

## Annex 1: Supporting Data

### 1.1. The cumulative shortfall

- In 2015, only 71% of the target for postgraduate physics teachers was achieved.<sup>1</sup>
- In 2011 written evidence submitted by the Advisory Committee on Mathematics Education (ACME) to the Education Select Committee stated that “Even with the overly generous definition of mathematics specialism used by TDA [Teacher Development Agency] when collecting workforce data, there is an acknowledged shortage of mathematics specialist teachers in secondary schools. From 2000 to 2010, there was a cumulative shortage of 4,075 mathematics teachers in meeting the government recruitment targets.”<sup>2</sup>
- In Scotland, the Teacher Workforce Planning Advisory Group (TWPAG) recognised “the effect of teacher recruitment difficulties in some subjects, e.g. physics, are being compounded year on year as a consequence of continual under-recruitment.”<sup>3</sup>
- In 2013, TWPAG also demonstrated that computing, chemistry, mathematics and physics are the subjects in Scotland with the lowest replenishment rates (student teacher intake vs number of teachers by subject). The computing replenishment rate was just 2.81%, compared to an average of 5.95%.

### 1.3. and 1.4. Subject specialist teachers

- The Royal Society of Chemistry has recently conducted research into the impact of subject specialist (degree qualified) teachers in chemistry on pupil progression. The initial evaluation of the data shows that subject specialist teachers in chemistry impact positively on pupil progression and attainment. More information and data on this will be released in due course and we are in the process of collecting comparable data for mathematics, biology and physics.
- Pupils make less progress when their teacher does not have a degree in the relevant subject and subject specialist teachers are particularly important for more technical subjects such as science and mathematics.<sup>4</sup>
- Compounding this, teachers in areas of high deprivation are more likely to have physics, mathematics and chemistry teachers without an academic degree in the subject.<sup>5</sup>
- Teacher qualifications are second only to pupil ability as a predictor of attainment in physics.<sup>5</sup>
- Data from the Department for Education’s (DfE) ‘School Workforce in England’<sup>6</sup> from 2010 to 2015 indicates changes in the number of teachers with a post-A level qualification in the subject they teach. These changes are shown in Annex 2, Figure 2 and Figure 3.

<sup>1</sup> Department for Education, Initial Teacher Training Census 2015/16 <https://www.gov.uk/government/statistics/initial-teacher-training-trainee-number-census-2015-to-2016>

<sup>2</sup> ACME written submission to Education Select Committee Enquiry ‘Attracting, training and retaining the best’. Adapted from the Royal Society’s 2011 State of the Nation, the UK’s science and mathematics teaching workforce, 2011 <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmeduc/1515/1515vw18.htm>

<sup>3</sup> Report of the Teacher Workforce Planning Advisory Group (TWPAG), December 2013 <http://www.gtcs.org.uk/web/FILES/about-gtcs/dual-reg-consultation-report-of-the-twpwg.pdf>

<sup>4</sup> Wayne, A.J. and Youngs, P. (2003) Teacher Characteristics and Student Gains: a review, Review of Educational Research 73 (1): 89–122. doi:10.3102/00346543073001089.

<sup>5</sup> Social inequalities in access to teachers <http://www.smf.co.uk/wp-content/uploads/2016/04/Social-Market-Foundation-Social-inequalities-in-access-to-teachers-Embargoed-0001-280416.pdf>

<sup>6</sup> Statistics: school workforce. Department for Education <https://www.gov.uk/government/collections/statistics-school-workforce>

- Annex 2, Figure 3 clearly shows that physics teachers, for which shortages are reportedly highest, have the highest number of teachers with no relevant post-A level qualification and that this appears to have increased over time. As seen in Annex 2, Figure 2, this was 31% in 2010 and has steadily increased to nearly 38% in 2015.
- Annex 2, Figure 2 also indicates that comparing 2010 and 2015, the number of non-subject specialist physics teachers has increased by 6.1%.
- For chemistry and mathematics, the number of non-subject specialist teachers is consistently high, at around 25% (Annex 2, Figures 2 and 3). In addition, due to shortages elsewhere, these teachers are likely to spend time teaching other science subjects for which they are not specialist.
- It is important to recognise the different situation in Scotland with regard to subject specialism. Among its key statutory functions, the General Teaching for Scotland (GTCS) is responsible for setting the minimum entry requirements to programmes in Scotland that lead to a recognised teaching qualification. The teaching qualification (secondary education) is awarded in a particular subject or subjects following completion of an applicable degree programme or a Post Graduate Diploma in Education (PGDE). Secondary teachers in Scotland are expected to teach their own subject (or subjects). The GTCS has recently instituted an additional form of registration for applicants that do not fully meet one or more of the criteria for registration for teachers qualified outside Scotland: *Provisional (Conditional)* registration. The rationale for this is to provide added flexibility to attract a wider range of teachers to teach in Scotland while ensuring that teaching standards are maintained. This type of registration means that the applicant's registration is subject to specified conditions which must be met within a stated period of time.<sup>7</sup>

## 1.5. Teacher vacancy data

### Scotland

- The Scottish Teacher Census<sup>8</sup> shows that the number of publicly-funded secondary school teachers has declined between 2008 and 2015, by 22% in computing studies, 16% in mathematics, 9% in physics and 6% in chemistry.
- In addition, teacher intake targets for Scotland (aimed at replenishing the teaching workforce at an equal rate across all subjects), are not being met in science, mathematics and computing. This is shown in Annex 2, Figure 7.
- In 2010 the Scottish Government discontinued its annual report on vacancy statistics for teachers.
- The Scottish Government and Scottish Funding Council have acknowledged that there is a lack of student demand in some specialist subjects for initial teacher education and emphasised the importance of proactively promoting teaching as a career on university campuses.
  - In September 2015 the Scottish Government launched a recruitment campaign to attract teachers to STEM subjects<sup>9</sup> and a transition training fund to support oil and gas workers to retrain as STEM teachers<sup>10</sup>
  - An analysis of the Scottish Government's initiatives to increase STEM teacher recruitment explored the perceptions of STEM professionals and STEM undergraduates of teaching. It highlights the absence of engagement between the teaching profession and undergraduates when students making career choices during university.<sup>11</sup>

