications companies were close to the overall average of 68 and 67 applications respectively. However, vacancies in construction companies or the consultancy sector had far fewer applications, with only 48 per job.

Fig. 22.2: Number of applications per vacancy received by AGR employers by sector (2010)



Source: AGR Summer Survey 2010

22.2 Graduate starting salaries

AGR members have estimated the starting salary of graduates recruited in 2010: Figure 22.3 shows the estimated year-on-year percentage growth in starting salaries. For the first time in the history of the AGR Graduate Recruitment Survey, the salary levels for new graduates are predicted to stay the same for two consecutive years, with an overall median salary of £25,000.

When looking at median starting salaries by sector (Table 22.1) it can be noted that those working in IT/telecommunications companies are predicted to earn an above average median salary of £25,500, while those employed by construction companies or consultancies will earn a median salary of £23,500, and those working for engineering or industrial companies will receive a median salary of £23,250.

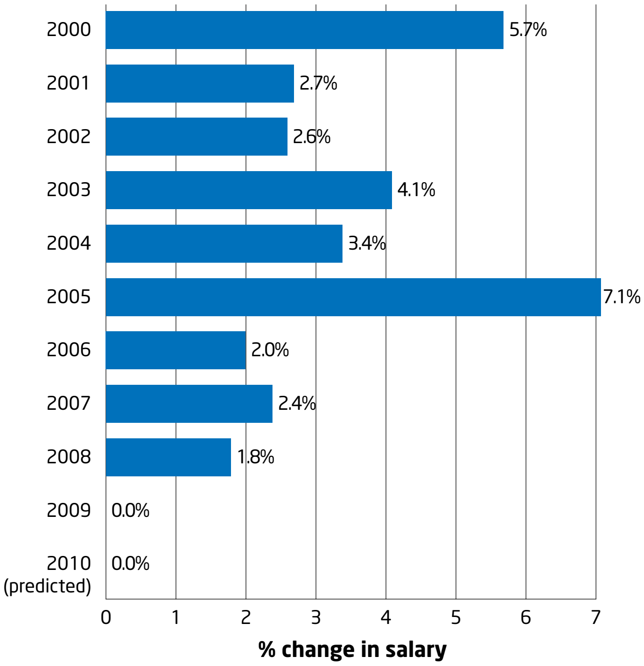
Table 22.3 shows median graduate starting salaries by career area. This analysis shows that there are two career areas which earn very high starting salaries: these are investment banking (£38,250) and legal work (£35,000). Those in manufacturing engineering (£25,000), electrical/electronic engineering (£24,500), mechanical engineering (£24,500) and civil engineering (£23,500) also earn good salaries.

The CBI's 2010 report *Ready to Grow: business priorities for education and skills* also reports on median graduate starting salaries for those companies which completed their survey. According to the CBI survey, those in engineering have the joint second highest median starting salary, along with legal, at £22,000. The highest median graduate starting salary in the CBI survey was £23,000 for those entering managerial careers.

Furthermore, research by the Royal Society of Chemistry[236] suggests that as a graduate you could earn around £160,000 more during your working life compared to someone who went into work after A levels (graduate lifetime earnings premium); however, engineering graduates can expect to earn significantly more - £243,730.

236 The Economic Benefit of Higher Education Qualifications produced for The Royal Society of Chemistry and the Institute of Physics by PricewaterhouseCoopers LLP, January 2005)

Fig. 22.3: Percentage change in graduate starting salaries (2000-2010)



Source: AGR Summer Survey 2010

Table 22.1: Median graduate starting salaries at AGR employers by sector in 2010

Law firm	£36,500
Investment bank or fund managers	£35,000
Banking or financial services	£28,500
Consulting or business services firm	£26,750
FMCG company	£26,500
IT / telecommunications company	£25,500
Insurance company	£25,500
Chemical or pharmaceutical company	£25,250
Accountancy or professional services firm	£25,000
Energy, water or utility company	£24,750
Public sector	£24,250
Retail	£23,500
Construction company or consultancy	£23,500
Transport or logistics company	£23,500
Engineering or industrial company	£23,250
Other	£21,500

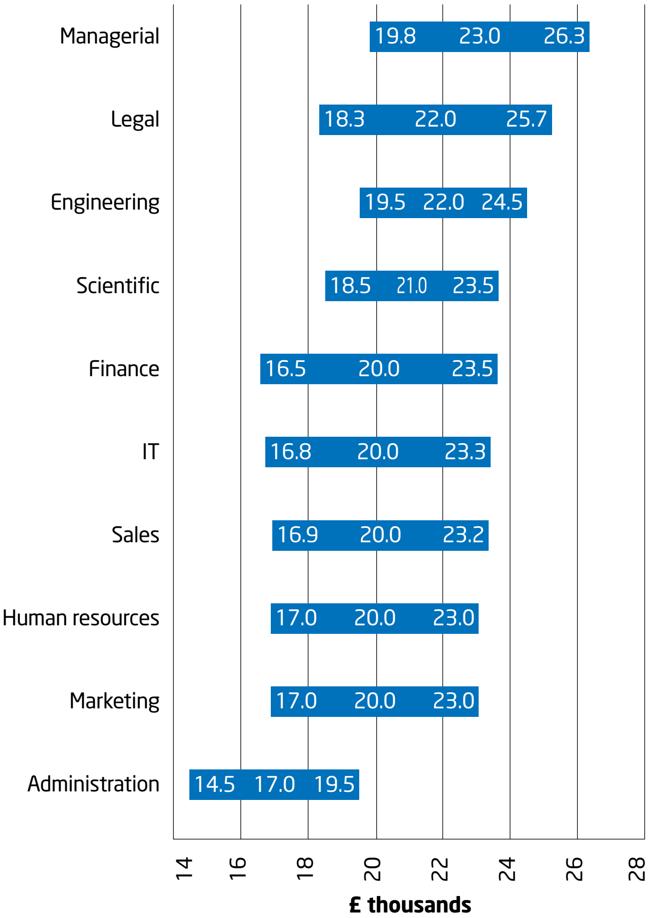
Source: AGR Summer Survey 2010

Table 22.2: Median graduate starting salaries at AGR employers by career area in 2010

Investment banking	£38,250
Legal work	£35,000
Consulting	£27,500
Actuarial work	£27,500
Accountancy	£25,000
IT	£25,000
Financial management	£25,000
Sales / customer management / business development	£25,000
Marketing	£25,000
Manufacturing engineering	£25,000
Human resources	£25,000
Logistics	£25,000
Research and development	£25,000
Electrical / electronic engineering	£24,500
Mechanical engineering	£24,500
Purchasing	£24,500
Science	£24,500
General management	£24,000
Retail management	£24,000
Civil engineering	£23,500
Other	£24,500

Source: AGR Summer Survey 2010

Fig. 22.4: Median starting salaries by job type with inter-quartile range (£000)



Source: CBI[237]

237 http://www.cbi.org.uk/pdf/20100501-cbi-education-and-skills-survey-2010.pdf

Part 3 Engineering in Employment
23.0 Earnings in STEM careers

23.1 Annual Survey of Hours and Earnings (ASHE)[238]

> The annual survey of hours and earnings (ASHE) provides information about the level, distribution and make-up of earnings paid to employees within industries, occupations and regions. This section presents mean UK salary figures for selected STEM professional careers (Figure 23.0) and also selected STEM technician/craft level careers (Figure 23.1).

This section presents mean[239] UK salary figures for selected STEM professional careers (Figure 23.0) and also selected STEM technician/craft level careers (Figure 23.1).

Among the selected STEM professional careers, not surprisingly, health professionals had the highest mean annual gross salary, at £71,422 in 2009. These were then closely followed by managers in the mining and energy sector who had a mean salary of £67,153. Research and development managers had the third highest mean salary, at £54,454. However, this is substantially below that earned by those working in the top two careers.

Electronic engineers earned an annual mean salary of £47,853 while electrical engineers had a comparable salary of £43,598. The highest paid ICT professionals were IT planning and strategy managers, who earned a mean salary of £53,575 in 2009.

Among the selected STEM professionals, the lowest paid category was production and process engineers (although in 2009 they still earned an annual mean salary of £35,122).

The mean salary for selected STEM technicians ranged from £18,675 to £35,915, with the highest paid career being energy plant operatives.

Other STEM technician careers which were paid well were IT operations technicians (£33,804) and pipe fitters (£33,128). The highest paid technicians in the health sector were health associate professionals who in 2009 had a mean salary of £29,604. At the other end of the scale, two careers were identified as having a mean salary below £20,000 per year. These were assemblers of electrical products (£18,675) and assemblers and routine operatives n.e.c[240] (£19,397).

Through combining[241] and analysing the most relevant technician occupational groups from the ASHE data (associate professional and technical occupations, skilled trades occupations and process, plant and machine operatives), it has been possible to calculate an approximate mean salary for engineering technicians and craftsmen of £26,291. This compares favourably to the approximate mean salary for all non-engineering occupations, which was found to be £22,320.

Whilst the ONS doesn't publish UK mean salary statistics for all workers, it is worth noting that the UK median average salary for someone in work in 2009 was £25,800.[242]

238 ASHE was developed to replace the New Earnings Survey (NES) in 2004

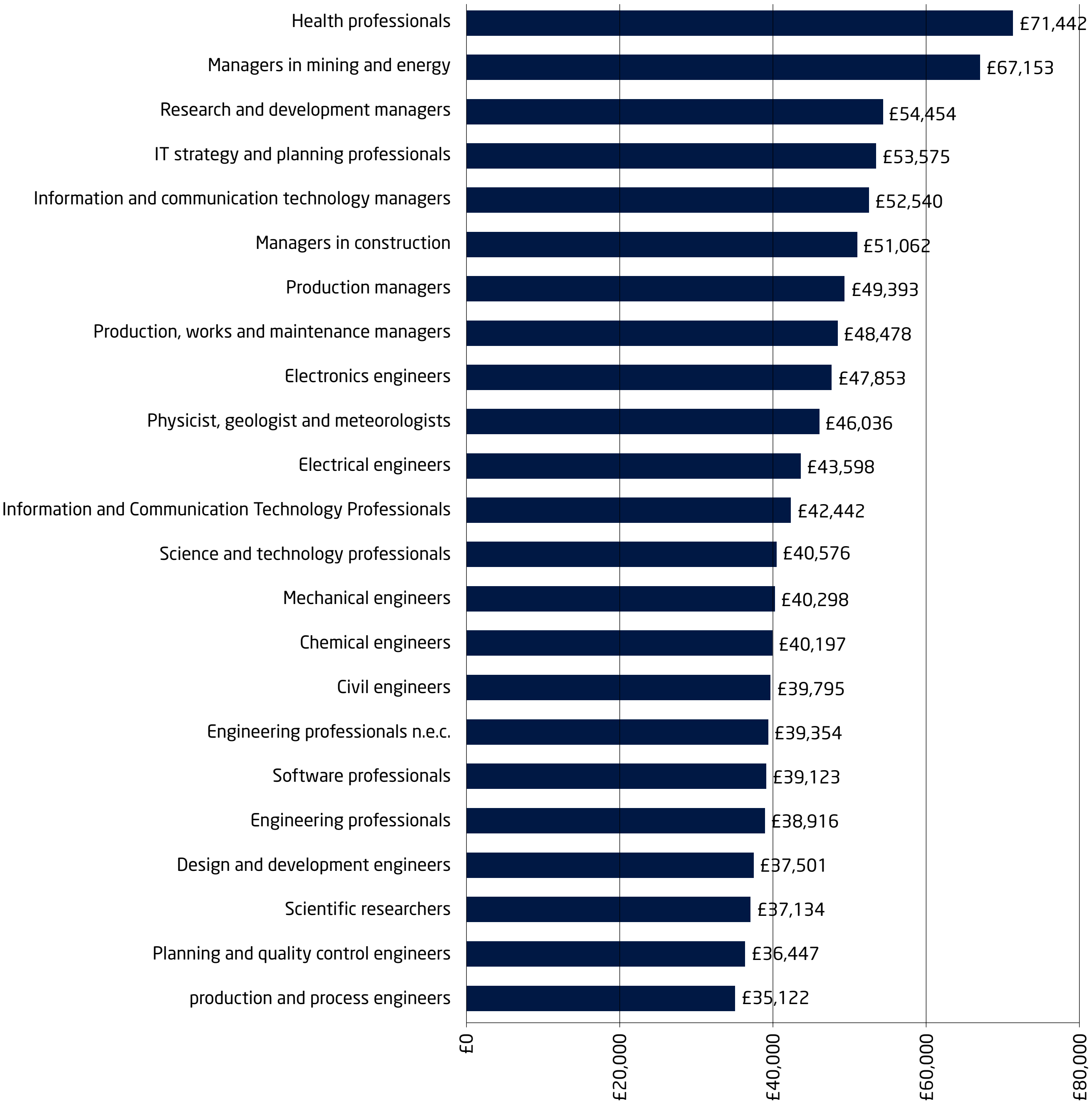
239 The mean salary can be distorted by a few large salaries in each career

240 Not elsewhere covered

241 In the ASHE dataset, figures for the number of jobs are indicative and are not an accurate estimate of employee job counts

