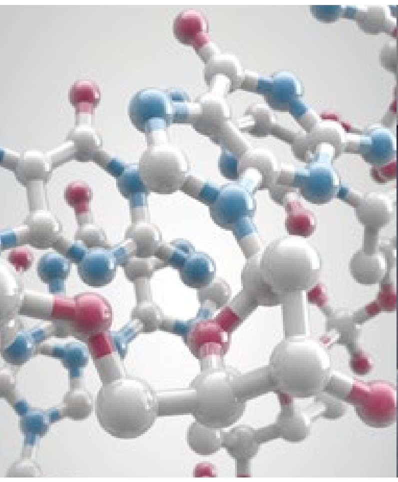
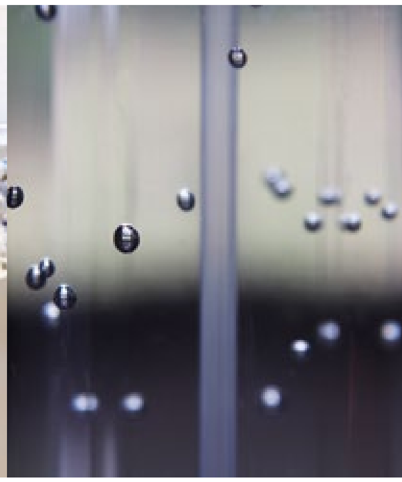
Under-funded and under pressure: the finances of UK university chemistry and physics departments



UK chemistry and physics departments in universities generate a wide range of beneficial economic and social impacts, but most of these departments are operating at substantial deficits in both their teaching and research, affecting their long-term sustainability. This briefing sets the state of funding for chemistry and physics departments[a] against recent policy developments and highlights the need for increased funding for these vital subjects.

KEY ISSUES

- Investment in chemistry and physics is critical to the future growth of the UK economy.
- Despite significant efficiency savings over recent years, UK chemistry and physics departments operate at a substantial and unsustainable deficit.
- Additional funding in England for Strategically Important and Vulnerable Subjects (SIVS) is essential to sustain the cost of these high cost laboratory subjects.
- There is an estimated annual shortfall of 40,000 STEM graduates in the UK. This cannot be met without investment in additional space and academic staff.
- Chemistry and physics departments are heavily dependent on public funding, making them particularly vulnerable to changes in the economic climate.

Stem subjects are critical to UK economic growth

UK universities are essential for training future generations in STEM skills, enabling social mobility and undertaking much of the research that drives innovation and knowledge transfer.

The publicly-funded research that begins in our universities translates into real economic gain,[1] driving a knowledge economy that supports a third of our businesses and pays 40% higher than the average wage. The UK chemical sector alone and all physics-based businesses contribute £60bn and £77bn a year, respectively to the UK economy and directly support more than 1.5 million jobs.[2,3] Case studies submitted to the 2014 Research Excellence Framework demonstrated the broad and valuable impact of university-generated chemistry and physics research to areas spanning manufacturing, defence, energy security, aerospace, the environment and healthcare.[4]

A healthy supply of talented chemistry and physics graduates is essential to generate high value-added employment, spur innovation and tackle the challenges that we face as a society. However, despite recent increases in the uptake of STEM subjects at university, there is an estimated annual shortfall of around 40,000 STEM graduates in the UK (requiring an increase of nearly 50% of those graduating in 2012/13).[5] Lifting the cap on student numbers in 2015/16 may reduce, but not eliminate, the shortfall and will bring its own tensions as funding per student is further squeezed.[6] With many chemistry and physics departments reaching capacity, investment in both space (for teaching laboratories) and academic staff will also be required to meet projected demand.

[a] *The research in this briefing is based on data from 2012/13 and from a sample of ten chemistry and ten physics departments. Although there is some cross-over, the chemistry and physics departments included are not all located at the same universities. When comparisons are made between this study and the 2010 report based on data from 2007/08, figures refer to the chemistry and physics departments common to both studies for which robust data are available. In each sample, eight universities were located in England and the remaining two in two other UK nations.*

Contribution to economic growth

- The UK is ranked 2nd in the world for innovation.[7]
- Every £1 invested in public research & development (R&D) results in a boost of between 20 and 30p per annum in perpetuity.[8,9]
- Every £1 invested by Innovate UK in collaborative R&D returns £7 to the economy.[10]
- Physics and chemistry departments perform world-leading research,[13] deliver world-class education and training, and maintain strong links with local, national and international businesses.

Return on investment in collaborative R&D by Innovate UK

With a new Government comprehensive spending review approaching, it is vital for the UK economy that existing funding streams for both teaching and research in physics and chemistry departments are protected, and opportunities for boosting this funding explored. To remain world-leading, UK chemistry and physics departments need support, certainty and stability throughout the current Parliament and beyond.

Financial pressures put UK university chemistry and physics departments at risk

Most UK chemistry and physics departments operate at a substantial and unsustainable deficit in both teaching and research activities.

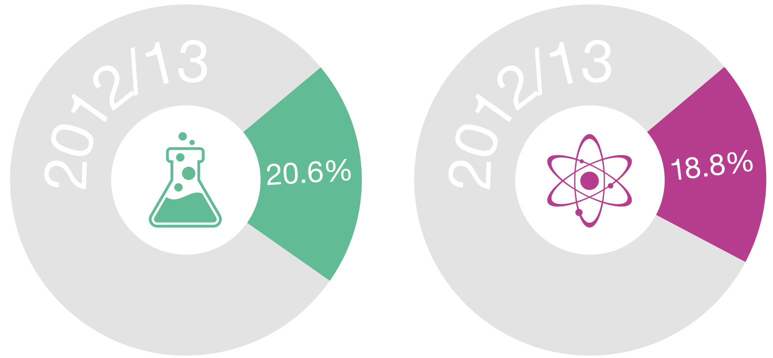
The Higher Education sector as a whole generated surpluses of around 3.9% of total income in 2012/13,[14] but Transparent Approach to Costing (TRAC) results show that the sector reported a sustainability gap of £870m (or 3.8%) of total income in 2012/13.