<sup>7</sup> <http://www.gtcs.org.uk/>

<sup>8</sup> Scottish Government, Teacher Census Results <http://www.gov.scot/Topics/Statistics/Browse/School-Education/PubTeacherCensus>

<sup>9</sup> Scottish Government, Education Secretary announces campaign to attract more teachers <http://news.scotland.gov.uk/News/Teacher-recruitment-1d77.aspx>

<sup>10</sup> Scottish Government, Teacher training for oil and gas workers <http://news.scotland.gov.uk/News/Teacher-training-for-oil-and-gas-workers-2567.aspx>

<sup>11</sup> An analysis prepared by TMP of the challenges facing the Scottish Government's initiatives to increase the recruitment of STEM based teachers, January 2015. <https://blogs.glowscotland.org.uk/glowblogs/plnetwork/files/2015/03/1069159-Scottish-Government-A3-doc.pdf>

- A survey conducted by the Supply Teachers Review Group of the Scottish Negotiating Committee for Teachers (SNCT)<sup>12</sup> found that all of the 28 respondent local authorities stated that obtaining a sufficient supply of secondary school subject specialist teachers was either 'difficult' (11/28) or 'very difficult' (17/28). Subjects of particular shortage were identified as STEM, Home Economics, Design and Technology, Computing, and Business.
  - In October 2015, local authorities in Scotland held a summit to address rising teacher vacancy levels where the leaders of seven councils called for a national taskforce to be established to deal with teacher recruitment problems.<sup>13,14</sup>

## England

- The vacancy data for teachers is presented for England in the 'School Workforce for England' data collected by the Department for Education. However issues have been raised with the suitability of this data:
  - In 2011, SCORE raised concerns with the quality of teacher vacancy data, stating that it was an inaccurate snapshot of staff shortages within schools due to being collected at the wrong time of year (November), ahead of the peak periods when schools advertise posts. Our organisations remain concerned that it is this data used to inform the teacher supply model and therefore teacher recruitment allocations.<sup>15</sup>
  - November is mid-way through the first school term, pupils are in classes, meaning vacancies must be covered, either with supply staff or by substituting for non-subject specialist teachers.
    - Malcolm Trobe, Interim General Secretary of the Association of School and College Leaders (ASCL), said: *"Teacher shortages leave schools with no option other than to use stop-gap solutions. Schools have to put teachers in front of classes. If they cannot recruit the staff they need, this means using supply staff and non-specialists to cover the gaps"*.<sup>16</sup>
  - TeachVac<sup>17</sup> was established as a free recruitment site for teachers in January 2015, through the website it is possible to record real time vacancy data for the profession.
    - The learned societies would like to make the MAC aware of the TeachVac submission to the Education Select Committee on their supply of teachers consultation, as this has a large amount of data relevant to the MAC's review.<sup>18,19</sup>
    - TeachVac data<sup>20</sup> indicates that most recruitment occurs between the Easter holidays and the end of May, further supporting the claim that DfE vacancy data is collected at the wrong time of year.
    - Anecdotally, head teachers have suggested that if existing teachers hand in resignations after March, it can be very difficult to replace them by September<sup>21</sup>.
    - To support this, data comparing the number of new initial teacher education entrants and the number of teacher vacancies indicates that by early May, vacancies outstrip the number of newly qualified teachers left in the recruitment

<sup>12</sup> Supply teachers review group survey, Scottish Negotiating Committee for Teachers

<http://www.snct.org.uk/library/2162/Supply%20Teachers%20Review%20Group%20Recommendations.pdf>

<sup>13</sup> [http://www.aberdeencity.gov.uk/CouncilNews/ci\\_cns/pr\\_teacher\\_summit\\_260815.asp](http://www.aberdeencity.gov.uk/CouncilNews/ci_cns/pr_teacher_summit_260815.asp)

<sup>14</sup> <http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-34395383>

<sup>15</sup> Assessment of the School Workforce Statistics produced by the Department for Education, SCORE, June 2011

<http://www.score-education.org/media/8030/swf.pdf>

<sup>16</sup> Survey shows damage of teacher shortages, ASCL [http://www.ascl.org.uk/news-and-views/news\\_news-detail.survey-shows-damage-of-teacher-shortages.html](http://www.ascl.org.uk/news-and-views/news_news-detail.survey-shows-damage-of-teacher-shortages.html)

<sup>17</sup> [www.teachvac.co.uk](http://www.teachvac.co.uk)

<sup>18</sup> TeachVac response to DfE Education Select Committee consultation on teacher supply

<http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/education-committee/supply-of-teachers/written/24299.html>

<sup>19</sup> TeachVac supplementary response to DfE Education Select Committee consultation on teacher supply

<http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/education-committee/supply-of-teachers/written/35068.pdf>

<sup>20</sup> The Teachvac Review. An analysis of the labour market for secondary school teachers in 2015

[https://www.researchgate.net/publication/280577031\\_TeachVac\\_Review\\_Teacher\\_recruitment](https://www.researchgate.net/publication/280577031_TeachVac_Review_Teacher_recruitment)

<sup>21</sup> <https://www.theguardian.com/education/2015/sep/15/not-enough-teachers-science-shortage-teaching-jobs>

pool. Figures illustrating this for a number of subjects are presented in the TeachVac July 2015 review.<sup>22</sup>

- Anecdotally, schools may be reluctant to report that they have long-term vacancies, as this makes the school look unattractive to potential candidates.
- Note that UCAS data shows a breakdown of initial teacher training applicants and acceptances by region, which the MAC may find useful in its investigations.<sup>23</sup>

Improved data on teacher vacancies and shortages is required

- With the data available, it is currently impossible to model the supply of newly qualified teachers by region. A regional breakdown of initial teacher training graduates would be helpful to compare vacancies against available candidates and whether there are any regional shortages.
- To further understand the impact of subject-specialist teaching, clear and robust data that uses the definition that the learned societies have specified for a 'subject specialist teacher' should be collected from each school in a way which does not allow teachers or schools to define their own specialism. The impact of this on progression and attainment could then be more accurately understood.