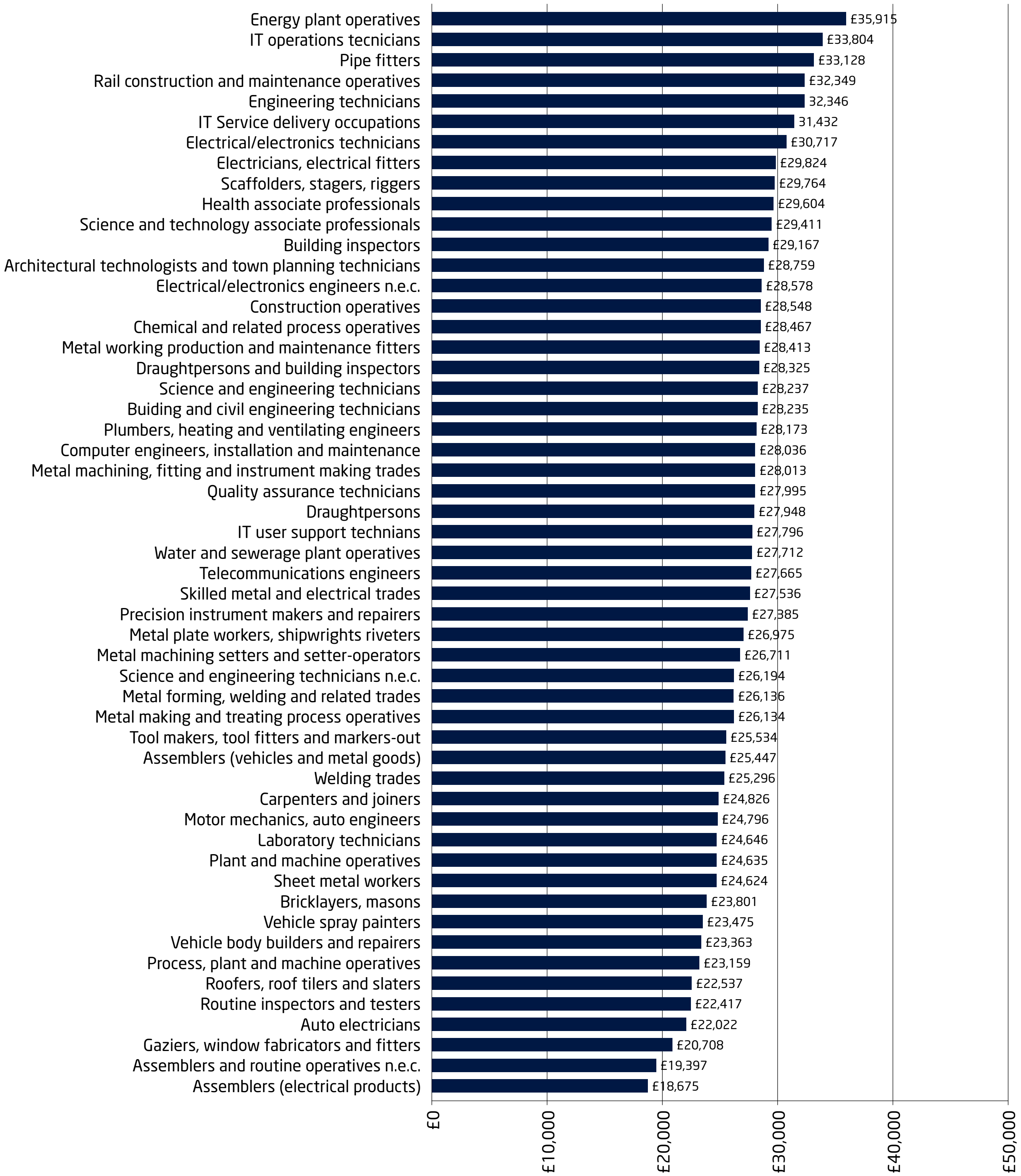
242 http://www.statistics.gov.uk/pdfdir/ashe1109.pdf

Fig. 23.0: Mean annual gross pay for selected STEM professions (2009) – UK



Source: ASHE 2010, ONS

Fig. 23.1: Mean annual gross pay for selected STEM technician and craft careers (2009) – UK



Source: ASHE 2010, ONS

23.2 Survey of registered engineers

This section was authored by Andrew Ramsay, former CEO, Engineering Council.

A survey of UK-based registered engineers and technicians, conducted in May 2010, gives an interesting picture of the benefits of being a registered engineer today.

Comparisons with a similar survey in 2007 show that, despite a rise in unemployment (from a very low 0.5% to 1.5% in 2010), salaries and benefits for most continue to advance. Between 2007 and 2010, the median income for Chartered Engineers rose 10% to £55,000 (income for Incorporated Engineers increased by 5% to £43,000, and for Engineering Technicians by 12% to £37,000). While base salaries had decreased for 13% of registrants, and 20% had seen their bonus reduced or withdrawn, there was still evidence of demand for engineers' skills. This was most apparent in energy, gas, oil and petrochemicals (where 13% actually saw an increase in their bonus) and, surprisingly, amongst those working in government (the majority of whom saw an increase in pay rates, while 15% also had an increased bonus).

The proportion of Chartered Engineers who have their subscription paid by their employer has leapt to 61% from 49% in 2007. 51% of Incorporated Engineers had their subscription paid for in 2007, along with 43% of Engineering Technicians – up a third from 32% in 2007.

Even more importantly, the willingness of employers to fund professional development continues to advance, with 64% of registrants receiving help (specifically, 65% of Chartered Engineers, 61% of Incorporated Engineers and 57% of Engineering Technicians). This figure shows a dramatic improvement on 51% in 2007.

Part 3 Engineering in Employment
24.0 Professional registered engineers

This section was authored by Andrew Ramsay, former CEO, Engineering Council.

The UK has no statutory requirement for engineers or technicians to be registered, although there are isolated areas of practice (including dams and reservoirs, aircraft maintenance and gas appliance installation and maintenance) where public registers are maintained. Nevertheless, many employers and clients seek evidence of competence for engineers and technicians they employ or instruct, and large numbers still take note of registration status in decisions on these matters.

The Engineering Council is the chartered body that sets standards[243] for registration of competent engineers and technicians. It maintains a register of all those who meet these standards. The process of assessment is undertaken by professional engineering institutions and societies licensed for that purpose by the Engineering Council. There are currently 36 of these.[244] The Engineering Council regularly reviews these licences and also works within international protocols to ensure that registered engineers and technicians meet internationally-agreed standards for practice.

A survey of a large sample of registered engineers in 2010 showed that the overwhelming reasons for registration were the wish to advance their career (77%) and to seek recognition of their competence (67%). 88% of Chartered Engineers and Incorporated Engineers would recommend registration. The survey indicated that Chartered Engineers were most often employed in petrochemical industries and IT. More Incorporated Engineers were found in the health sector and local authorities.

UK-SPEC is the national standard maintained by the Engineering Council for engineers and engineering technicians. The categories of registration set out in this standard are:

- Chartered Engineer, which requires evidence of competence including academic knowledge and understanding at or above level 7 of the National Qualifications Framework, or at Masters level
- Incorporated Engineer, which requires evidence of competence in practice including academic knowledge and understanding at or above level 6 of the National Qualifications Framework, or at Bachelors level
- Engineering Technician, which requires evidence of competence which includes academic knowledge and understanding at or above level 3[245]

The standard for ICT Technician is equivalent to that of Engineering Technician.

Candidates for all four registers must, in addition to demonstrating their competence to practise in accordance with the relevant standard, also demonstrate that they are committed to keeping their competence current and commit to acting in a professionally and socially responsible manner.

243 UK-SPEC http://www.engc.org.uk/professional-qualifications/standards/uk-spec

244 http://www.engc.org.uk/about-us/our-partners/professional-engineering-institutions

245 The equivalent academic standards in the Scottish Credit and Curriculum Framework are 11, 9 and 6 respectively

24.1 The number of registered engineers

The number of professional engineers in the UK economy is estimated at between 369,000[246] and 568,000.[247] Of this number 214,000 are registered with the Engineering Council: 180,000 as Chartered Engineers and 34,000 as Incorporated Engineers. Many commentators, including the government[248] and the Select Committee for Innovation, Universities, Science and Skills,[249] believe that more should be encouraged to register. In 2008, the Engineering Council embarked on a campaign to persuade more to do so. As a result, new registrations are starting to increase.

The proportion of registered professional engineers in the UK compares favourably with registration levels in comparable countries (Table 24.0). Canada has statutory regulation, although only 31% of its engineering graduates are licensed professional engineers or registered interns.

Table 24.0: International comparison of professional engineer and technologist registration (2007)

	Engineering Council	Engineers Ireland	Engineering Council South Africa	Institution of Professional Engineers New Zealand	Hong Kong Institution of Engineering	Engineers Australia	Engineers Canada
Population	60,800,000	4,100,000	44,000,000	4,100,000	7,000,000	20,400,000	33,400,000
Professional engineers/ CEng	188,701	15,177	14,727	5,250	11,568	47,555	160,000
Technologists/ IEng	40,466	2,468	2,944	125	1,713	708	29,991
Engineers/1000 population	3.10	3.70	0.33	1.28	1.65	2.33	4.79
Ratio engineer/ technologist	5 to 1	6 to 1	5 to 1	40 to 1	7 to 1	67 to 1	5 to 1

Source: Engineering Council

246 Engineering Professionals: Parliamentary Answer 16 July 2008 (quoting LFS 2003 data)

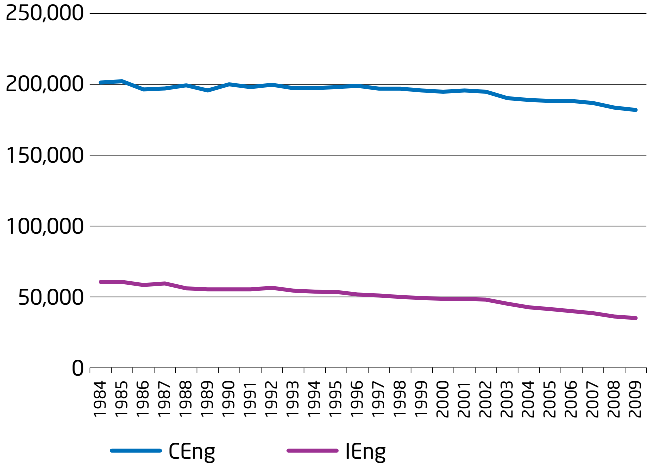
247 *Engineering L4+L5 in the economy: The Demand for STEM Graduates: some benchmark projections* Rob Wilson January 2009: table 3.3

248 http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdius/759/759.pdf

249 http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdius/50/50i.pdf Para 284

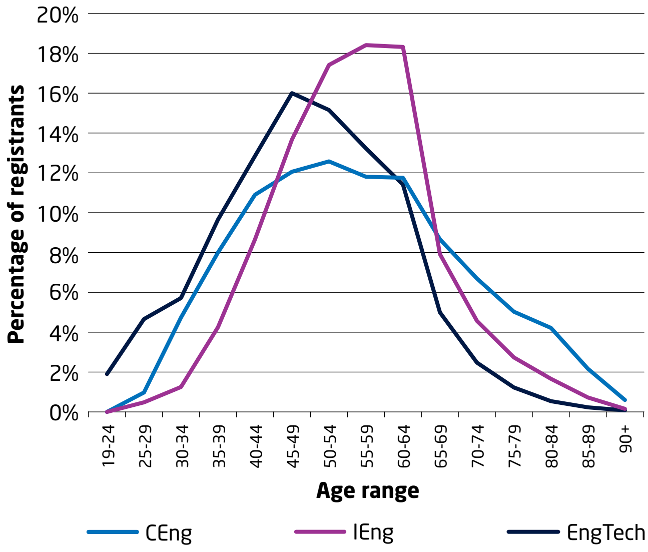
The numbers of registered Chartered Engineers and Incorporated Engineers are declining at present, despite the recovery in new registrations as a result of more effective marketing (Figure 24.0). This is in part because significant numbers are retired or close to retirement (Figure 24.1). Concerted efforts to increase the numbers of registered Engineering Technicians (from a very low base) are showing signs of success (Figure 24.2).

Fig. 24.0: Number of registered Chartered Engineers and Incorporated Engineers (1984-2009)



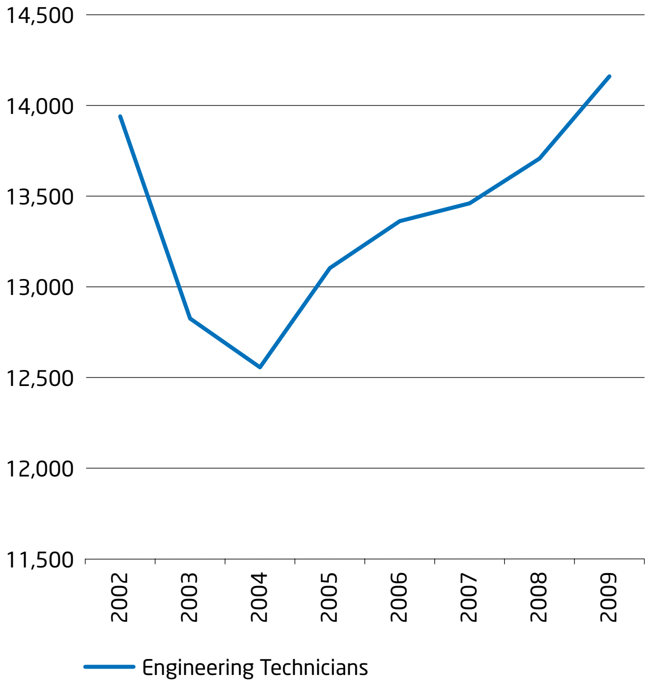
Source: Engineering Council 2010

Fig. 24.1: Age distribution of Chartered Engineers, Incorporated Engineers and Engineering Technicians



Source: Engineering Council 2010

Fig. 24.2: Number of Engineering Technicians (2002-2009)

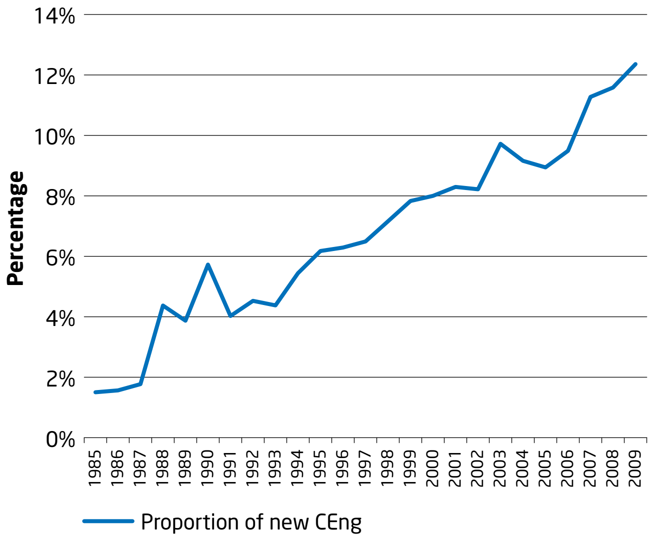


Source: Engineering Council 2010

The gender balance of registered engineers and technicians is strongly skewed against female engineers. However, the numbers registering in all categories continue to rise as a proportion of total new registrants (Figure 24.3).

Similarly, the ethnic composition of the registers is slowly changing, with 10% of engineers registering in the last five years being non-white.

Fig. 24.3: Proportion of new CEng registrants who are female



Source: Engineering Council 2010

Part 3 Engineering in Employment
25.0 Working Futures III: Implications for the engineering and manufacturing sectors

This section, a short summary of the full version originally published in Engineering UK 2009/10 (section 29), has been included for ease of reference. Working Futures III (WFIII) is a comprehensive set of employment projections for the period 2007-2017, covering the UK.

The manufacturing sector has faced a significant period of restructuring as a result of increased globalisation. While globalisation will remain a significant feature of the future world economy, the impact and pace of future restructuring is likely to be less severe. Over the long term, output growth in manufacturing could accelerate slightly, driven by a shift into higher-value added activities associated with productivity gains.

Over the 10-year period covered by WFIII, it is predicted that the manufacturing sector will need to recruit an additional 587,000 workers in order to meet replacement demand as workers leave the industry via retirement and other reasons. Table 25.0 shows that the greatest level of demand for new workers will be for managers and senior officials (165,000), machine and transport staff (109,000), associate professionals and technical occupations (108,000) and skilled trade occupations (91,000). However, it should be noted that new workers will be needed at all occupational levels.

It was noted in section 21 (skills shortage vacancies) that the engineering sector in England is more likely than average to experience hard-to-fill vacancies and skills shortage vacancies in the professional occupations and skilled trades occupations, which are two of the main occupational areas where the manufacturing sector needs to recruit new workers.

