

Choices in Science and Engineering for the **Nuclear Industry**

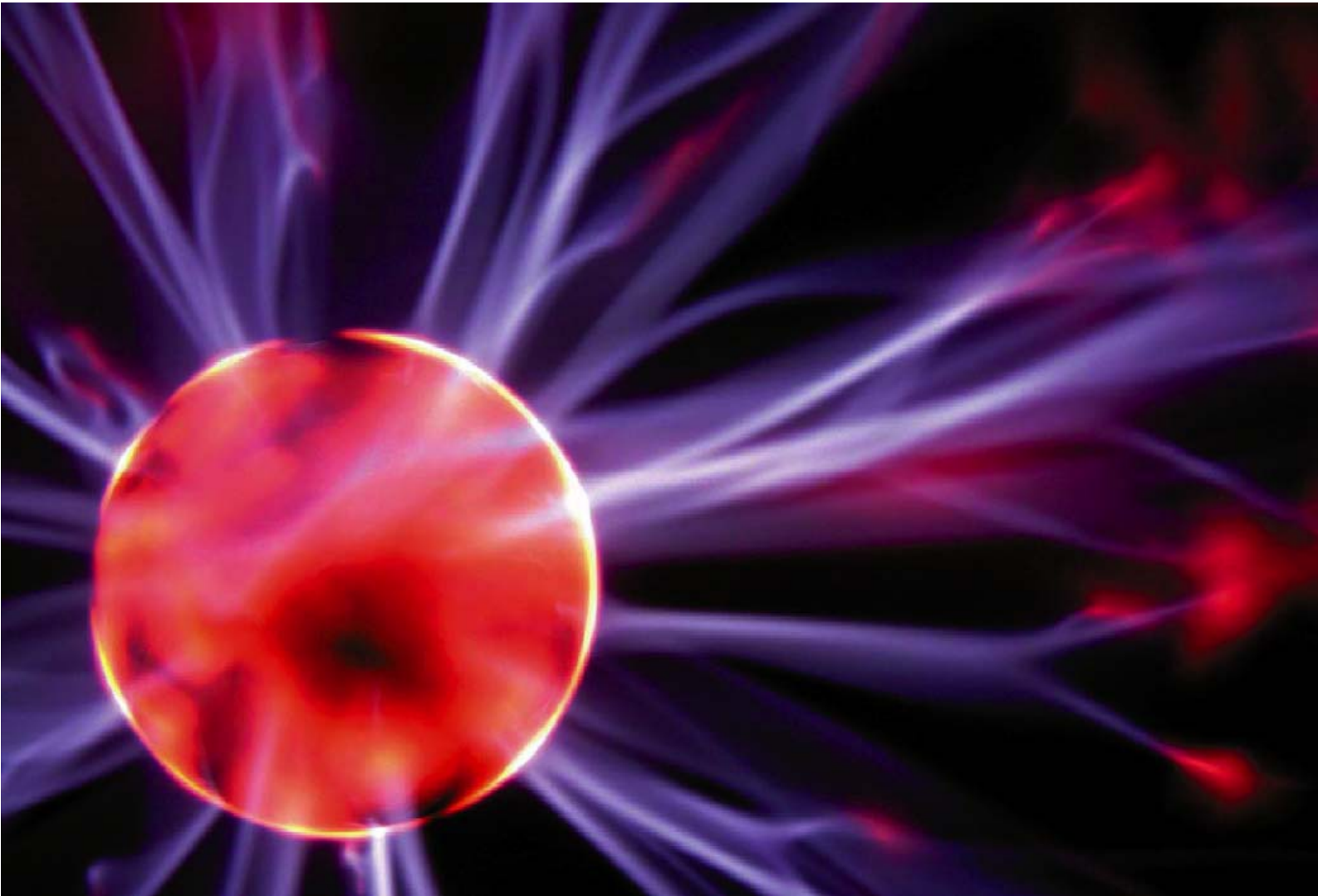
Reporting on science and engineering education choices, student destinations and entries to Nuclear

Innovation

Competence

Productivity

Sustainability



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1. Introduction

There are many reports written about the supply of the UK Science, Technology, Engineering and Mathematics (STEM) workforce, which come to the same conclusion: that employers are experiencing skill shortages, particularly in engineering disciplines. The majority of employers are looking for experienced recruits for the immediate future. However they also have concerns about longer term shortages, particularly in relation to the supply of suitably skilled and qualified people entering the STEM workforce from school, college and university.

As the existing reports have a broad focus either across all STEM subjects or broad subject areas such as engineering, it is the aim of this study to:

- Draw together findings and conclusions from the existing evidence base and;
- To further investigate trends and pull through rates in the education supply system in the subject areas identified by nuclear employers as of specific interest to them.

Cogent's work in 2005/06 on the Sector Skills Agreement (SSA) Assessment of Current Provision in education investigated trends in uptake of STEM subjects. This study seeks to investigate these trends over a longer period of time for the same specific set of subjects identified as critical for the nuclear industry.

2. Summary of Findings from other Broader STEM Surveys

A wide range of reports and studies on the subject of supply and demand for Science, Engineering and Technology workforce have been undertaken. However these studies have a broader focus than the subject areas of interest to the nuclear industry and include subjects such as computing, medical and biological sciences. These reports provide the essential context from which the issues and findings for the nuclear industry can be set and considered.

The following summarise headline findings from studies undertaken by / for the Department for Education and Skills, the Engineering Training Board, The Royal Academy of Engineering and the Institution of Engineering and Technology.

- Earlier demographic forecasts from the Government Actuary's Department suggested that the 16 and 18 year old populations are going to be relatively stable until 2010. More recent revisions to population projections have since predicted that the 16 and 18 year old populations will go into decline from 2007. This compares with growth of 10.5% of the population of 16 year olds over the past 10 years.
- The overall position of the UK in terms of "stock" (current population) of STEM employees is a strong one but this masks trends at subject level. In the immediate future, the fall in numbers taking maths and physics A Levels may reduce the numbers progressing to study these subjects at Higher Education. Although this has not yet affected the number of people studying for a maths degree, there is the potential for impact upon engineering and science degrees, as entry to these subjects at University level, have been falling in recent years.
- High wage returns for subjects like maths and engineering suggest high demand for graduates in these subject areas. It is expected that as students become more aware of earnings information and employment prospects the supply of graduates will respond to these market signals. The Department for Education and Skills notes that this effect is to be monitored.

- The projections of increases in supply of STEM skills and progressions into STEM jobs suggests supply will broadly meet demand over the next 10 years. However, this hides underlying problems with specific subjects. On current trends, increases in supply of engineering and physical sciences are relatively low and with over half of these graduates going into non-STEM occupations there is the potential that supply will not meet demand. However market forces may adjust the flow of supply.
- Overall, the UK has a large stock of STEM skills, with a generally steady supply and is in a good position to take advantage of increased demand for these skills. However, declines in the uptake of maths and science A Levels are cause for concern and there could be further future decline. It is not clear as yet whether the incentive of increasing wage premiums in specific subject areas will impact upon supply of graduates.
- Adult perceptions of science, engineering and technology are positive however many have an old fashioned view of engineering careers as dirty and male orientated.
- Those that influence young people on their subject and career choices are not well informed about the options open to young people for SET careers. Assumptions are not challenged.
- The most frequent influence upon young people entering engineering professions is thought to be the prominence of a role model who is already working in the field.