### 1.6. Scotland has a shortage of computing teachers

- A report by Computing at School Scotland (CASS) in 2016<sup>24</sup> identified a drop in computing teachers of 25% in the past 10 years and that 17% of schools did not have a computer science teacher. 17 out of 32 local authorities have secondary schools without computing teachers. New computing teachers entering the profession is down 67% on 2006.

### 1.7. Teacher pay

- We have heard that some schools may increase the pay of newly-qualified teachers by promoting science and mathematics teachers more quickly, giving them additional departmental responsibilities. However, this may increase pressure on subject-specialist teachers who are likely to have a high workload already.
- In Wales training bursaries between £6,000 and £20,000 are available for mathematics, chemistry, physics, Welsh, ICT and Modern Foreign Languages. Smaller bursaries are available for a most other subjects.<sup>25</sup>
- In England, bursaries of up to £30,000 are available to attract physics graduates into teaching and up to £25,000 for chemistry, computing and languages. Again, smaller bursaries are available for all EBacc subjects.<sup>26</sup>
- In Scotland, a national salary scale agreed by the Scottish Negotiating Committee for Teachers applies to all local authority teachers. As at 1 April 2016, the starting annual salary for a probationary teacher is £22,416. This increases to £26,895 after the probationary year and increases an increment each year up to £35,763. A principal teacher can earn up to £50,319.<sup>27</sup>
- The most recent Higher Education Statistics Agency (HESA), Destinations of Leavers from Higher Education (DLHE) longitudinal data shows that the median salary of STEM graduates from the 2010/11 cohort in November 2014 was £35000 compared to an average of £31500 for non-STEM graduates (overall average was £32500).<sup>28</sup>

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<sup>22</sup> [https://www.researchgate.net/publication/280577031\\_TeachVac\\_Review\\_Teacher\\_recruitment](https://www.researchgate.net/publication/280577031_TeachVac_Review_Teacher_recruitment)

<sup>23</sup> UCAS end of cycle report 2015 <https://www.ucas.com/corporate/data-and-analysis/ucas-teacher-training-releases/ucas-teacher-training-2015-end-cycle#>

<sup>24</sup> Computing Science Teachers in Scotland 2016, Computing at School Scotland <http://www.cas.scot/latest-report-on-cs-teacher-numbers/>

<sup>25</sup> <http://gov.wales/docs/dcells/publications/160817-incentives-en1.pdf>

<sup>26</sup> <https://www.gov.uk/guidance/funding-initial-teacher-training-itt-academic-year-2016-to-17>

<sup>27</sup> Current salary scales, Scotland. [http://www.eis.org.uk/Pay\\_and\\_Conditions\\_of\\_Service/salary\\_scales.htm](http://www.eis.org.uk/Pay_and_Conditions_of_Service/salary_scales.htm)

<sup>28</sup> Higher Education Statistics Agency, Destinations of Leavers Data, Longitudinal survey. [https://www.hesa.ac.uk/index.php?option=com\\_content&view=article&id=1899&Itemid=239#long](https://www.hesa.ac.uk/index.php?option=com_content&view=article&id=1899&Itemid=239#long)

- DfE School Workforce in England data shows that average teacher pay is £24400 for teachers under 25 and £29300 for 25-29 year olds.<sup>29</sup>
- The National Foundation for Education Research (NFER) found that more than half of teachers who leave the profession take up jobs in the education sector.<sup>30</sup> In addition, NFER found that the wages of teachers who left the profession were 10% lower than those who remained in teaching. On average, teachers are not leaving the profession for more highly paid jobs.
- The National Audit Office (NAO) has recommended that the bursary schemes put in place by Government should be fully evaluated to assess their effectiveness.<sup>31</sup>

### 1.8. Hours worked and overtime

- Teacher overtime data for both Scottish and 'rest of UK' teachers is shown in the 2011 document 'Pay and Conditions of Scottish Teachers: Recent Evidence'.<sup>32</sup> Teachers in Scotland work on average 10 hours a week of unpaid overtime, compared to 5 hours a week for non-teaching professionals. In the rest of the UK, teachers work on average 12 hours a week of overtime, compared to 6 hours a week for non-teaching professionals.
- In 2010, teachers' average weekly hours in Scotland were 49, compared to 45 for non-teacher professionals. However in the rest of the UK, teachers work an average of 52 hours per week compared to 45 hours a week for non-teaching professionals.<sup>27</sup>
- In a National Union of Teachers (NUT) snapshot survey of school leaders, 49% said they were thinking of leaving the profession and the majority of these (85%) cited workload as the reason. 43% of school leaders reported that they are working 20-30 hours per week in addition to the 9am-3pm school day and 29% reported working an additional 30-40 hours.<sup>33</sup>
- An Association for Teachers and Leaders (ATL) survey present a similar picture, with 24% of teachers stating they plan to leave within two years and again cited workload as the main reason (over 90% of respondents). ATL members also felt that the main impact of teacher shortages was increased workload for existing teachers.<sup>34</sup>