Table 25.0: Replacement demand and recruitment need in manufacturing (2007-2017) – UK

	Employment 2017	Net change from 2007	Replacement demand	Total requirement	Requirement as % of 2017
Managers & Senior Officials	474,000	6,000	159,000	165,000	35%
Professional Occupations	217,000	-16,000	76,000	61,000	28%
Associate Professionals & Technical Occupations	346,000	-5,000	114,000	108,000	31%
Skilled Trades Occupations	554,000	-129,000	219,000	91,000	16%
Machine & Transport Operatives	536,000	-132,000	242,000	109,000	20%
Elementary Occupations	291,000	-67,000	121,000	53,000	18%
All Key Occupations	2,418,000	-343,000	931,000	587,000	24%

Source: Working Futures 2007-2017 Evidence Report 2

Part 3 Engineering in Employment
26.0 Women in engineering and technology

Throughout the Engineering UK Report 2011 we have included various analyses of women in engineering. In this section, we bring together some of the key issues relating to women in engineering.

26.1 Meeting the challenge

The UK must be well-placed to meet the global technological challenges that lie ahead, such as climate change, the low carbon economy, infrastructure renewal, clean water and population growth.

It is therefore pleasing to see the recognition, acknowledgement and government policy incentives that now surround the science, engineering and technology (SET) sectors to help achieve the numerous ambitions that have been set. These include achieving a world-class, high-level manufacturing base, working in a knowledge-based society and living in an interconnected digital world.

However, the real challenge lies in how we meet the resultant demand for skilled technicians, graduates and researchers. The predicted decline in the number of 15- to 24-year-olds by 8% over the next ten years, together with an ageing workforce in which 27% of the working population[250] is over the age of 50, make that challenge more acute.

Within this context, women remain one of the country's most under-used resources.

26.2 Introduction

In recent years, engineering has enjoyed increased popularity both as a subject and career choice.[251] Applications to HE courses have steadily risen. EngineeringUK research found that, overwhelmingly, people thought engineering a 'well respected profession' and that engineers 'play a vital part in the future'. Analysis of UCAS and HESA data in the *Engineering UK 2009/10* report showed that, contrary to anecdotal evidence, the ethnic background of engineering students is representative of the UK population.

This section outlines the current position of female participation in STEM and, in particular, in engineering.

250 *Labour market statistics*, March 2010, p20

251 http://www.engineeringuk.com/viewitem.cfm?cit_id=382900

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26.3 Subject choice

Girls outperform boys in most subjects at school, and STEM subjects are no exception. In the 2009 GCSEs (Table 26.0), 72% of female entrants to design and technology (D&T) achieved grade A*-C, compared with 55% of males. In ICT, 76% of girls achieved C or above in comparison with 68% of boys. However, the differences in pass rates for compulsory subjects is smaller – only 3% more girls than boys passed additional science (formerly a double award) and in mathematics, the pass rate was actually 1% higher for boys than girls.

Table 26.0: A*-C pass rates for selected GCSE subjects (2009) – UK

	female	**male**
D&T	71.8	55.1
ICT	76.1	67.7
Mathematics	56.8	57.6
Additional science	64.5	61.0

Source: JCQ

Much government attention and strategy is now given to the rising numbers of students sitting the separate science GCSEs in biology, chemistry and physics (with one-year increases of 18%, 20% and 21% respectively). This has been driven by government targets because it is believed that, if taught separately, participants are more likely to continue their studies in this area. There exists a relatively minor gender imbalance in the uptake of separate sciences – in 2009, females made up 47% of biology, 45% of chemistry and 44% of physics entries at GCSE. It is also largely independent schools offering these qualifications, which means that there may be many able and engaged students in maintained schools that are not offered this opportunity.

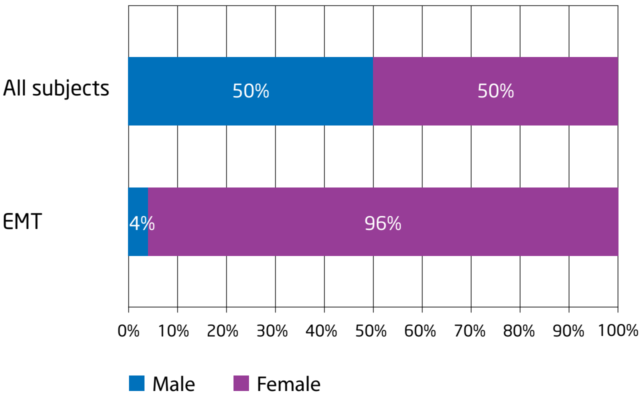
26.4 Diploma in Engineering

Latest figures (January 2010, Semta) indicate that, of the 6,400 enrolled students, only 7.7% are female.

26.5 Apprenticeships

The gender split for apprenticeships across all subjects is 50:50. However, when broken down by Sector Subject Area, this proportion varies considerably. Figure 26.0 illustrates the overwhelming male dominance in the engineering and manufacturing technologies (EMT) Sector Subject Area, where only 4% of those starting an apprenticeship are female.

Fig. 26.0: Gender breakdown of apprenticeship starts, all subjects vs EMT (2009) – England



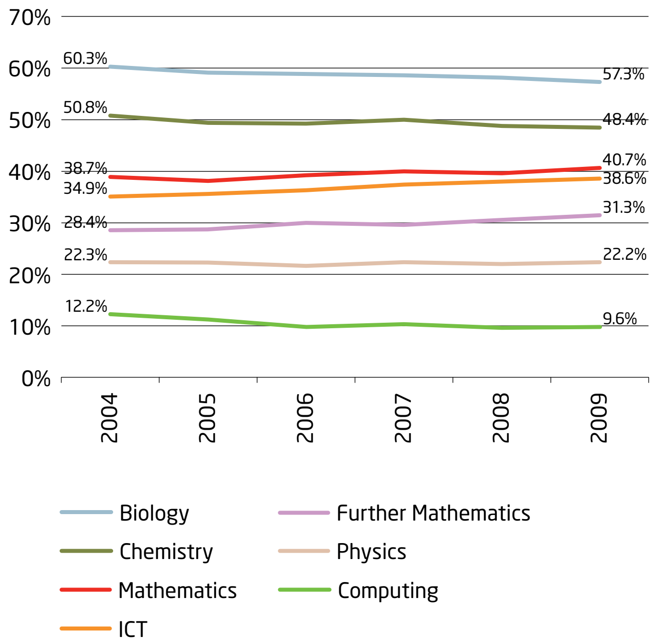
Source: Data Service

Other areas of apprenticeship are more female dominated. For example, in 2006, the hairdressing (92%) and children's care learning and development (97%) frameworks were very heavily skewed towards females.[252] The male-dominated engineering and construction sectors tend to be more likely to offer training at level 3, which is acceptable for entry into Higher Education.

26.6 A levels

Girls who decide to continue to study STEM by the more traditional A level route are better represented than those who study for vocational qualifications. In biology, female students outnumber males, and in chemistry it is almost 50:50. In all other STEM subjects there is a male dominance, varying greatly depending upon subject. While around 40% of A level mathematics entrants are female, they only make up 31% of those taking further mathematics. While A level physics is a prerequisite for most engineering degree courses, it remains unpopular with female students; only 22% of entrants in 2009 were girls. This proportion remains unchanged in the period shown in Figure 26.1. Of all STEM A level subjects, computing maintains the lowest proportion of female participation and has seen a drop from 12% to 10% since 2004. ICT is more popular with girls: there has been a slow but steady increase to 39% in 2009. Figure 26.2 illustrates the proportion of female entrants across STEM A level subjects over a five-year period. What is immediately evident is the lack of visible change.

Fig. 26.1: Proportion of female A level entrants by subject – UK

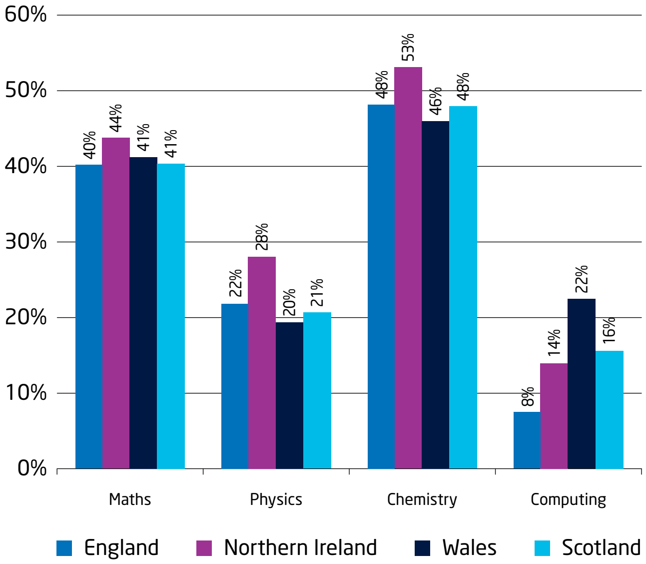


Source: JCQ

252 TUC (2008a) *Still More (Better Paid) Jobs for the Boys: Apprenticeships and Gender Segregation*

Examining the gender balance in some key STEM A level/ Advanced Higher subjects by the devolved UK nations (Figure 26.2) reveals that variation in levels of female participation does occur between nations. For example, Northern Ireland has the highest female physics participation rate, at 28%, and Wales has almost three times more females (22%) taking computing than England (8%). This phenomenon could bear further investigation.

Fig. 26.2: Female participation levels in selected STEM subjects at A level – England, NI and Wales and Advanced Higher – Scotland[253 254]



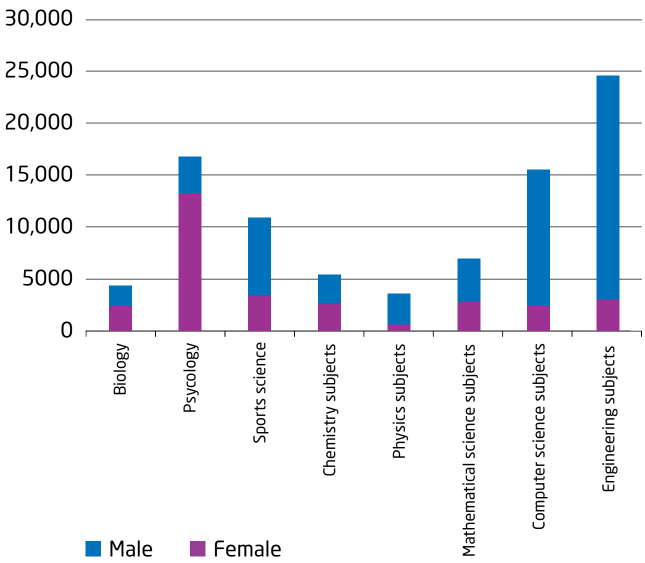
Source: JCQ

26.7 Higher Education

In Higher Education, female participation in STEM varies greatly between and within subject areas. Figure 26.3 shows the gender breakdown of applicants for 2007/08. It is useful to break down the broad UCAS groupings in biological sciences, physical sciences and mathematical and computer sciences to reveal differences in the component subject areas when looking at the gender balance. Biological sciences as a group is heavily female dominated. However, a breakdown reveals that the high take-up of psychology by women at 80% – making it by far the most popular subject in the group – significantly contributes to this. Biology is more balanced gender-wise, with 43% of applicants being male. Overall, the physical sciences group has 40% female applicants. However, within that group, there is a much greater gender imbalance in physics subjects (80% male) than in chemistry subjects (near parity at 52:48 male to female).

Computer science (15%) and engineering (12%) have the lowest proportion of female applicants within STEM, with engineering remaining static at around 12% over the last six years. This is set against a context which sees more women now going to university than men: in 2007/08, 56% of all UCAS applications were from females.

Fig. 26.3: Applicants to STEM subjects by gender[255]



Source: UCAS

253 While the Advanced Higher and A level qualifications are approximately the same level, caution should be exercised when making comparisons. Data above is for illustrative purposes only.

254 There were only 13 female entrants to A level computing in NI in 2009. This low base should be considered when using percentages.

255 Biology, psychology and sports science are subjects within the UCAS 'biological sciences' subject group C.
'Chemistry subjects' are chemistry and forensic and archaeological science, within UCAS 'physical sciences' subject group F.
'Physics subjects' are physics and astronomy, within UCAS 'physical sciences' subject group F.
'Mathematical science subjects' are mathematics, operations research and statistics within UCAS 'mathematical and computer Sciences' subject group G.
'Computer science subjects' are computer science, information systems, software engineering and artificial intelligence, within the UCAS 'Mathematical and Computer Sciences' subject group G.
'Engineering subjects' is UCAS subject group H.

26.8 Graduate destinations

Of the minority of women who study engineering and technology (E&T) at degree level, only around half go to work in an industry where E&T is the primary activity (Table 26.1), though more also go to work in an industry associated with E&T. As a result, the proportion of women leaving the sector altogether is nearly double the proportion of males that leave.

Table 26.1: Graduate engineering and technology degree destinations

Industry	Female	Male
E&T primary activity	51.5%	70.0%
Primary activity associated with E&T	11.1%	10.0%
No E&T	37.4%	20.0%

Source: HESA

26.9 International HE comparisons

Table 26.2 shows that internationally the UK's ability to recruit women onto HE engineering courses (15%) is significantly below the European (20%) and world (19%) average.