3. Secondary Education

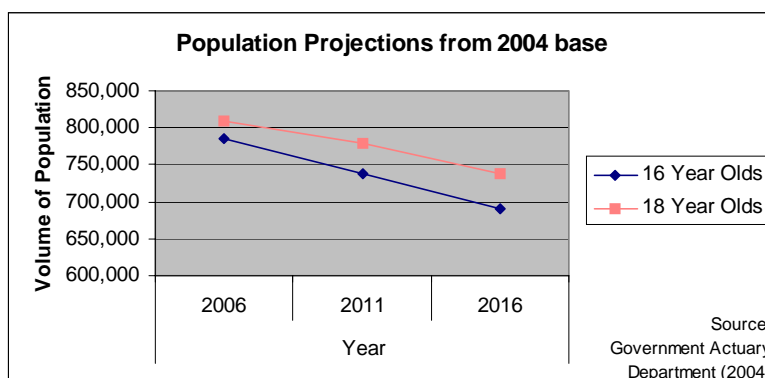
3.1 Education System Differences between Scotland & Rest of UK

The education system in Scotland differs from those across the rest of the UK. While those pupils in England, Northern Ireland and Wales are studying for GCSEs their Scottish counterparts are undertaking either Standard Grades or Intermediate 2 qualifications. Similarly at the next stage, at the time of undertaking a 2 year programme of studying A Levels in most parts of the UK, pupils in Scotland complete Highers over a period of one or two years.

For the purposes of this report in order to present a consolidated picture for the UK the equivalencies as described above have been assumed. It should also be noted that throughout this report while data is presented for a specific age group no analysis has been undertaken of the actual age profile of the candidates presented for examination. It has been assumed that the vast majority of candidates will be making a standard progression through the education system and therefore the total candidate data is presented at each stage.

3.2 Population Projections for 16 and 18 year olds in the UK

Demographic projections by the Government Actuary's Department (GAD) indicate the volume of 16-18 year olds is in overall decline from 2006/07. The projected decline in population of 16 and 18 year olds between 2006 and 2016 is illustrated in this graph and table below. This compares with net growth of this age group by about 10% over the past 10 year period according to Office for National Statistics data.



Population Projections from 2004 base							
	Year			Change		Change	
	2006	2011	2016	2006 - 2011		2006 - 2016	
16 Year Olds	786,000	737,000	691,000	-49,000	-6%	-95,000	-12%
18 Year Olds	810,000	779,000	738,000	-31,000	-4%	-72,000	-9%

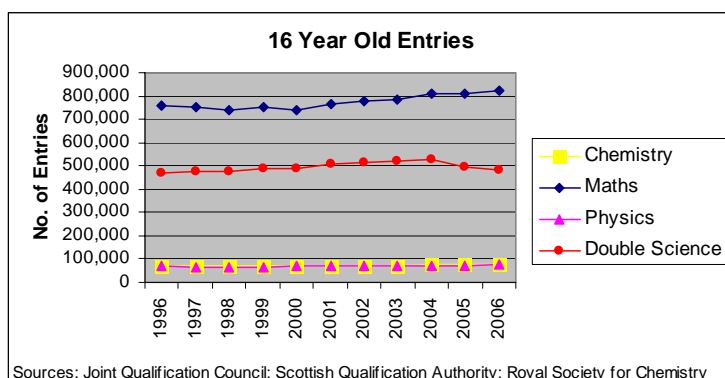
Source: Government Actuary Department (2004)

Indeed GAD shows a reduction in population of the age group 15-19 year olds of 364,000 over the period 2006-2016. This decline will have a knock on effect on the numbers sitting exams in all subjects. Should there be a similar proportion of decline in exam entrants for STEM subjects (12% and 9% respectively for 16 and 18 year olds) this will likely have implications for meeting industry demand for new entrants.

3.3 STEM Subjects Studied Age 14-16

Trends over the last 10 years are presented in the following chart (overleaf) for Chemistry, Double Science, Maths and Physics. Displaying these trends in a single chart, enabling direct comparison of uptake, results in some loss of detail for the chemistry and physics trends – to compensate Appendix 1 shows the trends for these subjects on a separate scale.

The uptake for both Chemistry and Physics has increased slowly over the period. For Chemistry the uptakes have increased by 11% over the period 1996 to 2006 to 79,812 while Physics uptakes rose by 12% to 75,729 – against a population growth of about 10%. In both cases the subjects saw slight declines from 1996 through to 1998 with a steady upward trend thereafter.



The volume of uptake for Double Science had increased steadily over the last ten years, until 2004, with uptakes increasing by 12% from 1996 to 2004 however the last two years have seen a dramatic decline in uptake of -9% between 2004 and 2006.

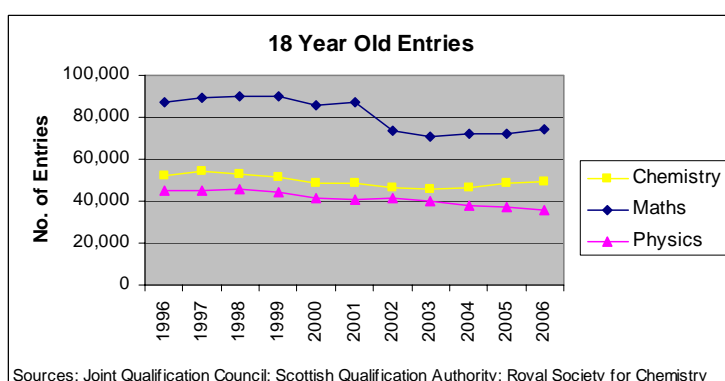
Uptakes for Maths have increased by 8% on their level in 1996 however the fluctuations in uptake here also reflect changes in population volumes. It is forecasted that

over the next ten years there will be a decline in the volume of 16 year olds in the UK and the uptake of Maths is anticipated to follow this trend.

In England, Wales and Northern Ireland the introduction of the Double Science award (first available in 1991) had a negative effect upon the uptake of Physics and Chemistry (as would be expected). The trends also suggest that this has had an impact upon the uptake of these subjects at A Level, as the rate of uptake has reduced markedly at this point and has continued to do so. As a study of sciences at A Level are a key route into higher education this trends of decline is of concern.

3.4 STEM Subjects Studied Age 16-18

All three (chemistry, maths and physics) subjects of interest have suffered a decline in uptake at this critical age over the 11 year period of this study. It is noted that the volume of passes at A-C has remained static (except for Chemistry A Level).



Overall, the number of students progressing from either Double Science or pure Chemistry studies has been declining over the period of this study. 6% fewer young people are studying either chemistry A Level or Higher although the trend since 2003 is upward.

Meanwhile for Maths A Level and Higher uptake the numbers have reduced even more dramatically with a decline of 15%. The decline noted between 2001 and 2002 has been attributed in external research by the Engineering Training Board in their report to problems experienced in the implementation of the new Curriculum 2000 for maths. It had been anticipated that the overall volumes studying at this level would recover however this has yet to materialise.