### 1.9. Surveys of School Leaders

- In its 'Training new teachers' report in February 2016,<sup>35</sup> the National Audit Office (NAO) stated that it is difficult on the basis of current data to accurately quantify the extent to which shortages exist. However alongside vacancy rates and the proportion of lessons taught by teachers without a relevant degree, surveys of school leaders should be considered.
- Here we present the results of recent teacher surveys:
  - In ASCL's most recent survey in March 2016, 84% of respondents stated that teacher shortages are having a detrimental impact on the education they are able to provide.<sup>36</sup>
  - 73% of NUT leadership members are finding it hard to recruit teachers and over half (51%) said that shortages mean lessons are being taught by non-subject specialists<sup>2,8</sup>
  - ATL survey results indicate that supply teachers are the most common response to teacher vacancies, with nearly 60% of members using supply teachers to cover teacher shortages.<sup>29</sup>

<sup>29</sup> School Workforce in England: November 2015. <https://www.gov.uk/government/statistics/school-workforce-in-england-november-2015>

<sup>30</sup> 'Should I stay or should I go?' NFER, 2015. <https://www.nfer.ac.uk/publications/LFSA01/LFSA01.pdf>

<sup>31</sup> National Audit Office, Training new teachers, 2016. <https://www.nao.org.uk/report/training-new-teachers/>

<sup>32</sup> Pay and Conditions of Scottish Teachers: Recent Evidence. David Bell, 2011

<http://www.gov.scot/resource/doc/920/0120757.pdf>

<sup>33</sup> Survey of NUT leadership members <https://www.teachers.org.uk/news-events/conference-2016/education-chaos-survey-leadership>

<sup>34</sup> ATL teacher survey <http://schoolsweek.co.uk/atl-teacher-survey-reveals-support-staff-often-cover-vacancies/>

<sup>35</sup> National Audit Office, Training new teachers, 2016. <https://www.nao.org.uk/report/training-new-teachers/>

<sup>36</sup> Survey shows damage of teacher shortages, ASCL [http://www.ascl.org.uk/news-and-views/news\\_news-detail.survey-shows-damage-of-teacher-shortages.html](http://www.ascl.org.uk/news-and-views/news_news-detail.survey-shows-damage-of-teacher-shortages.html)



- The Pearson 'Why Teach?'<sup>37</sup> survey found that overall 59% of teachers were considering leaving the profession. However 67% of science teachers were considering leaving, which was the highest for any subject. Mathematics teachers were the lowest, but this was still 49%.
- Teacher workload is regularly cited<sup>30,38,39</sup> as the number one reason why teachers consider leaving, or actually do leave the profession. Perceived pressures from Ofsted, tasks set by management and policy changes at both local and national level are significant drivers of workload.<sup>32</sup>
- As NFER present in their 2015 'Should I stay or should I go?' report, surveys do typically report a higher proportions of teachers considering leaving than the proportion who actually do leave.<sup>40</sup>

## 2.1. A greater number of science and mathematics teachers will be required over the next decade

- Changes in 16-18 mathematics provision and the Government's ambitions for more pupils studying science and mathematics to 18 mean that a larger number of teachers will be required to teach these subjects.
  - All pupils are now required to study some form of mathematics to 16 if they did not achieve a grade C or above in GCSE Mathematics.<sup>41</sup> Further education colleges have noted that they have struggled to find enough mathematics teachers to teach these additional lessons.<sup>42</sup>
  - The provision of the new Core Maths qualification,<sup>43</sup> alongside A level Mathematics and Further Mathematics, mean that many schools now require more mathematics teachers. ACME estimates that over 2000 more teachers will be required.<sup>44</sup>
  - The new GCSE Mathematics is being taught from 2015, with first examinations in 2017. This is a larger qualification and requires more taught hours per week.<sup>45</sup> All secondary schools will require a larger number of mathematics specialist staff.
  - The Government's 'Your Life' campaign aims to increase the number of young people studying mathematics and physics post-16 by 50% by the end of 2017.<sup>46</sup>

## 3.1. STEM skilled graduates are in demand elsewhere

- There is a wider shortage of STEM graduates in the UK due to too few students pursuing these subjects at A level and beyond. STEM graduates are in high demand, not just as teachers, but elsewhere.
- The high demand for graduates with STEM skills is well articulated in the Wakeham Review,<sup>47</sup> published in April 2016. This indicates that of the core sciences, biological science graduates are less likely, after both 6 months and 3.5 years, to be employed in a graduate level role. There are more than twice the number of biological sciences undergraduates than physical sciences in the UK, 148,140 compared to 66,660 in 2014/15. Potentially this is why there are a larger number of biology teachers.
- The Institute of Physics (IoP) looked at the employability of physics graduates in its 2012 publication, 'The Career Paths of Physics Graduates'. From IoP's own survey results of 1,448

<sup>37</sup> <http://whyteach.lkmco.org/wp-content/uploads/2015/10/Embargoed-until-Friday-23-October-2015-Why-Teach.pdf>

<sup>38</sup> Should I stay or should I go? Analysis of teachers joining and leaving the profession. NFER, 2015

<https://www.nfer.ac.uk/publications/LFSA01/LFSA01.pdf>

<sup>39</sup> Workload Challenge: Analysis of teacher consultation responses

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/401406/RR445\\_-\\_Workload\\_Challenge\\_-\\_Analysis\\_of\\_teacher\\_consultation\\_responses\\_FINAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401406/RR445_-_Workload_Challenge_-_Analysis_of_teacher_consultation_responses_FINAL.pdf)

<sup>40</sup> 'Should I stay or should I go?' NFER, 2015. <https://www.nfer.ac.uk/publications/LFSA01/LFSA01.pdf>

<sup>41</sup> <http://www.bbc.co.uk/news/education-23925033>

<sup>42</sup> Profile of the maths teaching workforce. Gatsby Charitable Foundation, 2015.