Table 26.2: Percentage females obtaining first degrees in selected countries and regions

% Females obtaining university first degrees in selected countries and regions	All university first degrees	All STEM	Field of university first degree				
			Sciences	Mathematics/ computer science	Agricultural sciences	Social sciences	Engineering
Japan	38%	23%	29%	24%	45%	27%	11%
Ireland	55%	43%	57%	37%	34%	73%	20%
Northern Ireland	61%	57%	49%	30%	72%	69%	21%
United Kingdom	54%	40%	52%	27%	56%	58%	15%
United States	57%	50%	55%	33%	46%	63%	21%
Europe	55%	39%	51%	32%	47%	57%	20%
World	52%	38%	51%	34%	42%	48%	19%

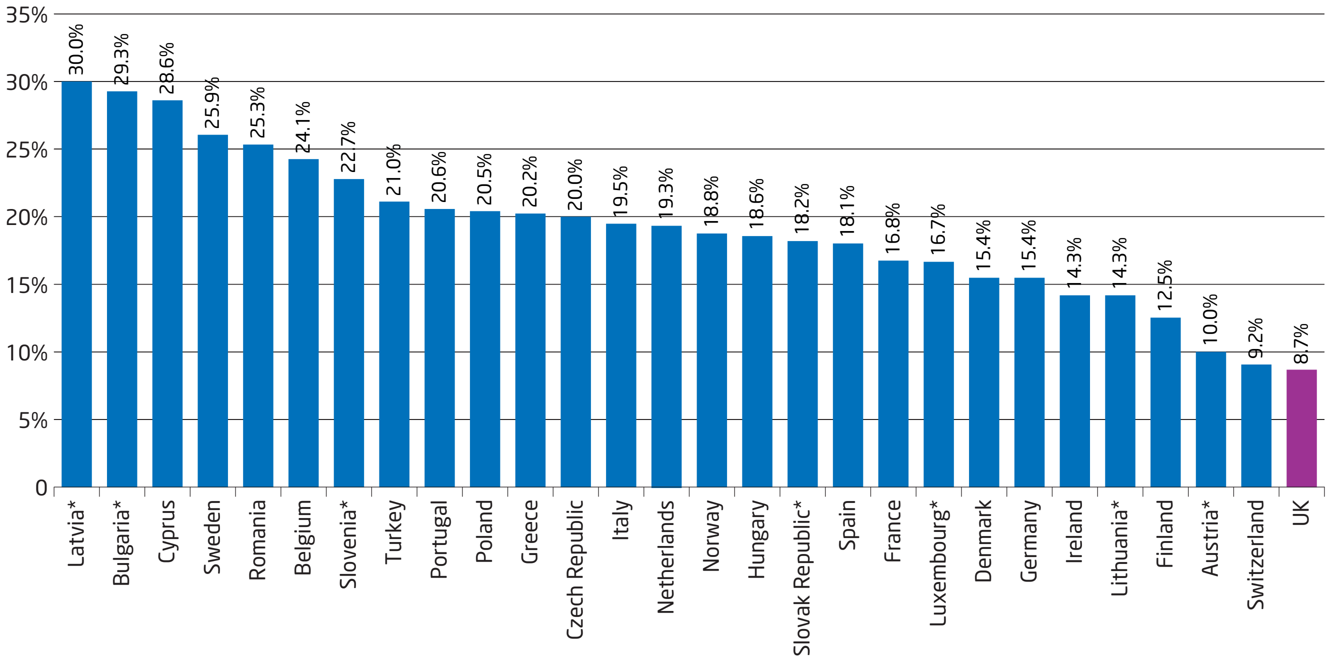
Source: Report of the STEM review- DENI and DELNI; p41, 2009

26.10 Proportion of female engineering professionals in EU countries

Increasing female participation in STEM study, specifically in engineering subjects, is paramount. However, this is a means to an end, which is to increase the number of women engineers actually working in the SET sectors.

Consequently, Figure 26.4 is both illuminating and concerning, since it shows that the UK has the lowest proportion of female engineering professionals of all the EU countries.

Fig. 26.4: Proportion of female engineering professionals in EU countries

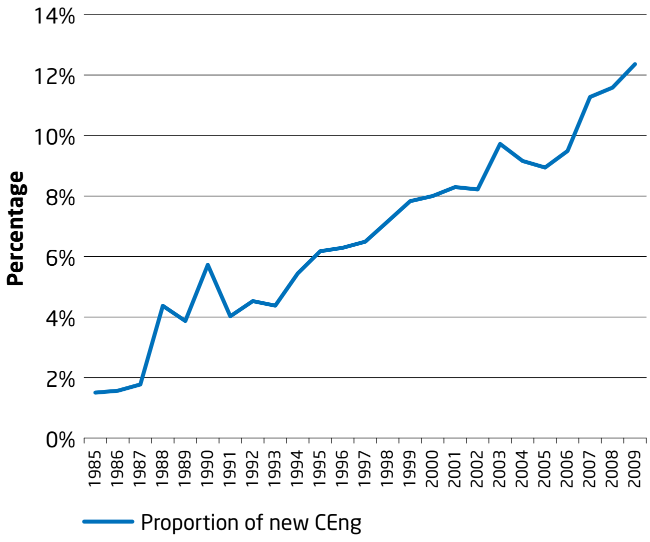


Source: UKRC's analysis of the European Labour Force Survey (2007)

26.11 Professional registration

In 2009, 12.4% of new Chartered Engineers were female. Though this proportion is low, it has been slowly increasing year-on-year from 1985, when it was only 2%. Figure 26.5 shows the steady growth across the period.

Fig. 26.5: Proportion of new CEng registrants who are female



Source: Engineering Council

26.12 Business benefits

Gender equality is being shown to provide real bottom-line business benefits. The UKRC report,[256] *Women Mean Business*, clearly highlights this, drawing attention to two key studies on the subject.

Firstly, it referred to a McKinsey study[257] of European listed companies. This revealed that those with the highest level of gender diversity in top management positions outperformed their peers in terms of return on equity (11.4% compared with 10.3%), operating profit (EBIT 11.1% compared with 5.8%) and stock price growth (64% compared with 47% between 2005 and 2007).

Similarly, a US study by Catalyst[258] showed that Fortune 500 companies with three or more women on their boards had stronger than average profits, based on the following financial measures: return on equity (16.7% compared with 11.5%), return on sales (16.8% compared with 11.5%) and return on invested capital (10% compared with 6.2%).

That said, there is still a long way to go; in 2008, women held only 9% of board directorships in SET FTSE 100 companies.[259] Although there is an improving trend, at the current rate of increase, women would still only hold 18% of directorships in FTSE 100 companies by 2030.

256 *Women Mean Business – why gender equality is essential in science, engineering and technology*, The UKRC, September 2010

257 McKinsey & Company, 2007, Women Matter: Gender diversity, a corporate performance driver, Desvaux, G., Devillard-Hoellinger, S., Baumgarten, P.

258 Catalyst, 2007, *The Bottom Line: Corporate performance and women's representation on boards*, Joy, L., Wagner, N.M., Wagner, H. and Narayanan, S. (http://www.catalyst.org/publication/200/the-bottom-line-corporateperformance-and-womens-representation-on-boards, accessed 17/07/09).

259 Data extrapolated by the UKRC from Sealy, R., Vinnicombe, S. and Singh, V. 2009, *The Female FTSE Report 2008: A decade of delay*, Cranfield School of Management http://www.som.cranfi eld.ac.uk/som/dinamic-content/research/documents/ft2008.pdf, accessed 08/06/10).

26.13 Findings and recommendations

Whilst our analyses show that engineering has enjoyed increased popularity, both as a subject and career choice for women, the pace of change is too slow compared with other countries. This leaves the UK vulnerable in the face of the many global challenges which will require buoyant UK SET sectors.

Some key findings are:

- Only 4% of engineering and manufacturing technologies (EMT) apprentices are women. This compares unfavourably to participation across all apprenticeship subjects, which is evenly split between men and women.
- There remains a large gender imbalance in the take up of A level physics, with only 22% female participation.
- Applications for engineering degrees by women remain the lowest of all STEM disciplines at 12%.
- Internationally, the UK's graduation rate for women from engineering degree courses (15%) is significantly below the European and world averages (20% and 19% respectively).
- Only half the UK's female engineering and technology (E&T) graduates enter an industry where E&T is the primary activity; nearly double the number of females to males leave the sector altogether.
- The UK has the lowest proportion of female engineering professionals of all the EU countries.
- The critical impact of timely, sustained and relevant careers information, advice and guidance (IAG) cannot be overlooked and must continue to be addressed in parallel by employers, the engineering community and appropriate government policies and interventions.
- STEM community co-ordinated large-scale interventions, such as The Big Bang in March 2010, demonstrate the significant potential to influence the gender challenge. Of the 23,573 visitors to The Big Bang 2010, 47% of under 19s were female.

- The appropriate use of role models has been widely recognised as a successful tool. The key challenge therefore, lies in reaching large numbers. STEMNET's 20,000 STEM ambassadors – of whom 40% are female – is an appropriate, successful programme. Of those ambassadors who are engineers, a significant proportion (25%) are female and 80% of these are under 35. Increasing the numbers of females attending and participating in various STEM-related initiatives is a prerequisite to improving attitudes. However, it cannot be stressed enough that initiatives need to be properly and systematically evaluated in order to determine true effectiveness. Section 7 in the recent *Science and Trust Expert Group Report & Action Plan*[260] provides useful guidance in this respect.

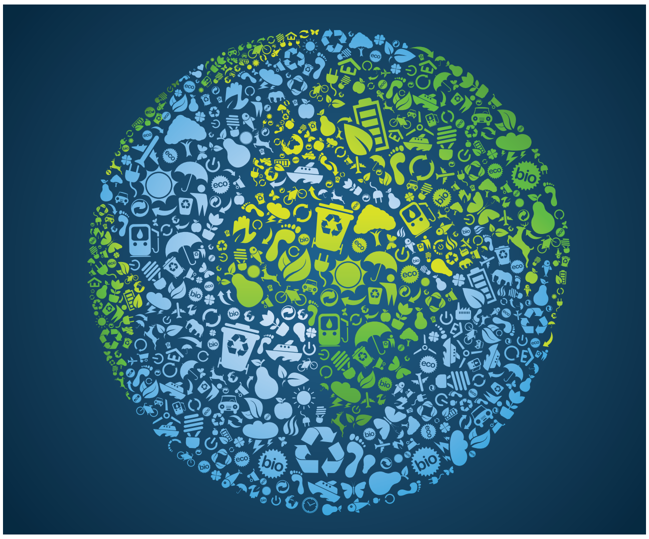
260 http://interactive.bis.gov.uk/scienceandsociety/site/trust/files/2010/03/Accessible-BIS-R9201-URN10-699-FAW.pdf

26.14 Conclusion

Our analyses show that engineering has enjoyed increased popularity, both as a subject and career choice for women. However, the pace of change is too slow and, compared with other countries, leaves the UK vulnerable in the face of the many global challenges which will require buoyant UK SET sectors. This weakness is exacerbated by the fact that the UK has the lowest proportion of female engineering professionals of the EU countries.

Whilst there is growing body of evidence to show the business benefits for gender equality, there is still a long way to go. In 2008, women held only 9% of directorships in FTSE 100 companies. At the current rate of increase, this figure would only rise to 18% by 2030.

Part 3 Engineering in Employment
27.0 UK Industry response to the low carbon challenge



27.1 Green, greener or just greenwash? What is industry actually doing?

This section was authored by Bob Windmill, UK Research Manager, SSC Alliance.

27.1.1 Background

Sector Skills Councils[261] (SSCs) represent some 26 million UK employees. Annually, each SSC is required to produce a Sector Skills Assessment (SSA) report which articulates the drivers of change and implications for skills in their sector. Notably, all but one SSC made significant references to the low carbon agenda in their 2009 reports.

The low carbon labour market is subject to the same drivers as its conventional counterpart; an ageing workforce, increasing use of technology to deliver the required outcomes and an increasing disinterest in science among young people. This is clearly articulated in the EU skills-led low carbon cluster report.[262]

The evidence from SSCs clearly shows that new job opportunities over the next ten years, green or otherwise, will come from replacement demand rather than from economic growth, by a ratio of 10:1. It follows that low carbon up-skilling must focus on in-work training and development.

It is also clear that it will not be practical to anticipate in detail the nature and skills requirements of future jobs. The theme from SSCs is that the workforce of the future will need to have sound skills for life, be competent in science and technology, and be flexible in its career expectations.

27.1.2 Green or greener

From the review of the SSA reports, it is clear that every Sector Skills Council has identified significant practical activity on the part of employers to reduce their carbon footprint. The majority relate to modifying existing processes and behaviours and contrast with various claims for the large number of new jobs that the (arguably mythical) green sector will create.

27.1.3 Greenwash?

In 2008, Energy and Utility Skills researched the public's perceptions of careers in the power industry.[263] While the research confirmed the interest of young women in 'green' jobs, the young people on the groups were scathing of the industry's environmental rhetoric – using words such as 'green', 'environmentally-aware' and 'caring'. They contrasted it with their perceptions of the industry as a money-making machine with no environmental or social conscience. They labelled the industry approach 'greenwashing'.

However, this contrasts with the fact that in 2009 investment in green energy overtook that in conventional energy.[264] If organisations wish to reap the attractive benefits that their green activities may actually merit, they clearly have a way to go in getting their message across.

261 Sector Skills Councils (SSCs) are independent, employer-led, UK–wide organisations designed to build a skills system that is driven by employer demand

262 http://www.euskills.co.uk/download.php?id=986

263 Public Attitudes to the Electricity Industry and the Careers it offers from: http://www.euskills.co.uk/download.php?id=621.

264 http://www.guardian.co.uk/environment/2009/jun/03/renewables-energy

27.1.4 Common issues

The energy and manufacturing SSCs note that the lack of clear government low carbon and environmental policies is hampering investment at a time when action is urgently needed. In particular, multi-billion pound investments are needed in energy generation if the UK is to have the low carbon energy supply mix that it aspires to.

27.1.5 Future jobs

As previously noted, the majority of job opportunities in the medium term will come from meeting replacement demand rather than from any growth or expansion.

Alongside this, the majority of employers see the increased use of technology as a key enabler of increased business performance. ICT stands out as a key cross-sector technology, while increasing STEM uptake and improving the general technical capability of employees is the common skills theme.

A key challenge will be to increase the STEM subject uptake among young people. The evidence from Oslo University[265] suggests that the more developed a country is, the less interested its young people are in science. This must be addressed if UK plc is to have the supply of technically-competent individuals it needs.

27.1.6 Selected industry examples

Nuclear

Nuclear energy is often criticised on the grounds that the embodied energy needed to create, run and dispose of a nuclear facility undermines its green energy credentials. However, evidence from DECC indicates that a nuclear power plant will recover its embodied energy in about seven months of operation. In addition, evidence cited by the Parliamentary Office of Science and Technology[266] shows that a nuclear plant will contribute around a tenth of the CO_2 emissions[267] of a correspondingly sized biomass plant. Together these suggest that nuclear is a credible low carbon option.

Manufacturing

Whilst manufacturing covers a wide range of transformational activities, it can broadly be divided into two discrete areas: mass manufacturing and advanced manufacturing. Much of the 'green' technology used in mass manufacture and other sectors comes from advanced manufacturing.

SEMTA notes the development of nanotechnology as a key emerging technology. Examples include using nanoparticle additives to increase the fuel efficiency of engines, significantly cheaper solar cells, more efficient hydrogen storage and improved fuel cells in hydrogen-powered vehicles, and using aerogel insulation for solid-walled buildings and nano-coatings for windows.

Skills for Logistics (the Skills Sector Council for freight transport) has identified the development of lightweight composite materials as key to the production of lighter, more fuel-efficient vehicles, while the food and drink industry uses advance manufacturing technologies in the development of smart food tags which can tell a consumer when a food product is deteriorating. This, in turn, reduces food waste.

265 http://www.ils.uio.no/english/rose/network/countries/norway/eng/nor-Sjoberg-Schreiner-overview-2010.pdf

266 *Parliamentary Office of Science and Technology, 2006, Carbon Footprint of Electricity generation, Postnote* 268

267 Grams of CO_2 per kWh as determined by the Life Cycle Assessment methodology

Transport

Go Skills (the Skills Sector Council for passenger transport) and Skills for Logistics (freight transport) both highlight the potential of a reduction in vehicle fuel consumption to lower carbon emissions and generate an economic benefit. Skills for Logistics estimates that putting HGV drivers through an eco-driving programme will result in annual fuel savings of £300 million. Similarly, calculations on fuel usage data from DECC[268] suggests that a 5% reduction in fuel consumption could result in £1 billion annual saving for employers.