There has been a consistent downward trend in the level of uptake of physics study for both A Levels and Highers. Overall across the UK there has been a decline of 21% in numbers studying Physics at these levels. It is reported by the Royal Society that since 1991 the uptake of A Level Physics has declined by 37% (to 2006). In Scotland Higher Level uptake has dropped by 21% over the same period.

The large declines in uptake of both Maths and Physics uptakes at A Level and Higher Level has serious implications for the potential entry to Higher Education to study STEM subjects as a route into employment in the nuclear industry.

4. Higher Education

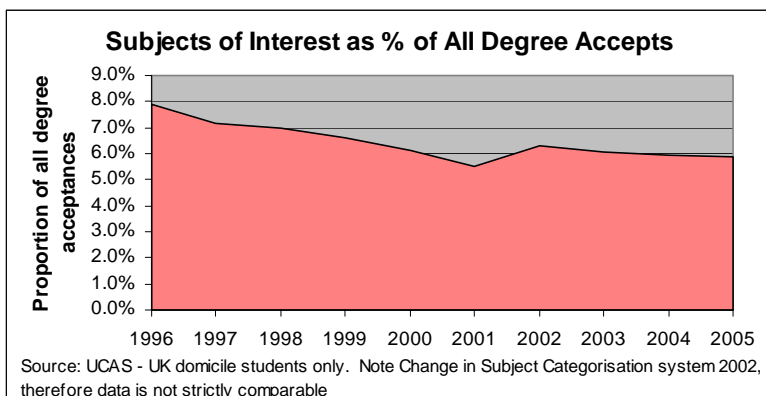
The Nuclear Employer Steering Group (NESG) requested that Cogent investigate patterns in uptake to study the following Subjects of Interest at University:

- Chemistry
- Chemical, Process and Energy Engineering
- Civil Engineering
- Electrical / Electronic Engineering
- Mathematics
- Mechanical Engineering
- Physics

Data has been sourced from the Universities and Colleges Admissions Service (UCAS) for information about UK domicile student entries to Higher Education. Further data has been sourced from the Cogent SSA Assessment of Current Provision and the Higher Education Statistics Agency regarding graduations and graduate destinations. It should be noted that the subject classification system changed in 2002 meaning that the data pre and post this date are not strictly comparable as they are based on different methodologies. However broadly speaking the figures will be indicative of changes over the period of time and have been presented on this basis.

4.1 Trends in Applications to Higher Education

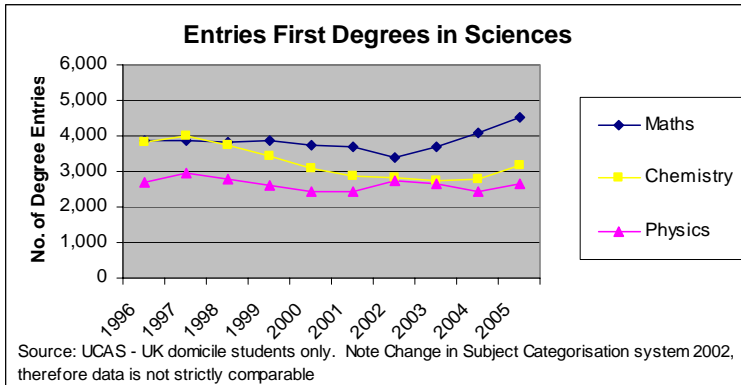
The number of UK domicile students who successfully applied to study the subjects of interest as listed in section 4. The total number has increased in absolute terms over the last 10 years from 19,511 up to 20,446. This seems to be an encouraging sign for the industry in securing supply of suitably skilled and qualified workforce in the future. However employers across the science and engineering based sectors continue to experience shortages. Largely the increase in volume can be attributed to the current policy drive to encourage 50% of young people into further or higher education (FE/HE) which has to date resulted in year on year increases in entrants to FE/HE.



While there has been a 42% increase in acceptances to study first degrees, there has only been a 5% increase in acceptances to the subjects of interest to the nuclear industry. When examined in relative terms, the subjects of interest to the nuclear industry used to represent 7.9% of the overall student population now they only attract 5.9%. This means a clear skills supply problem for the nuclear industry.

Overleaf, is a table illustrating the trends in entries of UK domicile students into first degrees in the science subjects of interest to nuclear employers – Chemistry, Maths and Physics.

The trends in volume of entries to study a first degree in Chemistry follow the trend in volumes taking up Chemistry studies at A Level and Higher at age 18. While there was an encouraging increase in



volume between 2004 and 2005 overall uptake is 17% down on 1996 levels. In relative terms as a proportion of overall undergraduate students studying first degrees chemistry represented 1.5% of acceptances in 1996 but this has declined steadily to 0.9%.

The trend in volume of entries for first degrees in Physics has also followed the trends illustrated in uptake at A Level and Higher fluctuating over the years. While

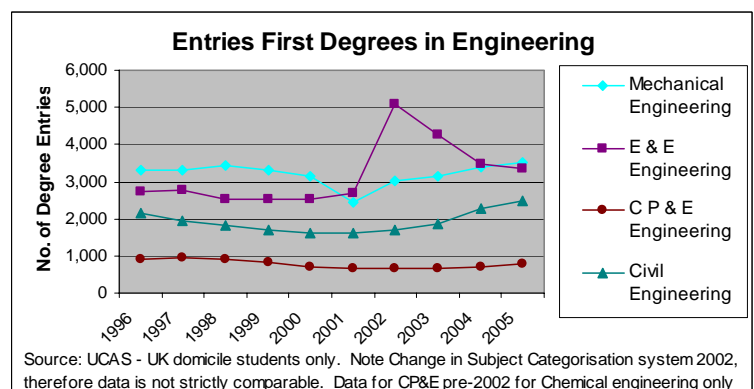
uptake in 2005 was only 2% below that for 1996 in 2000 the uptake had declined by 10%. In relative terms as a proportion of the total undergraduate first degree students physics accounted for 1.1% but had declined to 0.8%.

Maths first degree entries have increased by 17% over the period of this study after being in decline until 2002. In relative terms, this is not good news for the industry, as maths has also reduced its share of the undergraduate population by 0.3% from 1.6% to 1.3%.

The table below illustrates the comparative trends in entries of UK domicile students into the engineering degrees identified by the NESG. There are only a small number of undergraduates studying chemical, process and energy engineering and yet this is an area of demand from employers. Prior to 2002 this category measured chemical engineering only. Based on this small number of students over the period 1996 to 2005 acceptances to study first degrees has declined by 14%. In 1996 this subject made up only 0.4% of the first degree population now it only accounts for 0.2%.

Civil Engineering is most closely related to the decommissioning agenda. The uptake of study in this engineering discipline has been on the increase in recent years and is 14% higher in 2005 than it was in 1996. However even this increase has seen the relative share of undergraduate students declining with 0.9% of the first degree students taking civil engineering in 1996 compared to 0.7% in 2005.