<http://www.gatsby.org.uk/uploads/education/reports/pdf/profile-of-the-maths-teaching-workforce.pdf>

<sup>43</sup> <http://www.core-maths.org/>

<sup>44</sup> ACME maths snapshots, Teachers of maths: supply training and development <http://www.acme-uk.org/media/20263/teachersofmaths.pdf>

<sup>45</sup> <https://www.gov.uk/government/news/setting-standards-for-new-gcses-in-2017>

<sup>46</sup> <http://www.yourlife.org.uk/>

<sup>47</sup> STEM degree provision and graduate employability: Wakeham review, BIS and HEFCE, May 2016

<https://www.gov.uk/government/publications/stem-degree-provision-and-graduate-employability-wakeham-review>

students, one year after graduation, 6% were pursuing a PGCE, which is the same percentage as those unemployed. 38% of graduates were employed, 18% were studying for a masters and 27% were studying for a PhD.

- The most recent 'destinations of leavers' (DLHE) data from HESA shows that six months after graduation 93% of STEM subject graduates are employed versus 89% of graduates from non-STEM subjects. Five years after graduating, HESA longitudinal data from the 2010/11 cohort shows that 73% of STEM graduates are in full time paid work, compared to 70% of non-STEM graduates.
- Annex 2, Figure 5, is from the Royal Academy of Engineering's 'The UK STEM Education Landscape' report, published in May 2016. It shows clearly the pipeline of engineering graduates and the key transition points. It indicates that subject choice at A level is vital. The subject choices and transition points highlighted below are very similar to that for mathematics and physics teachers.
- For current data on the STEM skills pipeline please also see Gatsby's updated 2016 document 'Key Indicators in STEM education',<sup>48</sup> which shows the number of students studying these subjects at GCSE, A-Level and undergraduate degree.
- The Shadbolt Review,<sup>49</sup> published in April 2016, indicates that computer science graduates have relatively high unemployment rates, despite significant demand for computer science skills among UK businesses and a growing digital economy. Many employers feel that computer science graduates are not meeting their skills needs, particularly with relation to work experience, 'softer skills' and business awareness. If these graduates lack the transferrable skills required to succeed in business, then maybe they also lack the required soft skills to enter teaching; this is purely speculative.
- In 2005/06 nearly a quarter of physics graduates training to be teachers were training to be mathematics teachers.<sup>50</sup>
- Cogent Skills, the UK's strategic body for skills in the science industries, has estimated that chemistry-using industries in the UK will need 33,000 apprentices and 37,000 graduates by 2020, yet projected supply is only 21,000 and 18,000 respectively.<sup>51</sup>

### 3.2. A self-perpetuating negative feedback cycle

- Without subject specialist teachers to inspire high achievement and the pursuit of these subjects at A level and beyond, these persistent STEM skills shortages are going to be difficult to address.
- Long-term trends of low levels of participation and progression in science 5-19 (particularly evident in England and Wales) have led to a self-perpetuating negative feedback cycle.<sup>52,53</sup> This must be resolved both to produce the scientists and technologists that businesses and the UK economy needs<sup>54</sup>, as well as a viable supply of subject specialist teachers in the sciences and mathematics.
- ASPIRES research from King's College London shows that if students are not inspired by a career in science by age 10, then they are unlikely to be by the time they are 14. Indicating the importance of inspiring primary age pupils.<sup>55</sup>

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<sup>48</sup> <http://www.gatsby.org.uk/uploads/education/reports/pdf/key-indicators-in-stem-education-gatsby.pdf>

<sup>49</sup> Computer science degree accreditation and graduate employability: Shadbolt review  
<https://www.gov.uk/government/publications/computer-science-degree-accreditation-and-graduate-employability-shadbolt-review>

<sup>50</sup> Physics in Schools IV Supply and Retention of Teachers, Smithers and Robinson, 2008.

<http://www.gatsby.org.uk/uploads/education/reports/pdf/16-physics-in-schools-supply-and-retention-of-teachers-june-2008.pdf>

<sup>51</sup> Parliamentary briefing: Specialist chemistry and primary science teaching in England, Royal Society of Chemistry.  
<http://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/campaign-for-specialist-teaching/parliamentary-briefing-england.pdf>

<sup>52</sup> State of the Nation: preparing for the transfer from school and college science and mathematics education to UK STEM higher education. The Royal Society, 2011.

<sup>53</sup> Assessment of School Workforce Statistics produced by the Department of Education, June 2011 <http://www.score-education.org/media/8030/swf.pdf>

<sup>54</sup> CBI/Pearson Education and Skills Survey 2015 <http://news.cbi.org.uk/reports/education-and-skills-survey-2015/>

<sup>55</sup> ASPIRES Young people's science and career aspirations age 10-14. Kings College London.  
<http://www.kcl.ac.uk/sspp/departments/education/research/ASPIRES/ASPIRES-final-report-December-2013.pdf>

- Just 3% of primary teachers hold a post- A level science qualification and 5% hold a post-A level mathematics qualification.<sup>56</sup>
- Education Scotland have indicated that many Scottish primary teachers report low confidence in teaching science.<sup>57</sup>

### 3.3. Teacher recruitment during a recession

- Changes in teacher applications after a recession give an indication of the perceived status of teaching among graduates.
  - Smithers and Robinson<sup>58</sup> show in their ‘Coping with teacher shortages’ report that during the recession years of 1991-1993 secondary teacher recruitment targets were reached and exceeded. This is shown in Annex 2, Figure 6.
  - The UCAS Graduate Teacher Training Registry data indicates the increase in teacher training applications in the years 2008-10 immediately following the recession (see Annex 2, Figure 7). Whilst we cannot infer causation, this may indicate that graduates are more likely to enter teacher training when there are fewer graduate opportunities elsewhere.
  - Smithers and Robinson<sup>59</sup>, reached a similar conclusion when assessing teacher training intake during the early 1990’s recession. They state “The application pattern [for initial teacher training] is remarkably like that for new graduate unemployment. It appears that teaching can attract applications when opportunities elsewhere are limited, but as soon as the economy picks up teacher training struggles to fill its places.” Further data is presented by Smithers and Robinson in the report.