Benefits are already being realised in passenger aviation, with fuel consumption in litres per 100 passenger miles falling by 37% between 1985 and 2005.[269] For cars, the improvements are even more spectacular: a 2010 BMW Mini Cooper (72.4mpg) outperforms its 1960s' cousin (32mpg) by 126%. This is without the use of any resource-intensive hybrid technologies and is a powerful argument for refinement over revolution.

General low carbon programmes

The majority of SSCs refer to low carbon programmes aimed at helping employers reduce their carbon footprint. Financial Services SSC and e-Skills UK both focus on minimising energy consumption in large scale computer usage. This in turn impacts on Asset Skills, the Asset Management SSC, which represent employers who are increasingly required to operate facilities (including data centres) in a carbon-friendly manner.

Skills for Health has identified the move to carbon neutral operation as a key strategic objective.[270] Initiatives include the increased use of bioscience to reduce energy consumption and improve operational management. Skills for Health notes that the Grampian Health Board has achieved a reduction in CO_2 of 37.8% since 1989/90 and is currently working to an annual reduction of 2%, which it believes will save it £6.9 million annually.

While it is often the high-profile energy generation schemes that grab the headlines, it is clear that these incremental carbon reduction strategies across large scale operations will be a significant contributor to meeting the UK's CO_2 reduction targets.

27.1.7 Standards and qualifications

While it is arguable that much of the de-carbonising activity is centred on existing technology, it is also acknowledged that many new skills, or combinations of skills, will be required. This is reflected in the 2009 sector skills assessments: the majority of SSCs have some kind of low carbon qualification or framework in place. These range from Cogent's £2.9 million HEFCE-funded work-based learning degree programme, to Asset Skills Energy Assessors programme.

27.1.8 A key message?

It is clear that there is no one way of reducing carbon emissions but that every part of UK plc has a role to play. It is likely that, in the future, successful organisations will regard reducing their carbon footprint as business as usual. But for now, a focus on carbon reduction is a useful tool. This was well articulated in the BIS *Emerging Findings*[271] report:

"Carbon reduction is not the only critical issue for the industry, nor the only measure of sustainability, but a concentration on carbon brings simplicity and rigour, and provides a new focus for action and a sense of priority."

There is an opportunity for policy makers and employers to work together and tap into the public's enthusiasm for the green agenda. This highlights the key role of technology in developing solutions and creating the up-skilling frameworks that will give potential and existing workforce members access to the training they need.

Missing this opportunity is not an option.

268 http://www.decc.gov.uk/en/content/cms/statistics/publications/ecuk/ecuk.aspx

269 www.aviationmanagement.nl/.../The%20flight%20to%20CO2%20reduction.ppt

270 http://www.skillsforhealth.org.uk/~/media/Resource-Library/PDF/rehearsing-uncertain-futures.ashx

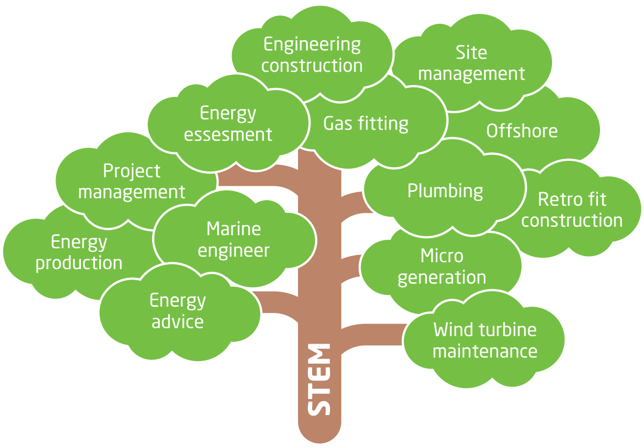
271 http://www.bis.gov.uk/assets/biscore/business-sectors/docs/10-671-construction-igt-emerging-findings.pdf

27.2 Addressing the renewable energy skills challenge

This section was authored by Rob Moore, Strategy Manager, Renewables, Energy & Utility Skills Ltd.

Renewable energy sits at the heart of the government's low carbon strategy which states that, "renewable energy is a vital component of the UK's diverse energy mix".[272] It is not a new industry. Rather, it is a specific area of extension to existing industries and activities, cutting across all business sectors in the UK, with STEM as the key driver in delivering the skills required (Figure 27.0).

Fig. 27.0: STEM is the key to renewable energy skills



Reporting to the Department for Energy and Climate Change, the Renewable Energy Skills Strategy group consists of seven Sector Skills Councils (SSCs) and one Standard Setting Body.[273] Its remit is to present a holistic understanding of the skills requirements in the deployment of renewable energy technologies across the UK.

27.2.1 Scope of work

The group identified the current renewable energy technologies with each representative focusing on the contribution to deployment made by skills from their respective sectors, across the different sections of the supply chain.

The outputs from each member were collated and rationalised, resulting in 138 roles being identified in nine sections of the supply chain for 12 different technologies.[274]

Looking at transferable skills, competency standards, training requirements, provision and demand, the roles were prioritised, with the high priority roles being highlighted for urgent action.

27.2.2 Key findings

Most of the skills the UK needs already exist. There is no clear evidence that technical jobs will change significantly over the next decade, though it is likely that up-skilling of core skills, with renewable-specific elements, will be required. Most of the 138 roles identified were evident in multiple technologies.

The number of 'renewables' jobs is low but set to rise. Employment in renewable energy is currently relatively low in terms of direct job numbers. But there is potential for significant growth, with an increase in the number of UK jobs depending on the technology and section of the supply chain.

There are few purely 'renewables' jobs. Employers will generally not recruit specifically for 'renewables' roles. But rather, 'renewables' are likely to diversify and extend many existing jobs. Without the addition of the 'renewables' elements, these jobs could be lost and be given to workers from outside the UK.

Research and development skills are lacking in the UK. The areas identified as having the greatest lack of skills are research and development, and design, with the skills and expertise currently being purchased from outside the UK rather than being developed.

272 Department for Energy and Climate Change

273 Sector Skills Councils are industry-led organisations that write National Occupational Standards, create apprenticeship frameworks and approve sector-relevant qualifications to be included on the Qualification Credit Framework.
The 7 Sector Skills Councils involved in the Renewable Energy Skills Strategy group are: ASSET Skills, Construction Skills, Cogent, Energy and Utility Skills, LANTRA, SEMTA and Summitskills. The Standard Setting Body involved was ECITB.
The Alliance is an organisation comprising all licensed UK Sector Skills Councils and specific information on each SSC can be found at: www.sscalliance.org

274 The group outputs are presented in a data pack made up of a series of Powerpoint presentations, spreadsheets and Word documents. These can be downloaded from the 'low carbon' section of the Energy & Utility Skills website at: www.euskills.co.uk.

Experienced project managers needed. The top priority roles identified were centred on project management skills. This highlighted the fact that all the projects will require project managers and will be competing for these skills with the other initiatives taking place. Off-shore project management stands out as a particular priority.

27.2.3 Provision

Beginning with the National Occupational Standards (written by and owned by the SSCs), the availability of suitable qualifications was assessed, along with the location, capability and capacity of training providers. Using this information, the SSCs are able to prioritise qualification and training development to fill the gaps in priority areas, working collaboratively to span traditional sectoral boundaries. Where atypical training for a sector has been identified, and it becomes evident that skills exist across boundaries, the SSCs work together to provide employers with a 'one-stop shop'.

Training provision needs to meet short, medium and long-term skills requirements.

Short-term – Modular training to up-skill people who currently work in the related industries and provide the 'renewable enhancements'. The modular approach will allow tailored packages to be created to cover a range of routes to competence.

Short-medium term – Modular training designed to re-skill experienced engineers from unrelated industries so that they can move into renewable-energy-focused roles.

Long-term – Apprenticeships and Higher Education programmes. Candidates will be need to have STEM backgrounds and experience. Strong science, engineering and mathematical skills are essential to access the modular, renewable-specific training. Large numbers of engineers, of all disciplines, will be needed to meet the skills demands of renewable energy.

27.2.4 Opportunities

Providing a framework for making sure the necessary skills exist to deliver renewable technology presents a number of opportunities:

- Investment in research and design will allow the UK to develop expertise in renewable technologies.
- The right skills will improve UK manufacturing capacity, allowing the renewable energy technologies supply chain to take advantage of the competition and exploit bottlenecks.[275]
- By coordinating the planning of large-scale construction projects, we can smooth the skills demand in the construction industry.
- The UK can take the lead in determining the dominant technologies in marine energy. Whilst marine energy has not progressed sufficiently to contribute to the 2020 carbon targets, it is expected to be essential in meeting the targets agreed for 2050.

27.2.5 Skills are not the only aspect

Whilst the skills to design, manufacture, construct, operate and maintain renewable energy technologies are pressing issues, other issues (outside the remit of the group) were highlighted that need considering.

Global competition exists for products, services and materials related to renewable energy. This presents an issue in terms of cost and availability.

Competition between construction projects in the UK could result in temporary skills shortages in the construction industry if the planning of these projects is not coordinated.

Not all areas of renewable energy currently have a 'dominant technology'. For example, marine energy has massive potential but it is not clear which of the technologies will actually be deployed. This uncertainty not only impacts on the skills required but also the demand for training from employers.

275 JDR Cable Systems has been awarded a £2 million Department of Energy and Climate Change (DECC) grant to develop high voltage cables. The award forms part of DECC's plans to help UK companies invest in the equipment and technology required to support the country's transition to a low carbon future. www.rovworld.com/article4566.html

276 The Low Carbon Steering Group is chaired by Energy & Utility Skills with representation from the licensed SSCs, the Alliance of SSCs, UKCES, DECC, and BIS. The steering group co-ordinates the collaborative work carried out by the Sector Skills Councils on the Low Carbon skills issues.

277 National Skills Academies are employer-led centres of training excellence. The government's mission is to create a world class workforce by delivering the skills that employers need in each sector of the economy. www.nationalskillsacademy.co.uk.

27.2.6 On-going work

The group's work has identified the roles required to use renewable energy technology effectively. But the numbers of skilled operatives needed have yet to be quantified, or when they will be required and what the regional impact of this will be. This work will continue through the Low Carbon Steering Group.[276]

Working with government through the Alliance and the National Skills Academies,[277] the priority issues identified are being resolved on a national and regional basis (Figure 27.1). We aim to make sure that the UK has the necessary skills to effectively deploy renewable energy technologies, meet our carbon reduction obligations and gain maximum return on the opportunities presented by renewable energy.

Fig. 27.1: Summary of the findings of the Renewable Energy Skills Strategy Group

Stimulate Demand	Creating 'New Jobs'	Flexible Training	Supply Chain
Issue: without the demand employers are unwilling to train – there is a need for information to generate demand	Issue: new jobs will predominantly come from up-skilling existing workers – already skills shortages across energy sector	Issue: the skilled workforce will come from a range of routes. The different routes will have different training requirements	Issue: skills, knowledge and capacity in the supply chain are potential barriers to deployment of renewables
Implications: need stimulus to break the training vs lack of demand cycle	Implications: need additional workers who need to be trained in core skills before they can receive specialist 'renewables' training	Implications: need to provide different training for transferable routes and non-traditional entry routes	Implications: capacity needs to grow to facilitate deployment, the need for skills and knowledge deliver will be even greater
SSCs: need to increase awareness and pump prime providers	SSCs: need to support sector attractiveness measures and develop 'renewables' modules/ re-package existing qualifications	SSCs: need to understand renewables requirements and work with providers to develop the flexible training for the different routes	SSCs: need to work with 'renewables' supply chain to identify and develop the training required
Government: incentives will play a critical role, but also need to remove barriers and provide clear information to employers	Government: support for vocational options and funding needs to support energy sector with 'renewables' as a pathway rather than an industry	Government: create a funding model that will allow rapid response and support the flexible training developed to support atypical routes	Government: need to fund top-up modules and short courses in the supply chain

27.3 Wind and marine renewable energy

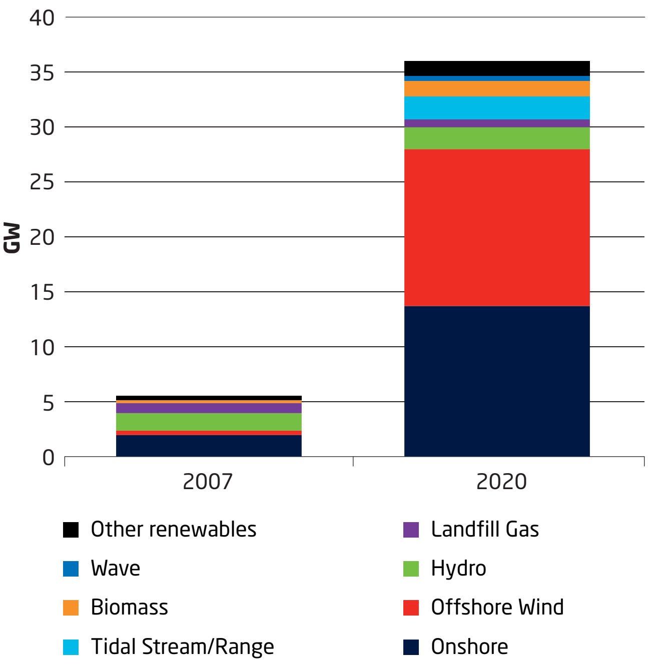
This section was authored by Fruzsina Kemenes, Skills & Education Policy Officer, RenewableUK.

27.3.1 Introduction

The UK government is committed to generating 15% of all our energy from renewables by 2020. This means that the energy portfolio of the nation will have to drastically restructure in order to switch to a low carbon model (Figure 27.2).

The urgent need for climate change mitigation, the depletion of indigenous fossil fuel resources and associated security-of-supply and price-volatility issues are the key drivers for change, alongside the fact that around one third of our ageing energy infrastructure is due for retirement in the next 10-15 years. Today, approximately 6% of all the UK's electricity comes from renewable sources; within a decade this needs to rise to 32% or around 40 Gigawatts (GW) of installed capacity.[278] A broad spectrum of technologies will contribute to the transition. Notably, wind energy is to dominate efforts because of the availability of this free natural resource, the short lead time to install individual units, favourable overall costs, and the reliability of the technology in comparison to today's alternatives. Other technologies, like wave and tidal devices, are likely to play a prominent role in the 2020s and beyond as they mature both technically and commercially.

Fig. 27.2: Historic and projected renewable energy generation capacity 2007-2020



Today, renewables account for 25% of global electricity capacity (1,230GW out of a 4,800GW total for all sources, including coal, gas and nuclear). Core clean energy now represents the fastest growing form of industrial investment. In 2009, more than £97 billion was invested in new renewable energy capacity and manufacturing plants – up from just £19 billion in 2004.[279] At least 50% or more of the newly-installed power capacity in the world is expected to come from renewables between 2010 and 2011.[280]

278 DECC (2009) Renewable Energy Strategy

279 REN21, 2010, *Renewables 2010 Global Status Report*

280 UNEP SEFI and Bloomberg New Energy Finance, 2010, *Global Trends in Sustainable Energy Investment 2010 Report*

27.3.2 UK renewable energy workforce to expand more than tenfold in the coming decade

The UK wind industry alone has the potential to create 60,000 new, direct jobs over the course of the next ten years. This means that by 2020, the workforce needs to effectively expand to well over ten times its current size. Recruitment issues are already slowing the rate at which UK renewables businesses can expand, due to shortages of skilled and experienced candidates for some critical roles.[281] Across renewables, electrical, mechanical and power systems engineers and technicians are particularly difficult to recruit, alongside experienced technical project managers.[282] The limitations of the UK talent pool are compounded for employers by competition from other sectors with overlapping skills needs. In the absence of UK candidates equipped with strong core science, technology, engineering and mathematics-related qualifications, businesses will be forced to look overseas to plug gaps. This would mean losing out on local employment benefits.