The pattern of uptake for Electrical and Electronic Engineering has been variable. Prior to 2002 when the two subjects were combined into the same classification the data for the two courses has been added together. As can be seen in the chart in 2002 when the subject classifications were changed a dramatic increase in uptake is recorded. It is unclear to what extent this reclassification influenced the data or whether there was a genuine increase in uptake of this subject however the 2005 level of entries has remained higher than the level recorded for 1996. Over the period from 1996 to 2005 there has been a 22% increase in intake to Electrical and Electronic Engineering first degrees. This subject is the closest to having maintained its uptake relative to the overall increase in university students, as it has only decreased as an overall proportion of all subjects studied from 1.1% to 1.0%.





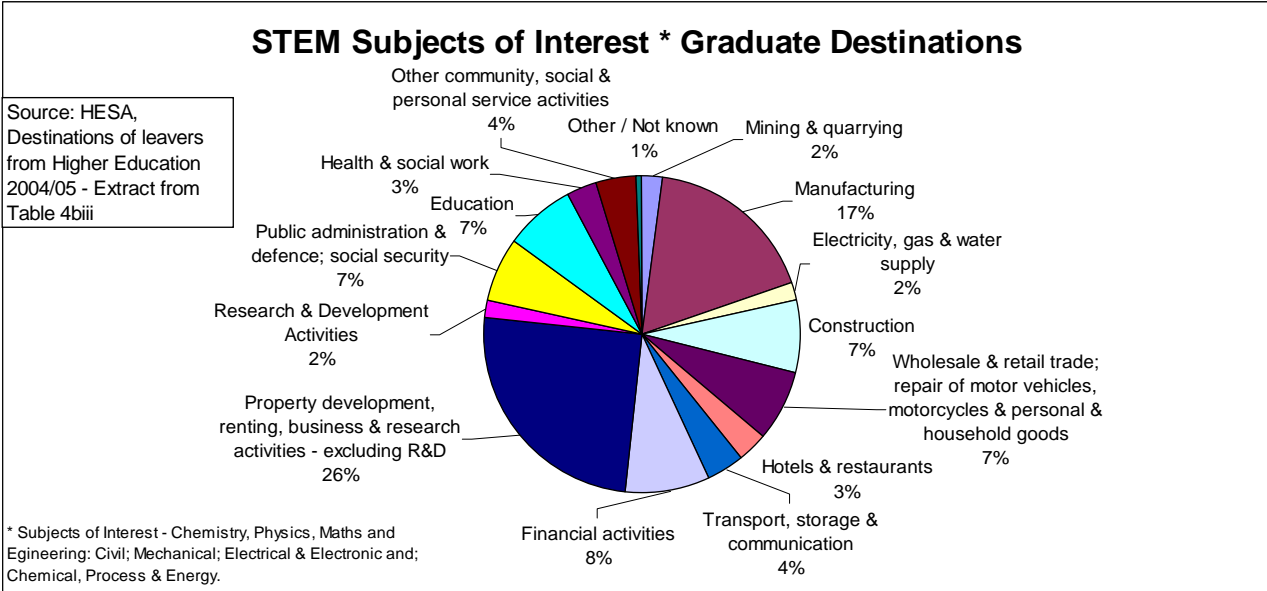
Mechanical Engineering although having had varied uptake over the period has increased its level of uptake between 1996 and 2005 by 7%. Like the other subjects of interest Mechanical Engineering has also declined as a proportion of overall UK based students applying for a first degree. As a proportion of overall students the subject represented 1.3% of students in 1996 and in 2005 1%.

A comparative picture of uptake for all of these subjects can be viewed in Appendix 1 where individual graphs for all of the above subjects are presented in one page.

4.2 Graduate Destinations

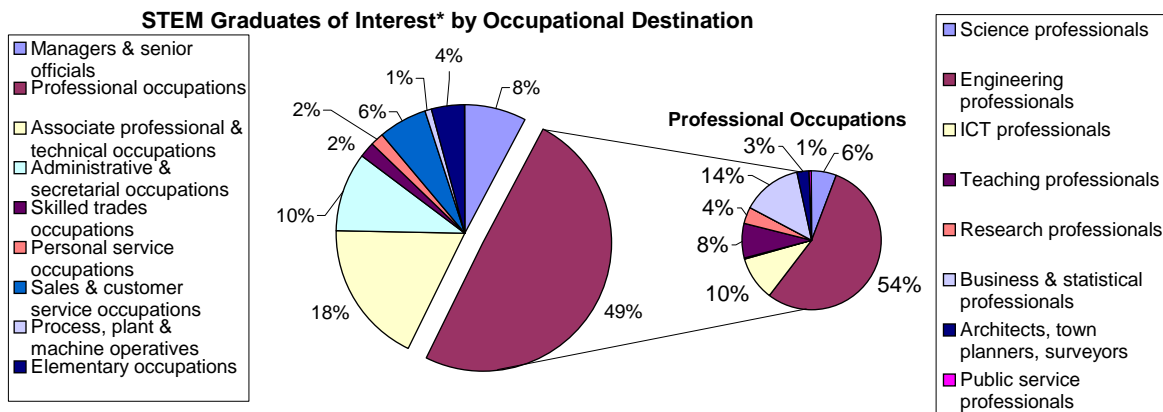
The Higher Education Statistics Agency undertake an annual survey of UK graduates 6 months after completion to ask about where they are and what they are doing. This survey provides the opportunity to analyse destinations of STEM graduates by whether or not they are in employment and if so in which industry and in what type of occupation.

The results of the study for 2004/05 finds that of the 16,270 graduates from the seven subjects of interest, 9,290 responded to the survey as being in employment and 8,990 graduates provided their sectoral destination (equivalent to 55% of the original graduates). Predominantly this group have moved into property development, renting, business & research activities. This sector incorporates R&D in science and engineering as well as engineering consultancy services however any further detail relating to the nuclear industry cannot be isolated within this category. The pie chart below illustrates the broad sector destinations of graduates in STEM subjects of interest. Under SIC codes, the nuclear industry is categorised within Manufacturing - relating to the processing of nuclear fuel; while the Electricity, Gas and Water supply will incorporate nuclear power generation activities.