### 3.4. See section 1.7, above.

### 3.5. Teacher professional status

- The Teaching and Learning International Survey (TALIS), led by the OECD is an international, self-reporting survey of teachers own views of their practice.
  - TALIS results for England in 2013<sup>60</sup> showed that fewer teachers in England express overall satisfaction with their job than in any other OECD country.
  - In the same survey 35% of teachers felt that their profession is valued by society, which, whilst low, is actually higher than many countries.
  - 73% of teachers in England feel underpaid compared to other similarly qualified professions, but note that this question was only asked in England so there is no comparison.
- The Royal Society’s 2014 Vision for science and mathematics education report<sup>61</sup> highlights throughout how teacher professional status and supply are fundamentally linked. It is important that MAC recognises this connection within its own recommendations. If the status of the profession were to be raised and teaching were to be well marketed to undergraduates, this would undoubtedly attract a larger number of high-quality, subject-specific candidates.
- The Royal Society’s Vision report recommends several combined approaches to raise the professional status of teachers over the long term:
  - The provision of high quality, subject-specific continuing professional development .
  - Strengthened subject-specialist career pathways.
  - A formal definition of subject specialism to establish a commonly applied national standard.<sup>62</sup>

<sup>56</sup> State of the Nation, Science and mathematics education 5-14, The Royal Society 2010. <https://royalsociety.org/topics-policy/projects/state-of-nation/5-14/>

<sup>57</sup> Education Scotland: Sciences 3-18 curriculum impact report update (2013) [http://www.educationscotland.gov.uk/resources/Oto9/genericresource\\_tcm4817001.asp](http://www.educationscotland.gov.uk/resources/Oto9/genericresource_tcm4817001.asp)

<sup>58</sup> Smithers and Robinson, Coping with Teacher Shortages, 2000. <https://www.teachers.org.uk/files/active/0/Shortages.doc>

<sup>59</sup> Coping with teacher shortages, Smithers and Robinson, 2000.

<sup>60</sup> <https://www.oecd.org/edu/school/UK-TALIS-2013-national-report.pdf>

<sup>61</sup> <https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf>

<sup>62</sup> This is discussed in detail in the SCORE document ‘Subject specialist teaching in the sciences: Definitions, targets and data.



- The establishment of a College of Teaching.<sup>63</sup>
  - Mentoring and career support networks, both for newly qualified and established teachers.
- Both high-quality initial teacher education and ongoing professional development are important contributors to teacher professional status. The key elements of effective initial teacher education for mathematics teachers are described in ACME's 2015 report 'Beginning teaching: best in class?'.<sup>64</sup>

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<sup>63</sup> This is now in progress and presents an excellent opportunity, see [www.claimyourcollege.org](http://www.claimyourcollege.org)

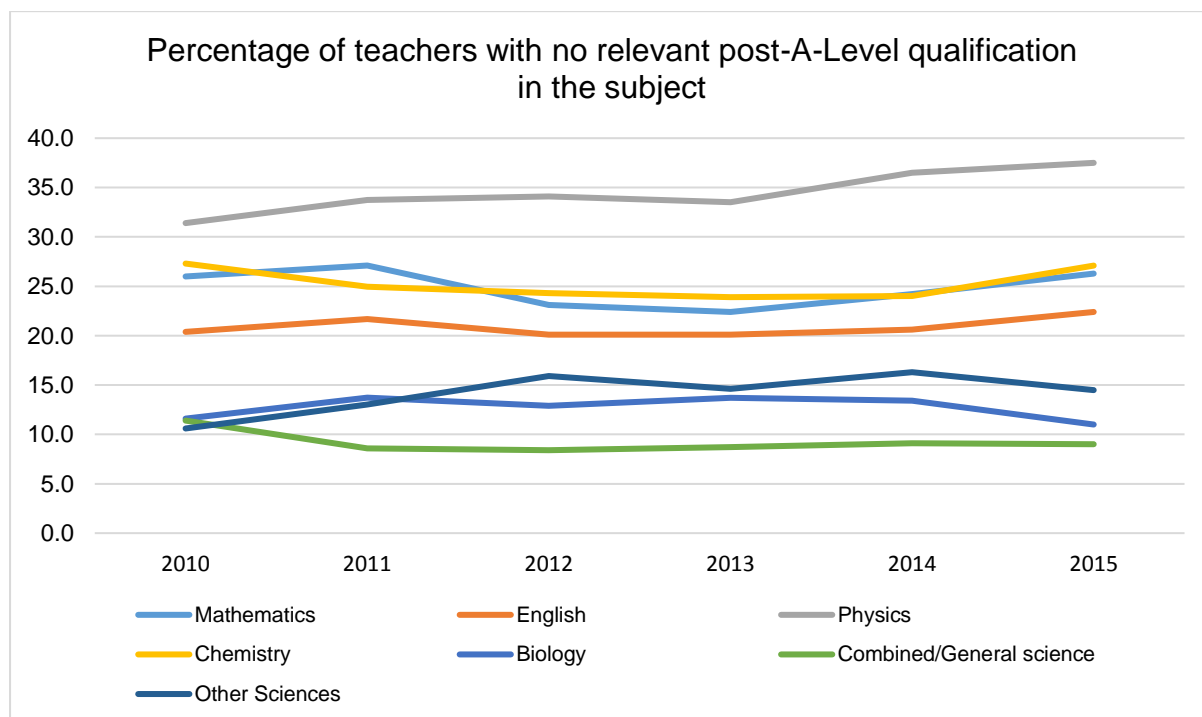
<sup>64</sup> Advisory Committee on Mathematics Education, Beginning Teaching: best in class?, 2015. <http://www.acme-uk.org/media/33228/beginningteachingbestinclass2015.pdf>