Different subsets of the sector offer different career opportunities and a snapshot of each market represented by RenewableUK is provided below:

27.3.3 Onshore wind – leading the way

Since the first wind farm in the UK was built at Delabole in 1991, onshore wind energy has established itself as a mature, clean energy-generating technology. In 2007, wind energy overtook hydropower to become the largest renewable generation source, contributing 2.2% of the UK's electricity supply. Today, onshore wind comprises the bulk of our renewable energy generation portfolio, supplying the equivalent of over two and a half million homes with electricity.[283]

> Whilst the design and manufacture of onshore turbines takes place primarily overseas, the industry still provided 4,100 domestic jobs in 2008. The UK traditionally has its strengths in technical and environmental consultancy, planning and development – but careers in R&D, construction and maintenance, and wind energy related services are also available.[284]

First-generation onshore turbines are now coming to the end of their lives, and are to be upgraded with models twice as high and with four times the power of their predecessors. A modern 2.5MW turbine at a reasonable site will generate 6.5 million units of electricity each year; enough to meet the annual needs of over 1,400 households. In January 2009, wind turbines in the UK had the capacity to prevent the emission of 3,682,563 tonnes of carbon dioxide per annum[285] from conventional power stations.

281 Bain & Co, 2008, *Employment opportunities and challenges in the context of rapid industry growth*

282 RSM, 2010

283 RenewableUK, 2010, UK Wind Energy Database(UKWED)

284 REN21, 2010, *Renewables 2010 Global Status Report*

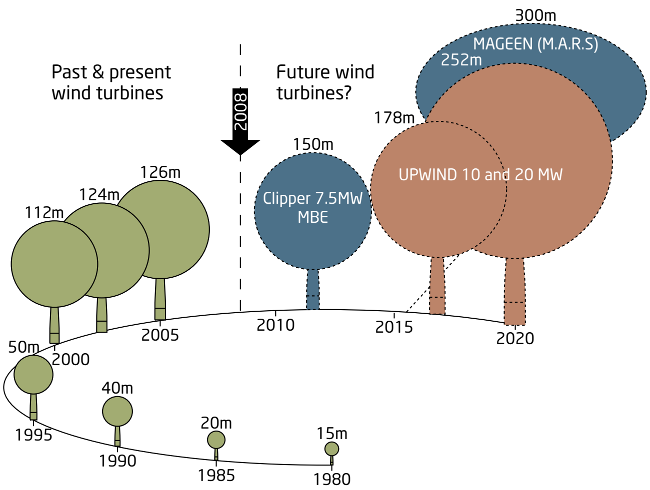
285 RenewableUK website, www.renewable-uk.com

27.3.4 Offshore wind – the waking giant

The rollout of UK offshore wind is one of the biggest offshore infrastructure developments in the world today. Offshore wind technology is reaching commercial maturity and is on track to grow at a dramatic pace in coming decades. With just over 1,500MW worth of projects installed worldwide, offshore generation currently makes up a modest 1% of total installed global wind capacity. By 2050 if just 29% of the offshore wind resource is exploited through 169GW of installed technology, the UK could rise to being a net electricity exporter.[286]

Offshore wind technology is not only giant in terms of the potential market. The devices themselves are on a pioneering scale. An offshore turbine today is rated in the 3-5MW range, with a typical tip height of 90-160m and blade span of 80-110m.[287] Figure 27.3 illustrates the differences in the scale of the onshore and offshore technologies in use and in research.

Fig. 27.3: The spectrum of different wind turbine technology sizes[288]



Today 1,040MW of clean electricity is generated off the British coastline – which makes the UK the largest offshore wind generator in the world.[289]

With long-term sustainable demand in the market for offshore wind, it is expected that at least five turbine plants and related clusters could be set up in the UK in the period to 2030, to satisfy the capacity requirements of the domestic market alone.[290] The UK has a tremendous opportunity to build a world-leading supply chain to service its domestic market and also export to the burgeoning European markets and beyond.

As offshore activity intensifies, the number of employment opportunities is set to rise. In 2008, 700 full-time equivalent employees were employed in the field. Today, 2,000 people work in offshore wind-related activities. The sector could provide 45,000 jobs by 2020 and up to 145,000 by 2050. This scale of domestic employment opportunity hinges heavily on whether manufacturers are drawn to the country, as well as continued political commitment for harnessing this natural resource to the full.

27.3.5 Marine energy – on the horizon

With one of the best tidal stream and wave climates in the world, the UK has established a lead for developing technologies for the extraction and conversion of marine energy to electricity. The sector is in its infancy. Nevertheless, the Carbon Trust has reported that it could envisage 1–2GW worth of schemes installed by 2020.[291]

RenewableUK's own research shows that by 2030 a successfully-supported marine energy sector could be creating as much as £900 million annually for the UK economy. In the longer term, the UK's natural marine resources may be able to provide as much as 20% of our electricity supply.

286 The Offshore Valuation Group, 2010, *A valuation of the UK's offshore renewable energy resource*

287 RenewableUK, 2010, Review of tip heights and rotor sizes taken from UKWED of currently installed and consented projects

288 Garrad Hassan, 2008, *Wind Energy – The Facts*

289 RenewableUK, 2010, What does the Round 3 announcement mean?

290 Douglas Westwood, 2010, UK offshore wind: building an industry

291 Carbon Trust, 2008

27.3.6 Addressing the skills gaps

Skills gaps are considered to be one of the most severe ostacles to growth for individual businesses, alongside connecting to the national grid and gaining planning permission.[292]

RenewableUK[293] has been facilitating the collaboration between companies to articulate and address their skills needs. At our Skills Summit, which was a part of the 2009 annual conference, business and skills body leaders pledged their commitment to the 'Renewable Energy Apprenticeships Programme Accord', and the 'Renewable Energy Careers and Science, Technology, Engineering and Mathematics (STEM) Guidance Accord'. Each accord sets out the responsibilities of different organisations for ensuring that a specific skills issue is systematically addressed. RenewableUK has been assisting the work of EU Skills, other Sector Skills Councils and the National Skills Academy for Power in resolving issues around vocational training. Employers predominantly need individuals with level 3+ engineering and STEM qualifications to transfer from relevant occupations or come to them directly from college. There is scope for some sector specific training, however this should be concentrated in those regions which are strategically significant to the development of renewable energy and should be delivered through regional centres of excellence.

27.4 Construction and Low Carbon

This section was authored by Lee Bryer, Research & Development Operations Manager, ConstructionSkills.

Engineering work and skills, especially civil engineering, is an important element of the UK construction industry and there are several factors that will be significant in shaping potential opportunities. One of the most important (if not the most important) is the impact that low carbon policy is having, and will continue to have, on future construction work.

Meeting the UK's legally-binding climate change targets will generate both challenges and opportunities for the construction industry, as highlighted in the UKCES *Low Carbon Cluster* report[294] and by the work of the Innovation and Growth Task Force on Low Carbon Construction.[295] But nowhere will the opportunities and challenges be more evident than in relation to jobs and skills.

From the emerging policy, the main impacts will be around ensuring that the UK is able to build a suitable energy infrastructure that supports the move to low carbon power generation, while also ensuring that new and existing buildings are as energy-efficient as possible. Both of these aspects will require a construction workforce that has the right skills at the right time. The engineering aspects will be especially important for large-scale energy infrastructure projects such as the construction of wind farms and new nuclear power stations.

Current forecasts show continued growth in the infrastructure sector while other sectors (such as private housing and commercial) have suffered during the recession (Figure 27.4). While there has also been growth in public non-housing work, this will undoubtedly come under increasing pressure, with cuts in public sector spending imminent. However, forecasts through to 2015 indicate that infrastructure work will continue to grow to an estimated £12 billion by 2015; public non-housing is expected to decline to less than £10 billion over the same period.

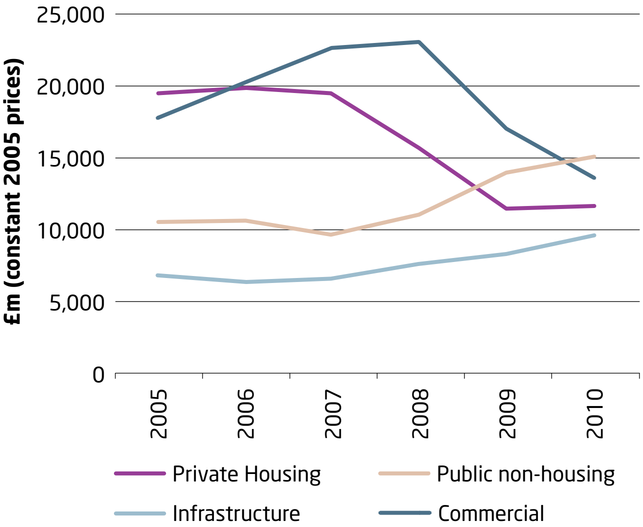
292 Bain & Co, 2008, *Employment opportunities and challenges in the context of rapid industry growth*

293 RenewableUK, previously known as BWEA, is the leading UK renewable energy trade association. Established in 1978 with over 650 corporate members today, RenewableUK represents the large majority of the wind, wave and tidal energy companies in the sector.

294 *Low Carbon Cluster, Sector Skills Assessment Report*, December 2009 http://www.sscalliance.org/nmsruntime/saveasdialog.aspx?lID=974&sID=1858

295 *Low Carbon Construction Innovation & Growth Team: Emerging Finding*, Spring 2010 http://www.bis.gov.uk/assets/biscore/business-sectors/docs/10-671-construction-igt-emerging-findings.pdf

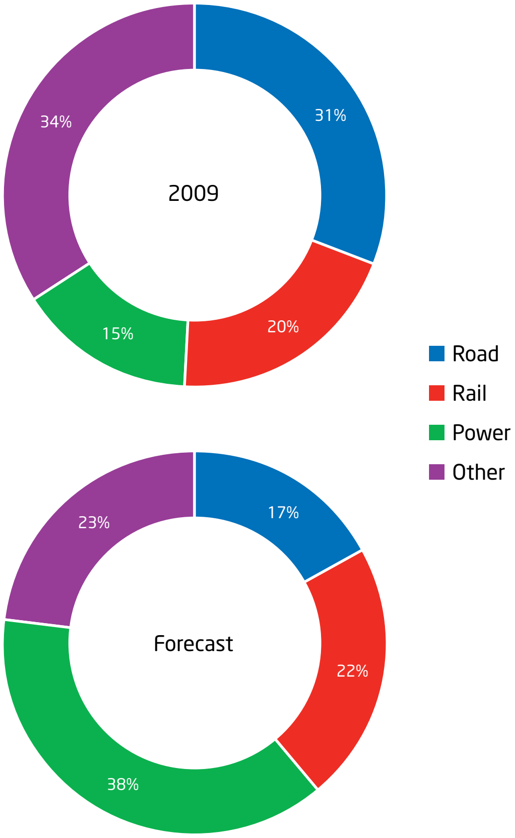
Fig. 27.4: Construction output, selected sectors (2005-2010)



Source: Construction Skills Network, 2010

As noted earlier, energy-related infrastructure projects will play a large part in future output and this is shown by Figure 27.5, which looks at the balance of work in the sector. During 2009, road and rail work accounted for around 50% of output, with power work contributing around 15%. Looking forward, this balance is set to change, with rail and road work accounting for less than 40% of output while the share of power-related work more than doubles.

Fig. 27.5: Balance of infrastructure output, 2009 against forecast



Source: Construction Skills Network, 2010

This highlights the need for suitably qualified and experienced staff to deliver very large scale projects if the UK is to have a low carbon power generation capacity.

While power generation will play an important part, it is also vital to ensure that new and existing buildings use energy in the most cost effective and efficient manner, as heating and power used in buildings is currently responsible for around 47% of all UK carbon emissions.[296] Measures to improve the energy efficiency of buildings, while incorporating low carbon/renewable power systems, will therefore play a major role in being able to reduce emissions.

The importance of tackling emissions for existing domestic buildings is further emphasised by the fact that, "80% of the homes that will be standing in 2050 have already been built," (Low Carbon Cluster, p54).

Addressing the challenge of having low carbon buildings is a significant opportunity for the construction industry, as the impact will be felt across all sectors of work from new housing through to the repair and maintenance of existing buildings. Recent work undertaken by ConstructionSkills indicates that, if there were to be a rapid uptake of low carbon measures, particularly in the non-domestic sectors, up to 60% of the workforce would have to adapt their skills.

In terms of how this skills requirement could be delivered, there is an established network of Further Education colleges, Higher Education institutions and private training providers across the UK that delivers a range of training for the construction industry and the wider built environment. However, much of the current evidence and opinion points to manufacturer-based training as being the emerging and potentially significant route for knowledge transfer and up-skilling.

It will therefore be vitally important that engineering professionals, technicians and operatives involved in the built environment have a thorough understanding of the impact that low carbon measures will have, as well and the necessary skills and knowledge, to effectively meet these challenges and opportunities.

296 *Low Carbon Cluster Sector Skills Assessment Report*, 2009, UKCES

28.0 Annex

28.1 QCF, NVQs and NOS

The Qualification and Credit Framework (QCF) went live in September 2008 and should be fully implemented by September 2010. It includes new operating rules for NVQ 'type' qualifications. These are set out in *Operating rules for using the term 'NVQ' in a QCF qualification title* (Ofqual Aug 2008).[297]

Meanwhile, many SSCs have been updating and rationalising their National Occupational Standards (NOS) – upon which, for example, (NVQ)s must be solely based – although not all SSCs have slimmed down yet. The UK Commission for Employment and Skills (UKCES) has carried out a review of NOS. It has also been overseeing re-licensing of the SSCs.

Level descriptors (QCF)

QCF level descriptors may provide a helpful tool in the future. All qualifications and units accredited to the QFC must conform to these level descriptors. Although, strictly speaking, they provide a guideline for practitioners involved in the design and delivery of qualification units. However, QCA has helpfully stated that, "the level descriptors are concerned with the outcomes of learning and not the process of learning or the method of assessment," [QCA, 2008:2]. The QCF level 3 descriptor is set out in Table 28.0.