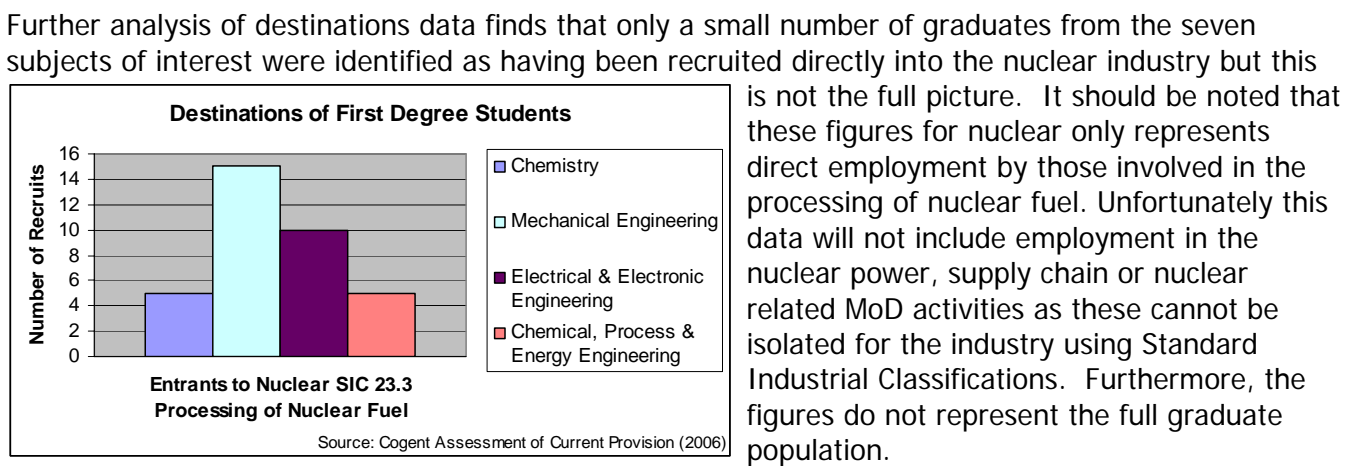


When graduate destinations are broken down by each individual subject area the sectoral splits vary quite significantly. Graduates most likely to enter Manufacturing are from: Mechanical Engineering; Chemistry and; Chemical, Process and Energy Engineering with just below a third in each case joining that sector. Maths students are the most likely to enter Financial Services. Electricity, gas and water draw small numbers of graduates from engineering the major contributors again to this section are Chemistry and Chemical Process and Energy Engineering. The full set of pie charts providing the sectoral breakdown of destination by subject studied are presented in Appendix 2.

It is also interesting to review the type of occupation that graduates from the seven STEM subjects tend to enter. The charts below provide an overview of the main occupational groups that those in employment have entered into and for the largest occupational category – professional - a breakdown by more detailed occupational group.



The occupational destination for the overall group of STEM graduates from the nuclear subjects of interest finds that nearly half enter professional occupations and of this group over half again have entered engineering professions. Examination of the breakdown of occupational destination by subject varies significantly. The engineering graduates are almost twice as likely to have entered professional occupations as the science graduates – except for Electrical and Electronic Engineering graduates where Associate Professional and Technical occupations are also a frequent destination. All subjects were similarly likely to enter Managerial occupations and Physics graduates the most likely of all the subjects to report working in Elementary occupations (requiring low level skills). A full breakdown of occupational destination by subject of study is presented in Appendix 3.



The Nuclear Employer Survey in 2005 undertaken with a broader range of nuclear employers found that for the 20 responding companies a total of 233 science and engineering graduates were recruited. It is estimated following further work with employers for the Sector Skills Agreement process that overall nuclear industry recruitment is in the region of 500 graduates per annum across all disciplines of study.

5. Education Progression Rates

It was requested that this study examine trends of the progression of young people through the various stages of education from choosing subjects at approximately age 14, sitting GCSE / Standard Grades at age 16, again choosing subjects post-exams and then sitting A Level / Higher at approximately age 18. This progression was then to be tracked through the Higher Education subjects identified by the nuclear industry as providing their workforce supply.

5.1 Education Progression Age 16-18

The first table below examines the “pull through” of students studying Maths at school over a period of six years. Reading down the rows: starting with the actual number of people sitting the GCSE, this can be compared with the second row showing the actual number of sixteen year olds in the UK in that year. As the number sitting the exam is higher than the actual number of 16 year olds, this means that there is a proportion of those sitting GCSE / Standard Grades who are not sitting the exam through the standard academic progression route i.e. at age 16. No analysis of the age profile of those sitting the exams has been undertaken, for this study it is assumed the vast majority of students are making standard progression through the education system.

The third row shows the number of people sitting the exam who achieved a grade A-C (or equivalent), with the row below showing this number as a percentage of the total number sitting the exam i.e. the “pull through” at age 16.

The following row shows the number of students choosing to study to sit an A Level / Higher with Maths as their subject choice for study. The row below shows this number as a percentage of those who had passed their GCSE / Standard Grades.

The next two rows show the number of students passing their A Level / Higher Maths at grade A-C (or equivalent) and the number of passes at A-C as a percentage of those sitting the exams. The final row shows as a percentage those gaining a pass at grades A-C for their exams at age 18 as a proportion of those who chose Maths as a subject of study at age 14.

Progression rates of Maths Students at School from 1999 to 2004							
	Age	Maths Students at School GCSE/Std Grade in 1999	Maths Students at School GCSE/Std Grade in 2000	Maths Students at School GCSE/Std Grade in 2001	Maths Students at School GCSE/Std Grade in 2002	Maths Students at School GCSE/Std Grade in 2003	Maths Students at School GCSE/Std Grade in 2004
No. 16 Year Olds in UK in year of sitting GCSE / Std Grade *	16	n/a	775,340	777,010	728,059	724,974	740,934
No. Students Selecting Maths from Subject Choices made at Passing Maths Exams at 16 (A-C) **	14	751,515	742,034	762,049	780,601	782,029	812,181
	16	368,242	376,187	384,309	403,337	395,188	423,504
Proportion of Student Pull through from passing Exams	16	49%	51%	50%	52%	51%	52%
No. Students Selecting Maths from Subject Choices made at age 16 **	16	87,026	73,730	70,568	72,182	72,078	74,515
Student Pull through to further Study as a Proportion of those passing Exams at age 16	16	24%	20%	18%	18%	18%	18%
Passing Exams at 18 (A-C) **	18	57,023	51,514	51,627	53,245	54,436	57,436
Proportion of Student Pull through from passing Exams	18	66%	70%	73%	74%	76%	77%
Pull through from Sitting Exams at 16 to Passing Exams at 18		7.6%	6.9%	6.8%	6.8%	7.0%	7.1%

Sources: * © Government Actuary's Department; ** JCQ & SQA; *** UCAS; **** HESA

As can be seen the proportion of students passing Maths at GCSE / Standard Grade with a grade A-C (or equivalent) has remained constant over the years at approximately half of the studying population. However of those numbers, a declining proportion have been choosing to continue their study of

Maths beyond this stage from 24% to 18%. It is also noted that an increasing proportion of students are passing A Levels / Highers with grades A-C. It should also be noted that across the period a consistent level of those who chose to study maths at 14 continue to study through to age 18 and successfully achieve an A-C grade.

Similar tables for progression rates for Chemistry and Physics are presented below.