## Annex 2: Supporting figures

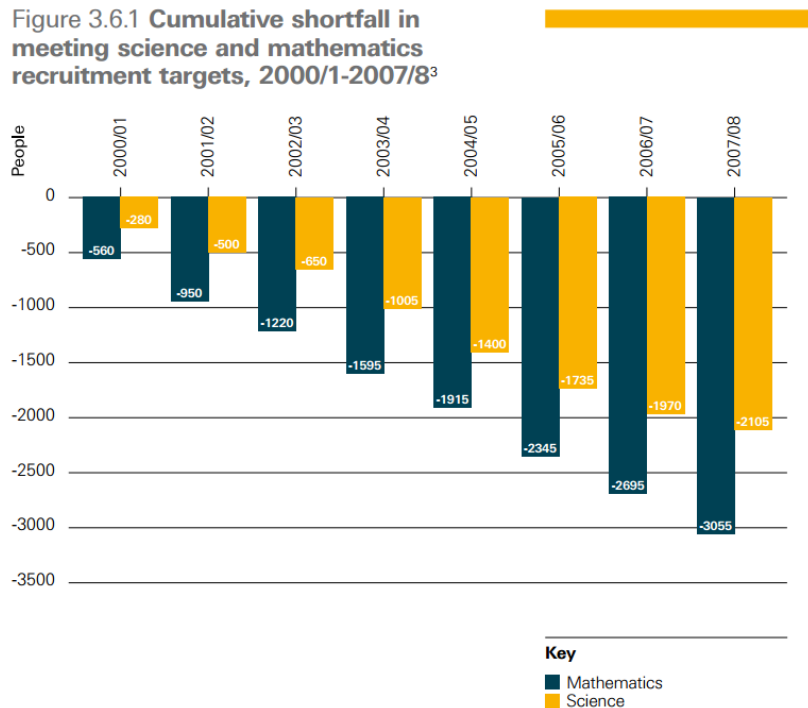
**Figure 1: Table presenting the Department for Education School Workforce in England data 2010 to 2015 showing the percentage of teachers with no relevant post-A Level qualification in the subject that they teach.**

Subject	% of teachers surveyed with no post-A-Level qualification						Difference 2015 on 2010
	2010	2011	2012	2013	2014	2015	
Mathematics	26.0	27.1	23.1	22.4	24.2	26.3	0.3
English	20.4	21.7	20.1	20.1	20.6	22.4	2.0
Physics	31.4	33.7	34.1	33.5	36.5	37.5	6.1
Chemistry	27.3	25.0	24.3	23.9	24.0	27.1	-0.2
Biology	11.6	13.7	12.9	13.7	13.4	11.0	-0.6
Combined/General science	11.4	8.6	8.4	8.7	9.1	9.0	-2.4
Other Sciences	10.6	13.0	15.9	14.6	16.3	14.5	3.9

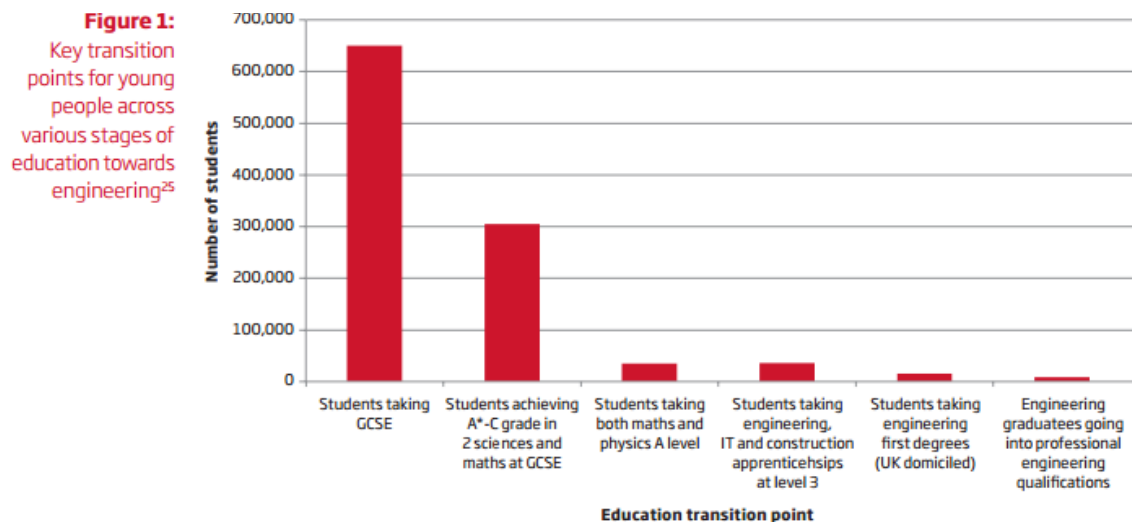
**Figure 2: Graph presenting the Department for Education School Workforce in England data on the percentage of teachers with no relevant post-A-Level qualification in the subject they teach, 2010-2015.**



**Figure 3: The cumulative shortfall of maths and science teachers 2000-2008, from the Royal Society's 'The Scientific Century'.**