297 Ofqual (2008b). Operating rules for using the term 'NVQ' in a QCF qualification title: http://www.ofqual.gov.uk/1947.aspx

Table 28.0: QCF level 3 descriptors[298] – England and Northern Ireland

Level summary	Knowledge and understanding	Application and action	Autonomy and accountability
Achievement at level 3 reflects the ability to identify and use relevant understanding, methods and skills to complete tasks and address problems that, while well defined, have a measure of complexity. It includes taking responsibility for initiating and completing tasks and procedures as well as exercising autonomy and judgement within limited parameters. It also reflects awareness of different perspectives or approaches within an area of study or work.	Use factual, procedural and theoretical understanding to complete tasks and address problems that, while well defined, may be complex and non-routine Interpret and evaluate relevant information and ideas Be aware of the nature of the area of study or work Have awareness of different perspectives or approaches within the area of study or work	Address problems that, while well defined, may be complex and non-routine Identify, select and use appropriate skills, methods and procedures Use appropriate investigation to inform actions Review how effective methods and actions have been	Take responsibility for initiating and completing tasks and procedures, including, where relevant, responsibility for supervising or guiding others Exercise autonomy and judgment within limited parameters

Credit

Credit in the QCF includes some notion of time-serving, which is a little problematic if the focus is on outcomes. However, all new units developed for the QCF must have a credit level and credit value and learners will be able to accumulate and transfer credit.

The level signifies the level of challenge or difficulty. The value indicates the amount of 'notional' learning time required, on average, for a learner to achieve a unit. One credit = 10 notional learning hours.

Notional learning differs from the Guided Learning Hours (GLH) figure currently used with NQF qualifications. As with GLH, it includes activities that learners need to do while supervised in order to complete their qualification, such as:

- Classes
- Tutorials
- Practical work
- Assessments

However, in addition to these notional learning time includes non-supervised activities such as homework, independent research, unsupervised rehearsals and work experience.[299]

298 QCDA (2008). Level descriptors for the QCF - Version 3. http://www.qca.org.uk/qca_20252.aspx

299 NCFE, 2009, Qualifications and Credit Framework (QCF) FAQs. www.ncfe.org.uk/download/Downloads/QCF%20FAQs%206%202%2009.doc

28.1.1 Qualification equivalences

Table 28.1: Qualifications can cross boundaries – a rough guide to comparing qualifications and levels in the UK and Ireland

Main stages of education / employment	Framework for higher education qualifications in England, Wales and Northern Ireland www.qaa.ac.uk/ academicinfrastructure/fheq	National Qualifications Framework for England,Wales and Northern Ireland* www.qca.org.uk/qualifications www.wales.gov.uk www.ccea.org.uk www.qca.org.uk/openquals	Credit and Qualification Framework for Wales www.cqfw.net	National Framework of Qualifications for Ireland www.nfq.ie	The Scottish Credit and Qualifications Framework www.scqf.org.uk
	Level	Level	Level	Level	Level
Professional or postgraduate education, research or employment Higher education Advanced skills training Specialised education and training Qualified/Skilled worker Entry to higher education Completion of secondary education Progression to skilled employment. Continuation of secondary education Secondary education Initial entry into employment or further education Qualifications can be taken at any age in order to continue or return to education or training	08 Doctoral Degrees 07 Master's Degrees, Integrated Master's Degrees, Postgraduate Diplomas, Postgraduate Certificate in Education (PGCE), Postgraduate Certificates 06 Bachelor's Degrees with Honours, Bachelor's Degrees, Professional Graduate Certificate in Education (PGCE), Graduate Diplomas, Graduate Certificates 05 Foundation Degrees, Diplomas of Higher Education (DipHE), Higher National Diplomas (HND) 04 Higher National Certificates (HNC), Certificates of Higher Education (CertHE) The table gives an indication of how you can compare qualifications across national boundaries. Examples of major qualifications at each level are provided. For more detail of the qualifications in another country, you will need to consult the website given at the head of each column. This leaflet is designed to give some information to help you begin this process, for example, by telling you what your qualification, or qualifications you are interested in studying, are broadly comparable to in other countries. Qualifications can cross boundaries – a rough guide to comparing qualifications in the UK and Ireland. March 2009.	08 Vocational Qualifications Level 8 07 Fellowships, NVQ Level 5, Vocational Qualifications Level 7 06 Vocational Qualifications Level 6 05 NVQ Level 4, Higher National Diplomas, (HND), Higher National Certificates (HNC), Vocational Qualifications Level 5 04 Vocational Qualifications Level 4 03 NVQ Level 3, Vocational Qualifications Level 3, GCE AS and A Level, Advanced Diplomas 02 NVQ Level 2,Vocational Qualifications Level 2, GCSEs at gradeA*–C, ESOL skills for life, Higher Diplomas, functional skills Level 2 (English,mathematics & ICT) 01 NVQ Level 1, Vocational Qualifications Level 1, GCSEs at grade D–G, ESOL skills for life, Foundation Diplomas, functional skills Level 1 (English, mathematics & ICT) **Entry Level** Entry Level Certificates (sub levels 1–3), ESOL skills for life, functional skills Entry Level (English, mathematics & ICT)	08 Doctoral Degrees 07 Master's Degrees, Integrated Master's Degrees, Postgraduate Diplomas, Postgraduate Certificate in Education (PGCE), Postgraduate Certificates 06 Bachelor's Degrees with Honours, Bachelor's Degrees, Professional Graduate Certificate in Education (PGCE), Graduate Diplomas, Graduate Certificates 05 Foundation Degrees, Diplomas of Higher Education (DipHE), Higher National Diplomas (HND) 04 Higher National Certificates (HNC), Certificates of Higher Education (CertHE) 03 NVQ Level 3, Vocational Qualifications Level 3, GCE AS and A Level, Welsh Baccalaureate Qualification Advanced 02 NVQ Level 2, Vocational Qualifications Level 2,Welsh Baccalaureate Qualification Intermediate, GCSEs grade A*–C 01 NVQ Level 1, Vocational Qualifications Level 1, GCSEs at grade D–G, Welsh Baccalaureate Qualification Foundation **Entry Level** Entry Level Certificate (sub levels 1–3)	10 Doctoral Degree,Higher Doctorate 09 Master's Degree, Postgraduate Diploma 08 Honours Bachelor Degree,Higher Diploma 07 Ordinary Bachelor Degree 06 Advanced Certificate, Higher Certificate 05 Level 5 Certificate, Leaving Certificate 04 Level 4 Certificate, Leaving Certificate 03 Level 3 Certificate, Junior Certificate 02 Level 2 Certificate 01 Level 1 Certificate	12 Professional Development Awards, Doctoral Degrees 11 SVQ Level 5, Professional Development Awards, Postgraduate Diplomas, Master's Degrees, Integrated Master's Degrees, Postgraduate Certificates, 10 Bachelor's Degrees with Honours, Professional Development Awards, Graduate Diplomas, Graduate Certificates 09 Bachelor's/Ordinary Degrees, Professional Development Awards, SVQ Level 4, Graduate Diplomas, Graduate Certificates 08 Higher National Diplomas, SVQ Level 4, Professional Development Awards, Diplomas of Higher Education (DipHE) 07 Professional Development Awards, Higher National Certificates (HNC), Certificates of Higher Education (CertHE) SVQ Level 3, Advanced Highers 06 Highers, SVQ Level 3, Professional Development Awards, National Progression Awards, National Certificates 05 Intermediate 2, Credit Standard Grade, SVQ 2, National Progression Awards, National Certificates 04 Intermediate 1, General Standard Grade, Scottish Vocational Qualifications (SVQ) 1, National Progression Awards, National Certificates 03 Access 3, Foundation Standard Grades, National Progression Awards, National Certificates 02 Access 2 National Progression Awards, National Certificates 01 Access 1

Source: QCA et al. Qualifications can cross boundaries 2009[300]

300 *Qualifications can cross boundaries – a rough guide to comparing qualifications in the UK and Ireland* (Last updated: 20 Apr 2009). Accessed 26 May 2009: http://www.qca.org.uk/qca_22197.aspx

28.2 Glossary of terms

Table 28.2: List of acronyms

ABI	Annual Business Inquiry	www.statistics.gov.uk/abi/
AGR	Association of Graduate Recruiters	www.agr.org.uk
ALP	Association of Learning Providers	www.learningproviders.org.uk/
API	Age Participation Index	
ASHE	Annual Survey of Hours and Earning	www.statistics.gov.uk/statBase/product.asp?vlnk=13101
ASSCs	Alliance of Sector Skills Councils	www.sscalliance.org/
BIS	Department for Business, Innovation and Skills	www.bis.gov.uk
BERR	Department for Business, Enterprise and Regulatory Reform (England)	www.berr.gov.uk/
CASE	Campaign for Science and Engineering	www.sciencecampaign.org.uk
CEM	Curriculum, Evaluation and Management	www.cemcentre.org/
CCC	Committee on Climate Change	www.theccc.org.uk
CCS	Carbon capture and storage	
CHP	Combined heat and power	
CIE	University of Cambridge International Examinations	www.cie.org.uk/
DCELLS	Department for Children, Education, Lifelong Learning and Skills (Wales)	http://new.wales.gov.uk/
DCSF	Department for Children, Schools and Families (England)	www.dcsf.gov.uk/
DE	Distributed energy	
DECC	Department of Energy and Climate Change	www.decc.gov.uk
DEFRA	Department for Environment, Food and Rural Affairs	http://www.defra.gov.uk/
DELNI	Department for Employment and Learning Northern Ireland	www.delni.gov.uk/
DENI	Department of Education Northern Ireland	www.deni.gov.uk/
DfE	Department for Education	www.education.gov.uk
DIUS	Department for Innovation, Universities & Skills (England)	www.dius.gov.uk/
DLHE	Destination of Leavers from Higher Education	
DWP	Department for Work and Pensions	www.dwp.gov.uk/
E&T	Engineering and Technology	
ECITB	Engineering Construction Industry Training Board	www.ecitb.org.uk/
ECUK	Engineering Council UK	www.engc.org.uk/
EDDP	Engineering Diploma Development Partnership	
EEA	European Economic Area	
EEBM	Engineers and Engineering Brand Monitor	

EHRC	Equalities and Human Rights Commission	www.equalityhumanrights.com
EMT	Engineering and manufacturing technologies	
EQF	European Qualifications Framework for Lifelong Learning	
ESM	Energy systems modelling	
E&T	Engineering and technology	
FE	Further Education	
FMA	Foundation Modern Apprenticeship	
FSB	Federation of Small Businesses	www.fsb.org.uk/
FSS	Futureskills Scotland	www.futureskillsscotland.org.uk/
FSSC	Financial Services Skills Council	www.fssc.org.uk
FSW	Futureskills Wales	www.learningobservatory.com/
GAD	Government Actuary's Department	www.gad.gov.uk/
GB	Great Britain (England, Wales and Scotland)	
GCSE	General Certificate of Secondary Education	
GLH	Guided learning hours	
HE	Higher Education	
HEFCE	Higher Education Funding Council for England	www.hefce.ac.uk/
HEFCW	Higher Education Funding Council for Wales	www.hefcw.ac.uk/
HEI	Higher Education Institution	
HEIPR	Higher Education Initial Participation Rate	
HESA	Higher Education Statistics Authority	www.hesa.ac.uk/
HIE	Highland and Islands Enterprise	www.hie.co.uk/
HTF(V)	Hard-to-fill vacancy	
ICE	Institution of Civil Engineers	www.ice.org.uk/
IDBR	Inter-Departmental Business Register	www.statistics.gov.uk/idbr/idbr.asp
IER	Institute of Employment Research	www.ier.org.uk
IGCSE	International General Certificate of Secondary Education	www.cie.org.uk/
JCQ	Joint Council for Qualifications	www.jcq.org.uk/
LFS	Labour Force Survey	
LLUK	Lifelong Learning UK	www.lluk.org/
LLWR	Lifelong Learning Wales Record	
LSC	Learning and Skills Council (England)	www.lsc.gov.uk/
LSN	Learning and Skills Network	www.lsnlearning.org.uk
MA	Modern Apprenticeship	
MAC	Migration Advisory Committee	http://ukba.homeoffice.gov.uk/
NEET	Not in education, employment or training	

NES	National Employers Service	http://nes.lsc.gov.uk/
NMW	National minimum wage	
NOS	National Occupational Standards	
NPV	Net present value	
OECD	Organisation for Economic Co-operation and Development	www.oecd.org/
Ofgem	Office for Gas, Electricity	http://www.ofgem.gov.uk/
Ofqual	Office for Qualifications and Examinations	www.ofqual.gov.uk
Ofsted	Office for Standards in Education, Children's Services and Skills	http://www.ofsted.gov.uk/
ONS	Office for National Statistics – UK Statistics Authority	http://www.statistics.gov.uk/
PARN	Professional Associations Research Network	www.parnglobal.com
PBS	Points-based system	
PGIPR	Post-Graduate Initial Participation Rate	
PSSSG	Power Sector Skills Strategy Group	
PV	Photo-voltaic	
QCDA	Qualifications and Curriculum Development Agency	http://www.qcda.gov.uk
QCF	Qualifications and Credit Framework	
RAE	Research Assessment Exercise	
RAEng	Royal Academy of Engineering	www.raeng.org.uk/
REF	Research Excellence Framework	
ROSE	Relevance of Science Education	
RPI	Retail Prices Index	
SIG	Special interest group	
S/NVQ	Scottish/National Vocational Qualification	
SCQF	Scottish Credit and Qualification Framework	www.scqf.org.uk/
SDS	Skills Development Scotland	www.skillsdevelopmentscotland.co.uk/
Semta	Science, Engineering, Manufacturing Technologies Alliance	www.semta.org.uk/
SEn	Scottish Enterprise	www.scottish-enterprise.com/
SET	Science, engineering and technology	
SFC	Scottish Funding Council (Further and Higher Education)	www.sfc.ac.uk/
SIC	Standard Industrial Classification	
SKOPE	Centre on Skills, Knowledge and Organisational Performance	www.skope.ox.ac.uk/
SOC	Standard Occupational Classification	
SOL	Shortage Occupation List	
SSAT	Specialist Schools and Academies Trust	www.ssatrust.org.uk
SSC	Sector Skills Council	www.sscalliance.org/
SSV	Skills shortage vacancy	

SQA	Scottish Qualifications Authority	www.sqa.org.uk/
SQS	Sector Qualification Strategy	
SSA	Sector Subject Area	
STEM	Science, technology, engineering and mathematics	
TNE	Trans-national education	
UCAS	Universities and Colleges Admissions Service	www.ucas.ac.uk/
UK	United Kingdom of Great Britain and Northern Ireland	
UKCES	UK Commission for Employment and Skills	www.ukces.org.uk/
UK-SPEC	UK Standard for Professional Engineering Competence	
UoC	University of Cambridge	www.cam.ac.uk/
UTC	University Technical College	
UUK	Universities UK	www.universitiesuk.ac.uk/
VRQ	Vocationally-Related Qualification	
WAG	Welsh Assembly Government	http://wales.gov.uk/
WBL	Work-Based Learning	
WFIII	Working Futures III	

28.3 SIC and SOC codes

Standard Occupational Classification (SOC) codes

The Standard Occupational Classification was first published in 1990 to replace both the Classification of Occupations 1980 (CO80) and the Classification of Occupations and Dictionary of Occupational Titles (CODOT). SOC 1990 has been revised and updated to produce SOC2000.