Progression rates of Chemistry Students at School from 1999 to 2004							
	Age	Chemistry Students at School GCSE/ Std Grade in 1999	Chemistry Students at School GCSE/ Std Grade in 2000	Chemistry Students at School GCSE/ Std Grade in 2001	Chemistry Students at School GCSE/ Std Grade in 2002	Chemistry Students at School GCSE/ Std Grade in 2003	Chemistry Students at School GCSE/ Std Grade in 2004
No. 16 Year Olds in UK in year of sitting GCSE / Std Grade *	16	n/a	775,340	777,010	728,059	724,974	740,934
No. Students Selecting Chemistry from Subject Choices made at age 14 **	14	70,130	71,410	71,589	71,247	73,036	75,085
Passing Chemistry Exams at 16 (A-C) **	16	60,631	61,820	61,892	61,528	63,251	65,532
Proportion of Student Pull through from passing Exams	16	86%	87%	86%	86%	87%	87%
No. Students Selecting Chemistry from Subject Choices made at age 16 **	16	48,525	46,208	45,402	46,525	48,262	49,192
Student Pull through to further Study as a Proportion of those passing Exams at age 16	16	80%	75%	73%	76%	76%	75%
Passing Exams at 18 (A-C) **	18	33,073	32,881	32,905	34,051	35,085	36,011
Proportion of Student Pull through from passing Exams	18	68%	71%	72%	73%	73%	73%
Pull through from Sitting Exams at 16 to Passing Exams at 18		47%	46%	46%	48%	48%	48%

Sources: * © Government Actuary's Department; ** JCQ & SQA; *** UCAS; **** HESA

As can be seen the proportion of students passing Chemistry at GCSE / Standard Grade with a grade A-C (or equivalent) has remained constant over the years. A reasonably stable proportion of these successful students are also choosing to continue their study of Chemistry. An increasing proportion of students are passing Chemistry A Levels / Highers with grades A-C. Across the period the proportion of those who chose to study Chemistry at 14 continue to study through to age 18 and successfully achieve an A-C grade has remained fairly steady.

Progression rates of Physics Students at School from 1999 to 2004							
	Age	Physics Students at School GCSE/ Std Grade in 1999	Physics Students at School GCSE/ Std Grade in 2000	Physics Students at School GCSE/ Std Grade in 2001	Physics Students at School GCSE/ Std Grade in 2002	Physics Students at School GCSE/ Std Grade in 2003	Physics Students at School GCSE/ Std Grade in 2004
No. 16 Year Olds in UK in year of sitting GCSE / Std Grade *	16	n/a	775,340	777,010	728,059	724,974	740,934
No. Students Selecting Physics from Subject Choices made at age 14 **	14	66,182	67,514	67,598	68,071	69,154	70,814
Passing Physics Exams at 16 (A-C) **	16	57,166	58,642	58,021	57,963	58,215	60,846
Proportion of Student Pull through from passing Exams	16	86%	87%	86%	85%	84%	86%
No. Students Selecting Physics from Subject Choices made at age 16 **	16	40,740	41,639	40,072	37,984	37,071	35,933
Student Pull through to further Study as a Proportion of those passing Exams at age 16	16	71%	71%	69%	66%	64%	59%
Passing Exams at 18 (A-C) **	18	26,829	27,669	27,296	26,342	25,834	25,141
Proportion of Student Pull through from passing Exams	18	66%	66%	68%	69%	70%	70%
Pull through from Sitting Exams at 16 to Passing Exams at 18		41%	41%	40%	39%	37%	36%

Sources: * © Government Actuary's Department; ** JCQ & SQA; *** UCAS; **** HESA

The proportion of students passing Physics at GCSE / Standard Grade with an A-C (or equivalent) has been declining over the four years to 2003 however in 2004, and 2005, this proportion increased to 86 then 88%. Of those passing, a declining proportion is choosing to continue their study of Physics beyond this stage. An increasing proportion of students are passing exams at age 18 with grades A-C. Across the period a slowly declining level of those who chose to study Physics at 14 continue to study through to age 18 and successfully achieve an A-C grade.

5.2 Education Progression Age 18-21

Pull-through rates for first degrees are calculated in the table below for each of the subjects of interest to the sector. All data in this table is based upon UK domicile students only. This shows the volume of students entering the course in 2002 and the number of graduates from that course in 2005. It is acknowledged that in Scotland an honours degree lasts for four years. However for the purposes of this exercise a three year degree is assumed. A pull-through of students from degree acceptances to graduations is then presented for each subject.

Destinations data is then used to present the number of students responding to the annual survey of graduates who are in employment six months after graduation. It should be noted that this survey does not have a 100% response rate and therefore the actual figures presented here do not represent destinations for the overall graduate population. The following row shows the proportion of graduates who have a known destination in employment. The final two rows show the number noted as having entered the nuclear industry (SIC 23.3) and then this number is presented as a proportion of acceptances to the course in 2002. It should be noted again that this employment in nuclear figures only represents direct employment most likely by license holders involved in the processing of nuclear fuel. Unfortunately data for nuclear power, the supply chain or nuclear related MoD activities cannot be isolated for the nuclear industry using Standard Industrial Classifications.

Detailed STEM Undergraduates Commencing Studies in 2002, Graduating 2005									
	Year	Chemistry	Maths	Physics	Mechanical Engineering	Electrical & Electronic Engineering	Chemical, Process & Energy Engineering	Civil Engineering	Total
Degree Acceptances [®]	2002	2,836	3,379	2,725	3,028	5,110	681	1,690	19,449
Graduations [#]	2005	2,530	3,300	2,080	2,635	3,570	535	1,620	16,270
Student Pull through of Graduates as proportion of Acceptances	2005	89%	98%	76%	87%	70%	79%	96%	84%
Number of Graduates Providing Destination as Employment after first degree [#]	2005	1,115	2,050	850	1,590	1,920	285	1,180	8,990
Proportion Graduates with known Working Destination as "In Employment"		44%	62%	41%	60%	54%	53%	73%	55%
Number of Graduates Entering Nuclear after First Degree [*]		5	0	0	15	10	5	0	35
Student Pull through from Acceptances to as Entering the Nuclear Industry		0.4%	0.0%	0.0%	0.9%	0.5%	1.8%	0.0%	0.2%

Sources: [®] UCAS; [#] HESA; ^{*} Cogent Assessment of Current Provision

Note: [#] ^{*} Data sourced from HESA is rounded to the nearest 5

As can be seen only a very small proportion of overall acceptances to degree courses of relevance are finally recorded as entering the primary nuclear industry. However as already noted nuclear industry recruitment of graduates is estimated to be approximately 500 per annum. If this demand for 500 graduates per annum is measured as a percentage of graduations the nuclear industry must recruit up to 3% of the targeted STEM subject graduates.

5.3 Education "Pull Through" Age 14-21

The final worked example of "pull through" rates takes the class of 2000 – those who sat their GCSE / Standard Grades in that year. Two assumptions are made for this example running from GCSE through to entry to the industry:

- those who studied STEM at university are likely to have studied Maths at each stage through their schooling. As a result we focus upon Maths students at school then the overall STEM subjects at university.

- b. As in the example above the assumption is made that it takes three years to complete a degree (in Scotland an honours degree lasts 4 years)

Pull Through from GCSE to Entering the Industry 1998 - 2006			
	Year	Total Number of Students at Each Stage	Students Progressing at each stage as a Proportion of those Passing Maths Exam at age 16
Number of Students Selecting Maths from Subject Choices made at age 14 *	1998	742,034	
Passing Maths Exams at 16 (A-C) *	2000	376,187	100.0%
Number of Students Selecting Maths from Subject Choices made at age 16 *	2000	73,730	19.6%
Passing Exams at 18 (A-C) *	2002	51,514	13.7%
Degree Acceptances to All STEM Subjects of Interest [®]	2002	19,449	5.2%
Graduations from All STEM Subjects of Interest [#]	2005	16,270	4.3%
Estimated Entries to Industry ^{**}	2005	500	0.13%

Sources: * JCQ & SQA; [®] UCAS; [#] HESA; ^{**} Cogent Sector Skills Agreement - Gap Analysis

The final column in the table above measures the percentage of the students who progress through each stage of the education process with the base of those who achieved a grade A-C in their Maths exam at age 16. The basis of industry recruitment of graduates being approximately 500 per annum rather than the 35 recorded by the HESA survey of graduate destinations is also used. The estimation from this worked example is that of those students passing their Maths exam in 2000 at age 16, just over one tenth of a percent were recruited into the nuclear industry.