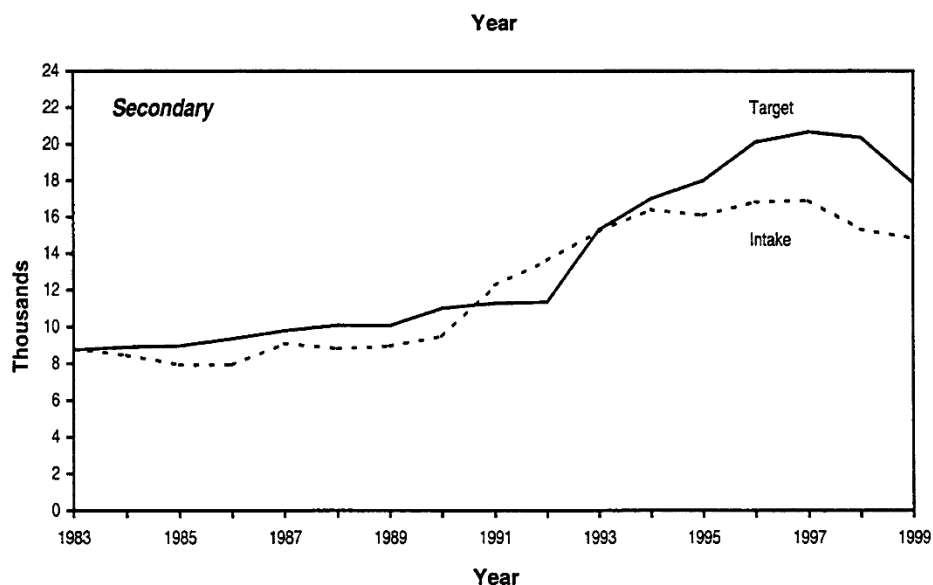
**Figure 4: Key transition points for young people across various stages of engineering. From the Royal Academy of Engineering's 'The UK STEM education landscape' . Data from Engineering UK, the State of Engineering, 2015.**



At each of these main transition points, many young people either do not attain sufficiently high grades to be able to pursue further study towards engineering or they make subject choices that do not enable them to easily progress with engineering as a future career.

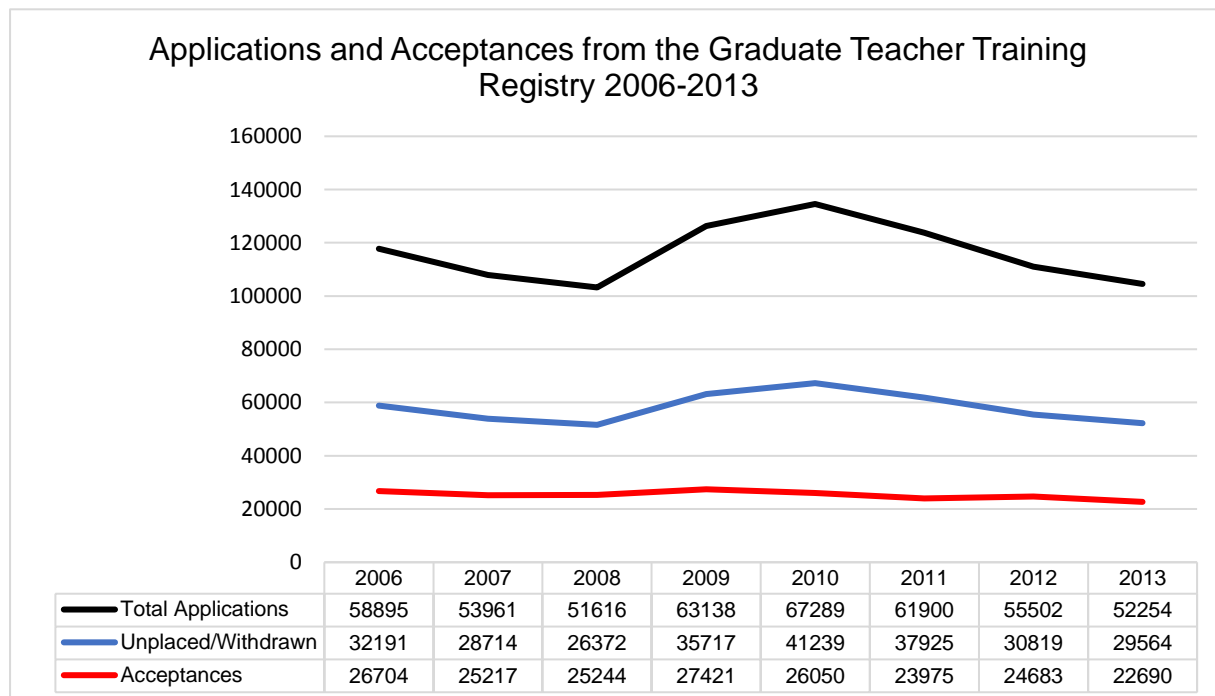
**Figure 1** above illustrates the scale of the challenge.

**Figure 5: Teacher recruitment target versus intake, 1983-1999. From Smithers and Robinson, 2000, 'Coping with teacher shortages'. Targets and intakes in secondary phase.**



Source: *School Teachers' Review Body Reports 1995-2000*, Welsh Assembly for data in 2000-2001, DfEE personal communication 11.7.00.

**Figure 6: UCAS Graduate Teacher Training Registry data. Applications and acceptances from the graduate teacher training registry 2006-2013.**



**Figure 7: Target and actual intake for initial teacher recruitment in Scotland. Times Education Supplement Scotland, 11 December 2015.**

<b>Subject</b>	<b>2015-16 Target Intake</b>	<b>2015-16 Actual Intake</b>	<b>Proportion of places unfilled (%)</b>	<b>Target intake for 2016-17</b>
Biology	88	81	8	91
Chemistry	69	57	17	75
Computing	37	20	46	52
Maths	146	76	48	179
Physics	54	38	30	60