The two main concepts of the classification remain unchanged:

- Kind of work performed (job)
- Competent performance of the tasks and duties (skill)

Office of National Statistics (ONS)

28.3.1 SOC codes used with Working Futures (section 25)

The analysis based around Working Futures III used the following SOC 2000 codes at two- and three-digit levels:

- 212 – Engineering professionals
- 213 – ICT professionals
- 31 – Science and technology associate professionals
- 52 – Skilled metal and electrical trades
- 531 – Construction trades
- 81 – Process, plant and machine operatives

28.3.2 Three-digit SOC 2000 codes – engineers and technicians (section 20)

The following list of SOC codes has been used to define engineers and technicians more specifically.

Table 28.3 Standard occupational classifications used to define engineers (2000)

Code	Standard occupation
112 (all)	Production managers
114 (all)	Quality & customer care managers
212 (all)	Engineering professionals
213 (all)	Information & communication technology professionals
231 (all)	Teaching professionals
243 (all)	Architects, town planners, surveyors
311 (all)	Science & engineering technicians
312 (all)	Draughtspersons & building inspectors
313 (all)	IT service delivery occupations
351 (all)	Transport associate professionals
354 (all)	Sales & related associate professionals
356 (all)	Public service & other associate professionals
521 (all)	Metal forming, welding and related trades
522 (all)	Metal machining, fitting and instrument making trades
523 (all)	Vehicle trades
524 (all)	Electrical trades
531 (all)	Construction trades
532 (all)	Building trades
811 (all)	Process operatives
812 (all)	Plant and machine operatives
813 (all)	Assemblers and routine operatives
814 (all)	Construction operatives
911 (all)	Elementary agricultural occupations
912 (all)	Elementary construction occupations
913 (all)	Elementary process plant occupations
914 (all)	Elementary goods storage occupations

Table 28.4 Standard occupational classifications used to define science and mathematics (2000)

Code	Standard occupation
118 (all)	Health & social services managers
211 (all)	Science professionals
221 (all)	Health professionals
232 (all)	Research professionals
321 (all)	Health associate professionals
355 (all)	Conservation associate professionals
611 (all)	Healthcare and related personal services
612 (all)	Childcare and related personal services
613 (all)	Animal care services

28.3.3 Standard Industrial Classification (SIC) codes

The United Kingdom Standard Industrial Classification (SIC) of economic activities is used to classify business establishments and other standard units by the type of economic activity in which they are engaged. It provides a framework for the collection, tabulation, presentation and analysis of data and its use promotes uniformity. In addition, it can be used for administrative purposes and by non-government bodies as a convenient way of classifying industrial activities into a common structure.

Table 28.5: Standard industrial classifications (2003)[301 302] (sections 6 and 21)

Code	Standard Industrial Classification
10 (all)	Mining of coal and lignite; extraction of peat
11 (all)	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12 (all)	Mining of uranium and thorium ores
13 (all)	Mining of metal ores
14 (all)	Other mining and quarrying
15.92	Production of ethyl alcohol from fermented materials
17.54.2	Manufacture of narrow fabrics
17.54.9	Manufacture of other textiles not elsewhere classified
20.30	Manufacture of builders' carpentry and joinery
23 (all)	Manufacture of coke, refined petroleum products and nuclear fuel
24 (all)	Manufacture of chemicals and chemical products
25 (all)	Manufacture of rubber and plastic products
26 (all)	Manufacture of other non-metallic mineral products
27 (all)	Manufacture of basic metals
28 (all)	Manufacture of fabricated metal products, except machinery and equipment
29 (all)	Manufacture of machinery and equipment not elsewhere classified
30 (all)	Manufacture of office machinery and computers
31 (all)	Manufacture of electrical machinery and apparatus not elsewhere classified
32 (all)	Manufacture of radio, television and communication equipment and apparatus
33 (all)	Manufacture of medical, precision and optical instruments, watches and clocks
34 (all)	Manufacture of motor vehicles, trailers and semi-trailers
35 (all)	Manufacture of other transport equipment
36.21	Striking of coins
36.40	Manufacture of sports goods
36.50	Manufacture of games and toys
37 (all)	Recycling

301 These codes have been mapped back to SIC 2003

302 Used for National Employer Skills Survey 2009 and Inter-Departmental Business Register analysis

40.11	Production of electricity
40.12	Transmission of electricity
40.21	Manufacture of gas
40.30	Steam and hot water supply
41 (all)	Collection, purification and distribution of water
45.11	Demolition and wrecking of buildings; earth moving
45.12	Test drilling and boring
45.21	General construction of buildings and civil engineering works
45.23	Construction of motorways, roads, railways, airfields and sports facilities
45.24	Construction of water projects
45.25	Other construction work involving special trades
45.31	Installation of electrical wiring and fittings
45.32	Insulation work activities
45.33	Plumbing
45.34	Other building installation
45.45	Other building completion
45.50	Renting of construction or demolition equipment with operator
50.20	Maintenance and repair of motor vehicles
52.72	Repair of electrical household goods
60.30	Transport via pipelines
62.30	Space transport
64.20	Telecommunications
72.10	Hardware consultancy
72.21	Publishing of software
72.22	Other software consultancy and supply
72.30	Data processing
72.50	Maintenance and repair of office, accounting and computing machinery
73.10	Research and experimental development on natural sciences and engineering
74.20.3	Quantity surveying activities
74.20.4	Engineering consultative and design activities
74.20.5	Engineering design activities for industrial process and production
74.20.6	Engineering related scientific and technical consulting activities
74.20.9	Other engineering activities
74.30	Technical testing and analysis
90.01	Collection and treatment of sewage
90.03	Sanitation, remediation and similar activities

Table 28.6: Standard industrial classifications for engineering and technology activity (2007)[303] (section 20)

Code	Standard Industrial Classification
05 (all)	Mining of coal and lignite
06 (all)	Extraction of crude petroleum and natural gas
07 (all)	Mining of metal ores
08 (all)	Other mining and quarrying
09 (all)	Mining support service activities
10 (all)	Manufacture of food products
11 (all)	Manufacture of beverages
12 (all)	Manufacture of tobacco products
13 (all)	Manufacture of textiles
14 (all)	Manufacture of wearing apparel
15 (all)	Manufacture of leather and related products
16 (all)	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17 (all)	Manufacture of paper and paper products
18 (all)	Printing and reproduction of recorded media
19 (all)	Manufacture of coke and refined petroleum products
20 (all)	Manufacture of chemicals and chemical products
21 (all)	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22 (all)	Manufacture of rubber and plastic products
23 (all)	Manufacture of other non-metallic mineral product
24 (all)	Manufacture of basic metals
25 (all)	Manufacture of fabricated metal products, except machinery and equipment

303 Used for analysing the graduate destinations data

26 (all)	Manufacture of computer, electronic and optical products
27 (all)	Manufacture of electrical equipment
28 (all)	Manufacture of machinery and equipment (not elsewhere classified)
29 (all)	Manufacture of motor vehicles, trailers and semi-trailers
30 (all)	Manufacture of other transport equipment
31 (all)	Manufacture of furniture
32 (all)	Other manufacturing
33 (all)	Repair and installation of machinery and equipment
35 (all)	Electricity, gas, steam and air conditioning supply
36 (all)	Water collection, treatment and supply
37 (all)	Sewerage
38 (all)	Waste collection, treatment and disposal activities; materials recovery
39 (all)	Remediation activities and other waste management services
41 (all)	Construction of buildings
42 (all)	Civil engineering
43 (all)	Specialised construction activities
45 (all)	Wholesale & retail trade and repair of motor vehicles and motorcycles
49 (all)	Land transport and transport via pipelines
50 (all)	Water transport
51 (all)	Air transport
52 (all)	Warehousing and support activities for transportation
59 (all)	Motion picture, video and television programme production, sound recording and music publishing activities
60 (all)	Programming and broadcasting activities
61 (all)	Telecommunications
62 (all)	Computer programming, consultancy and related activities
63 (all)	Information service activities
71 (all)	Architectural and engineering activities; technical testing and analysis
74 (all)	Other professional, scientific and technical activities
84 (all)	Public administration and defence; compulsory social security
85 (all)	Education
95 (all)	Repair of computers and personal and household goods

Table 28.7: Standard industrial classifications for science and mathematics activity (2007)[304] (section 20)

Code	Standard Industrial Classification
72 (all)	Scientific research and development
75 (all)	Veterinary activities
86 (all)	Human health activities

304 Used for analysing the graduate destinations data

28.4 Sector Skills Council (SSC) footprints

Table 28.8 lists the ten key Sector Skills Councils (SSCs) that cover engineering and technology industry in the UK:

Table 28.8: Definition of Sector Skills Council footprint (SIC 2007)

SSC	Description	SIC 2007 Code Footprint
Asset Skills	Facilities management, housing, property, planning, cleaning and parking	55.90, 68.10, 68.20, 68.20/1, 68.20/2, 68.20/9, 68.31, 68.32, 77.33, 81.10, 81.21, 81.22, 81.22/1, 81.22/2, 81.22/3, 81.22/9, 81.29, 81.29/1, 81.29/9
The Institute of the Automotive Industry	Vehicle maintenance and repair, motorcycle maintenance and repair, fast-fit operations (tyres, exhausts, batteries etc), accident repair, body building, parts distribution and supply, vehicle sales, vehicle rental and leasing (self drive or with driver), roadside assistance and recovery, lift truck maintenance and repair and motorsport maintenance and repair	45.11, 45.11/1, 45.11/2, 45.19, 45.20, 45.31, 45.32, 45.40, 52.21/9, 77.11, 77.12
Cogent SSC	Chemicals and pharmaceuticals, nuclear, oil and gas, petroleum, polymers and sign making	06.10, 06.20, 09.10, 19.10, 19.20, 19.20/1, 19.20/9, 20.11, 20.12, 20.13, 20.14, 20.15, 20.16, 20.17, 20.20, 20.41, 20.41/1, 20.41/2, 20.42, 20.51, 20.52, 20.53, 20.59, 21.10, 21.20, 22.19, 22.21, 22.22, 22.23, 22.29, 24.46, 47.30, 82.92
Construction Skills	Construction	41.10, 41.20, 41.20/1, 41.20/2, 42.11, 42.12, 42.13, 42.21, 42.22, 42.91, 42.99, 43.11, 43.12, 43.13, 43.29, 43.31, 43.32, 43.33, 43.34, 43.34/1, 43.34/2, 43.39, 43.91, 43.99, 43.99/1, 43.99/9, 71.11, 71.11/1, 71.11/2, 71.12/2, 71.12/9, 74.90/2
e-skills	IT, telecoms and contact centres (covering all industries as well as licensed SIC codes).	18.20/3, 58.21, 58.29, 61.10, 61.20, 61.30, 61.90, 62.01, 62.01/1, 62.01/2, 62.02, 62.03, 62.09, 63.11, 63.12, 95.11, 95.12
Energy & Utility Skills	Electricity, gas, waste management and water industries.	35.11, 35.12, 35.13, 35.14, 35.21, 35.22, 35.23, 36.00, 37.00, 38.11, 38.12, 38.21, 38.22, 38.31, 38.32, 39.00, 49.50
Go Skills	Aviation (airlines, airports and ground handling agents), bus, coach, community transport, driver training, inland waterways, rail operations, rail engineering, transport planning, taxi and private hire, chauffeur, metro, light rail and tram	49.10, 49.31, 49.31/1, 49.31/9, 49.32, 49.39, 50.30, 51.10, 51.10/1, 51.10/2, 52.21/2, 52.21/3, 52.23, 85.53
Proskills	Process and manufacturing of extractives, coatings, refractories, building products, paper and print	05.10, 05.10/1, 05.10/2, 05.20, 07.10, 07.21, 07.29, 08.11, 08.12, 08.91, 08.92, 08.93, 08.99, 09.90, 13.92/1, 16.10, 16.21, 16.22, 16.23, 16.24, 16.29, 17.11, 17.12, 17.21, 17.21/1, 17.21/9, 17.22, 17.23, 17.24, 17.29, 18.11, 18.12, 18.12/1, 18.12/9, 18.13, 18.14, 20.30, 20.30/1, 20.30/2, 23.11, 23.12, 23.13, 23.14, 23.19, 23.20, 23.31, 23.32, 23.41, 23.42, 23.43, 23.44, 23.49, 23.51, 23.52, 23.61, 23.62, 23.63, 23.64, 23.65, 23.69, 23.70, 23.91, 23.99, 31.01, 31.02, 31.03, 31.09, 95.24

SSC	Description	SIC 2007 Code Footprint
Semta	Science, engineering and manufacturing technologies.	22.11, 24.10, 24.20, 24.31, 24.32, 24.33, 24.34, 24.41, 24.42, 24.43, 24.44, 24.45, 24.51, 24.52, 24.53, 24.54, 25.11, 25.12, 25.21, 25.29, 25.30, 25.40, 25.50, 25.61, 25.62, 25.71, 25.72, 25.73, 25.91, 25.92, 25.93, 25.94, 25.99, 26.11, 26.12, 26.20, 26.30, 26.30/1, 26.30/9, 26.40, 26.51, 26.51/1, 26.51/2, 26.51/3, 26.51/4, 26.52, 26.60, 26.70, 26.70/1, 26.70/2, 26.80, 27.11, 27.12, 27.20, 27.31, 27.32, 27.33, 27.40, 27.51, 27.52, 27.90, 28.11, 28.12, 28.13, 28.13/1, 28.13/2, 28.14, 28.15, 28.21, 28.22, 28.23, 28.24, 28.25, 28.29, 28.30, 28.30/1, 28.30/2, 28.41, 28.49, 28.91, 28.92, 28.92/1, 28.92/2, 28.92/3, 28.93, 28.94, 28.95, 28.96, 28.99, 29.10, 29.20, 29.20/1, 29.20/2, 29.31, 29.32, 30.11, 30.12, 30.20, 30.30, 30.40, 30.91, 30.92, 30.99, 33.10, 33.11, 33.12, 33.13, 33.14, 33.15, 33.16, 33.17, 33.19, 33.20, 46.72, 71.12/1, 71.20, 72.10, 72.11, 72.19
SummitSkills	Building services engineering (electro-technical, heating, ventilation, air-conditioning, refrigeration and plumbing)	35.30, 43.21, 43.22, 95.21

Table 28.9: Definition of ITB footprint (SIC 2003)

ITB	Description	SIC 2007 Code Footprint
Description	SIC 2003 Code Footprint.	55.90, 68.10, 68.20, 68.20/1, 68.20/2, 68.20/9, 68.31, 68.32, 77.33, 81.10, 81.21, 81.22, 81.22/1, 81.22/2, 81.22/3, 81.22/9, 81.29, 81.29/1, 81.29/9

Source: UKCES and ECITB

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EngineeringUK
Weston House, 246 High Holborn, London WC1V 7EX
T 020 3206 0400 **E** info@EngineeringUK.com
www.EngineeringUK.com

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