6. Gender Breakdown of Education Supply

It is acknowledged that the industry has a male dominated workforce. While in part this may be attributed to the fact that the industry may not be attracting applications from suitably skilled and qualified females this factor is also influenced by the gender profile of the education supply. The table below shows the proportion of females for each subject and level of study.

	Chemistry		Double Science		Maths		Physics		Chemical, Process and Energy Engineering		Civil Engineering		Electrical & Electronic Engineering		Mechanical Engineering	
	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005
	% Female Students															
GCSE	41.1	42.0	50.5	50.6	49.9	50.6	39.3	40.7	-	-	-	-	-	-	-	-
Std Grade / Int 2	51.1	50.6	-	-	49.2	49.0	31.1	27.8	-	-	-	-	-	-	-	-
A Level	48.6	49.4	-	-	37.4	38.1	22.9	22.0	-	-	-	-	-	-	-	-
Higher	49.5	50.2	-	-	47.3	47.2	29.4	28.1	-	-	-	-	-	-	-	-
First Degree*	43.8	40.1	-	-	38.7	39.4	19.8	19.8	27.7	25.9	15.3	15.0	12.0	11.1	8.3	6.7
	% Female Employees 2005															
Nuclear Industry	17.0															

Source: JQC, SQA, * UCAS figures for acceptances to courses

In three subject areas the nuclear industry is in fact less gender biased than the student population – Civil, Electrical & Electronic and Mechanical Engineering. However for the remainder a higher proportion of females are studying in industry relevant subject areas than are being attracted to join the industry.

7. Findings

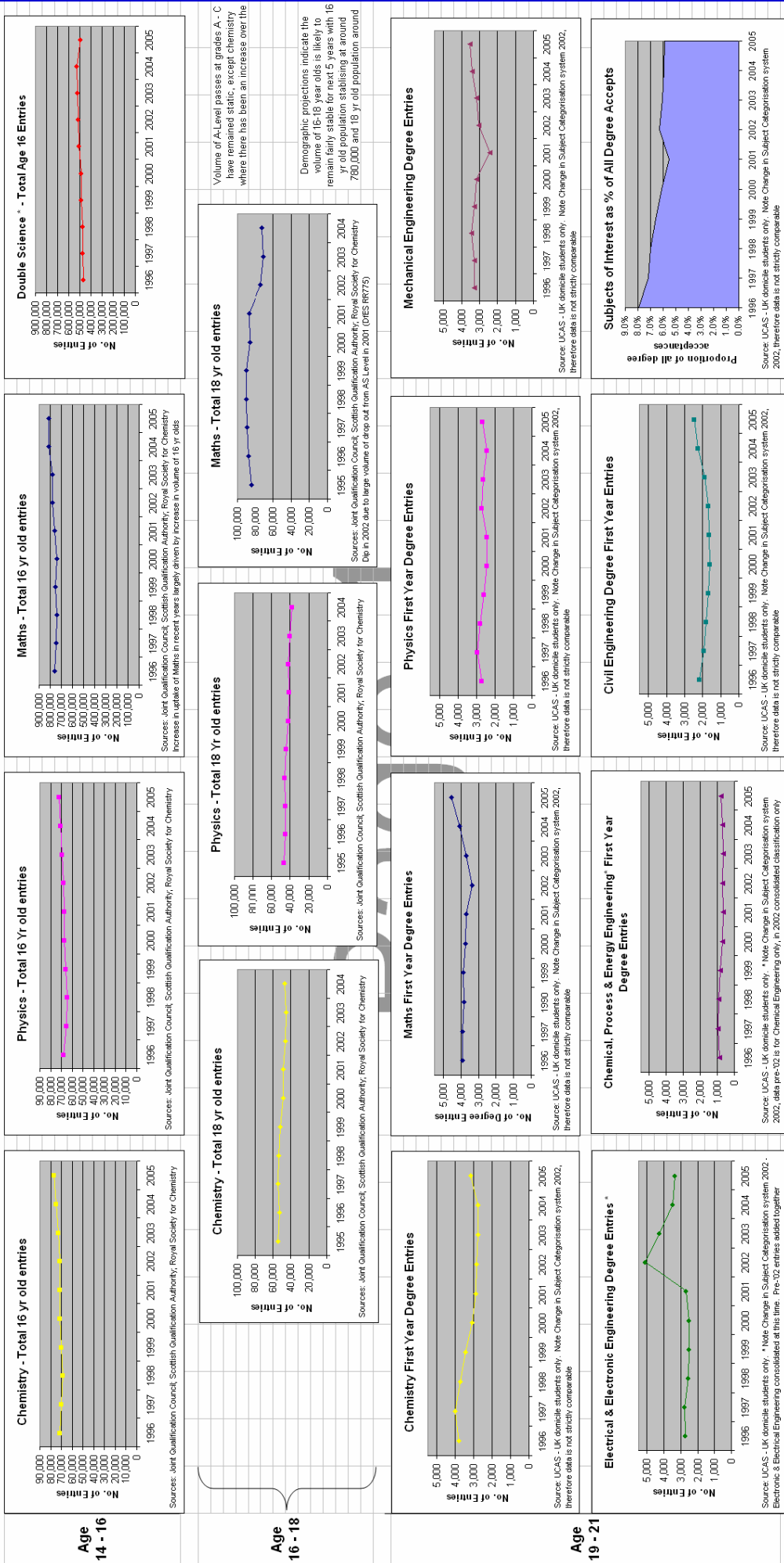
- The largest proportion of drop out from potential employment in STEM occupations occurs at age 16 when young people have completed their GCSEs or Standard Grades / Intermediate 2 studies and make choices regarding further study at A Level or Higher. For Maths approximately 80% of those passing their exams (A-C) at age 16 do not continue study of the subject; for Chemistry (as single science) in the region of 25% drop the subject after passing their exams at age 16 and for Physics around 35% discontinue their study.
- The decline in uptake of both Maths and Physics at A Level and Higher Level has serious implications for the potential entry to Higher Education for study of STEM subjects as a route into employment in the nuclear industry. In the last 10 years across the UK uptake at age 16-18 has declined, on average, for Maths by 17.6% and for Physics by 18%. Physics A Level has been in even greater decline over the last 15 years with those sitting the exam dropping by 37%, the problem is less severe but still of concern in Scotland with a decline over 15 years of 21%.
- Although over the last 10 years entries to study first degrees in the seven STEM subjects of most interest to the nuclear industry have increased by 1,000, there has been a decrease in relative terms. There has been a 42% increase in acceptances to study first degrees, but only a 5% increase in acceptances to the subjects of interest to the nuclear industry. While the subjects of interest to the nuclear industry used to represent 7.9% of the overall student population now they only attract 5.9%.
- At each stage of choice a lower proportion of females continue along the STEM route. Particularly this is an issue in Physics where between GCSE and A Level the proportion of female students halves from an already gender biased base. In Scotland gender bias is evident even at the first stage of subject choice where less and one third of Standard Grade / Intermediate 2 students are female. Young females are not attracted to study in this area.
- The nuclear industry has only a small proportion of the demand upon the STEM group of graduates – estimated at nearly 3% - however this demand is anticipated to remain steady meaning the industry must continue to attract graduates to meet replacement demand requirements.
- The next ten years can be expected to see a diminishing fraction of a falling student population taking STEM degrees. Whilst industry seems able currently to find the graduates that it needs, as student populations decline year on year shortages can be expected to arise, unless the fraction of students taking STEM subjects increases significantly. At the same time, the increasing life expectancy of post war babies means that energy demand can be expected to increase, with climate change considerations driving investment in new technology plant, including the nuclear new build programme. If so, the status quo is not sustainable.

8. Bibliography and Further Reading

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Appendix 1 - Education Qualification Trends for UK Science and Engineering Students

Education Qualification Trends for UK Science & Engineering Students



Appendix 2 - STEM Subjects of Interest Graduate Destinations by Standard Industrial Classification

STEM Subjects of Interest * Graduate Destinations	Civil Engineering Graduate Destinations	Chemical, Process & Energy Engineering Graduate Destinations
<p>STEM Subjects of Interest * Graduate Destinations</p> <p>Public administration & defence, social security 1%</p> <p>Health & social work 3%</p> <p>Education 3%</p> <p>Manufacturing 17%</p> <p>Electricity, gas & water supply 2%</p> <p>Construction 2%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 7%</p> <p>Hotels & restaurants 3%</p> <p>Financial activities 3%</p> <p>Transport, storage & communication 4%</p> <p>Property development, retailing, business & research activities - excluding R&D 2%</p> <p>Research & development activities 2%</p> <p>Other / Not known 1%</p> <p>Mining & quarrying 2%</p> <p>Social & personal service activities 4%</p>	<p>Civil Engineering Graduate Destinations</p> <p>Public administration & defence, social security 1%</p> <p>Health & social work 1%</p> <p>Education 1%</p> <p>Manufacturing 3%</p> <p>Electricity, gas & water supply 4%</p> <p>Construction 40%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 2%</p> <p>Hotels & restaurants 1%</p> <p>Financial activities 1%</p> <p>Transport, storage & communication 2%</p> <p>Property development, retailing, business & research activities - excluding R&D 3%</p> <p>Research & development activities 0%</p> <p>Other / Not known 0%</p> <p>Mining & quarrying 1%</p> <p>Social & personal service activities 1%</p>	<p>Chemical, Process & Energy Engineering Graduate Destinations</p> <p>Public administration & defence, social security 3%</p> <p>Health & social work 3%</p> <p>Education 3%</p> <p>Manufacturing 14%</p> <p>Electricity, gas & water supply 31%</p> <p>Construction 3%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 5%</p> <p>Hotels & restaurants 2%</p> <p>Financial activities 5%</p> <p>Transport, storage & communication 2%</p> <p>Property development, retailing, business & research activities - excluding R&D 24%</p> <p>Research & development activities 5%</p> <p>Other / Not known 0%</p> <p>Mining & quarrying 14%</p> <p>Social & personal service activities 3%</p>
<p>Mechanical Engineering Graduate Destinations</p> <p>Public administration & defence, social security 3%</p> <p>Health & social work 1%</p> <p>Education 1%</p> <p>Manufacturing 35%</p> <p>Electricity, gas & water supply 3%</p> <p>Construction 5%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 5%</p> <p>Hotels & restaurants 2%</p> <p>Financial activities 3%</p> <p>Transport, storage & communication 2%</p> <p>Property development, retailing, business & research activities - excluding R&D 19%</p> <p>Research & development activities 1%</p> <p>Other / Not known 1%</p> <p>Mining & quarrying 6%</p> <p>Social & personal service activities 3%</p>	<p>Electrical / Electronic Engineering Graduate Destinations</p> <p>Public administration & defence, social security 8%</p> <p>Health & social work 2%</p> <p>Education 5%</p> <p>Manufacturing 20%</p> <p>Electricity, gas & water supply 3%</p> <p>Construction 3%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 9%</p> <p>Hotels & restaurants 3%</p> <p>Financial activities 5%</p> <p>Transport, storage & communication 5%</p> <p>Property development, retailing, business & research activities - excluding R&D 25%</p> <p>Research & development activities 1%</p> <p>Other / Not known 7%</p> <p>Mining & quarrying 2%</p> <p>Social & personal service activities 1%</p>	<p>Chemistry Graduate Destinations</p> <p>Public administration & defence, social security 5%</p> <p>Health & social work 6%</p> <p>Education 10%</p> <p>Manufacturing 30%</p> <p>Electricity, gas & water supply 2%</p> <p>Construction 1%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 9%</p> <p>Hotels & restaurants 4%</p> <p>Financial activities 8%</p> <p>Transport, storage & communication 2%</p> <p>Property development, retailing, business & research activities - excluding R&D 16%</p> <p>Research & development activities 6%</p> <p>Other / Not known 0%</p> <p>Mining & quarrying 1%</p> <p>Social & personal service activities 3%</p>
<p>Maths Graduate Destinations</p> <p>Public administration & defence, social security 4%</p> <p>Health & social work 3%</p> <p>Education 14%</p> <p>Manufacturing 4%</p> <p>Electricity, gas & water supply 4%</p> <p>Construction 1%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 6%</p> <p>Hotels & restaurants 4%</p> <p>Financial activities 22%</p> <p>Transport, storage & communication 3%</p> <p>Property development, retailing, business & research activities - excluding R&D 28%</p> <p>Research & development activities 1%</p> <p>Other / Not known 1%</p> <p>Mining & quarrying 1%</p> <p>Social & personal service activities 4%</p>	<p>Physics Graduate Destinations</p> <p>Public administration & defence, social security 8%</p> <p>Health & social work 6%</p> <p>Education 11%</p> <p>Manufacturing 8%</p> <p>Electricity, gas & water supply 2%</p> <p>Construction 1%</p> <p>Wholesale & retail trade, repair of motor vehicles, motorcycles & personal & household goods 9%</p> <p>Hotels & restaurants 6%</p> <p>Financial activities 12%</p> <p>Transport, storage & communication 4%</p> <p>Property development, retailing, business & research activities - excluding R&D 23%</p> <p>Research & development activities 4%</p> <p>Other / Not known 1%</p> <p>Mining & quarrying 1%</p> <p>Social & personal service activities 4%</p>	

* Subjects of Interest: Chemistry, Physics, Maths and Engineering Civil, Mechanical, Electrical & Electronic and Chemical, Process & Energy.

Source: HESA, Destinations of leavers from Higher Education 2004/05 - Extract from Table 40a

Appendix 3- STEM Subjects of Interest Graduate Destinations by Standard Occupational Classification