The chemistry and physics departments consulted in this study reported an overall deficit close to 20% of their total income in 2012/13.[b] Departments have made impressive and substantial improvements to their operating efficiency, but the reduction in their deficits since 2007/08[15] has been small. Further efficiency savings alone cannot close the sustainability gap.

Departmental incomes and deficits

- In the chemistry departments sampled, total income ranged from £10.2M to £28.7M – an overall inflation-adjusted increase of around 12% between 2007/8 and 2012/13[c]
- Total income in the physics departments sampled in 2012/13 ranged from £6.2m to £28.4m – an overall inflation-adjusted increase of around 7% between 2007/08 and 20012/13.
- For the ten chemistry and ten physics departments for which full income and TRAC-derived cost data were available the overall deficits were 20.6% and 18.8% of income, respectively.

Average deficit on departmental income in chemistry and physics departments.



[b] TRAC-derived costs are based on the principle that the full economic cost of an activity should be accounted for, including an attribution of the cost of academic staff time and the institution's facilities, estates & indirect costs. Financial position compares the total income generated and TRAC-derived costs. Surpluses/deficits reported as a % of income.

[c] A figure of 17.4% increase in the retail prices index (RPI) between 2007/08 and 2012/13 has been used. (Source: Bank of England.)

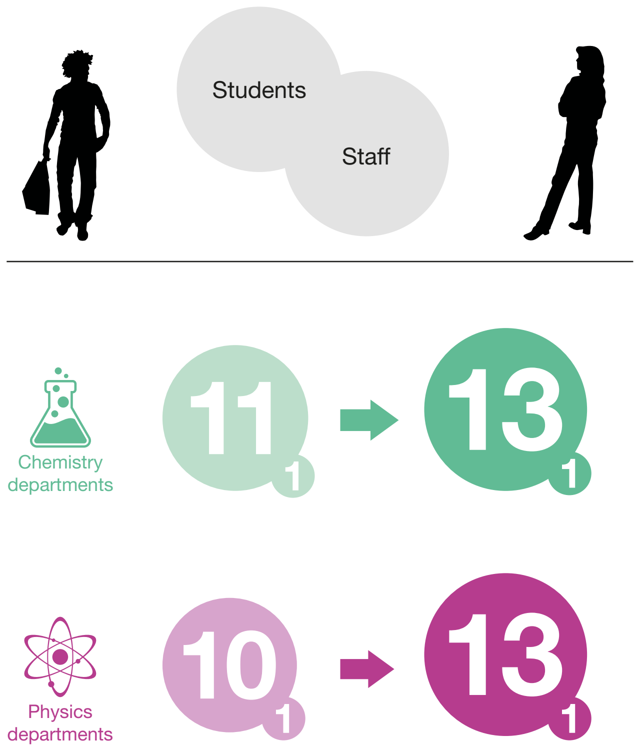
Demand for chemistry and physics degrees has increased, but rising student numbers may impact on teaching quality without appropriate increases in academic staff and teaching space.

Despite the increase in tuition fees under the new funding regime in England, sector-wide data show that student recruitment into both chemistry and physics departments remains buoyant. However, this is a double-edged sword, with departments facing increased student-staff ratios as the growth in the undergraduate student population outstrips that of the academic staff who teach them. Alongside this, many departments are reaching capacity for their teaching laboratories, despite running repeat sessions to accommodate more students. Although the increasing student-staff ratio is one of the many departmental efficiency savings introduced in recent years, this must be balanced against the quality of the student-learning experience. The proportion of staff time allocated to teaching activities also exceeds the proportion of total income available for teaching.

Undergraduate full time equivalent (FTE) numbers and student-staff ratios[d]

- Increases of 30% (chemistry) and 33% (physics) in Home and EU undergraduate FTEs. The corresponding growth in overseas undergraduate FTEs was 77% (chemistry) and 80% (physics).
- Increases of 17% (chemistry) and 29% (physics) in Home and EU postgraduate research student FTEs. The growth in overseas postgraduate research FTEs was 9% in chemistry and 34% in physics.
- SSR (student-staff ratios) increased from 10.8 to 12.8 for the chemistry departments, and from 9.5 to 13.1 for the physics departments.

Increase of average ratio of students to permanent academic staff 2007/08 - 2012/13.



Chemistry and physics are expensive subjects to teach due to their many specialist requirements.

As with medicine and other science subjects, chemistry and physics courses have specialist, high cost requirements to support effective teaching and enable students to develop the skills and competencies needed to become practising scientists. Proper health and safety procedures cannot be compromised; specific needs for physics and chemistry courses include well designed and appropriately provisioned laboratory space (including adequate fume hoods and their associated electricity costs for chemistry), specialist practical equipment and consumables, and technical support staff (for both practical classes and providing research experience).[16]

[d] Based on the FTE of all taught students (home, EU and overseas undergraduate and postgraduate) divided by, in 2007/08, total FTE of academic staff on permanent contracts excluding research fellows and post-doctoral fellows or, in 2012/13, divided by permanent academic staff with teaching responsibilities funded through the departmental budget.

Investment in these high value subjects is essential

The funding mechanisms for undergraduate education differ across different nations within the UK, but the survey finds similar shortfalls in the funding of English and non-English chemistry and physics departments.

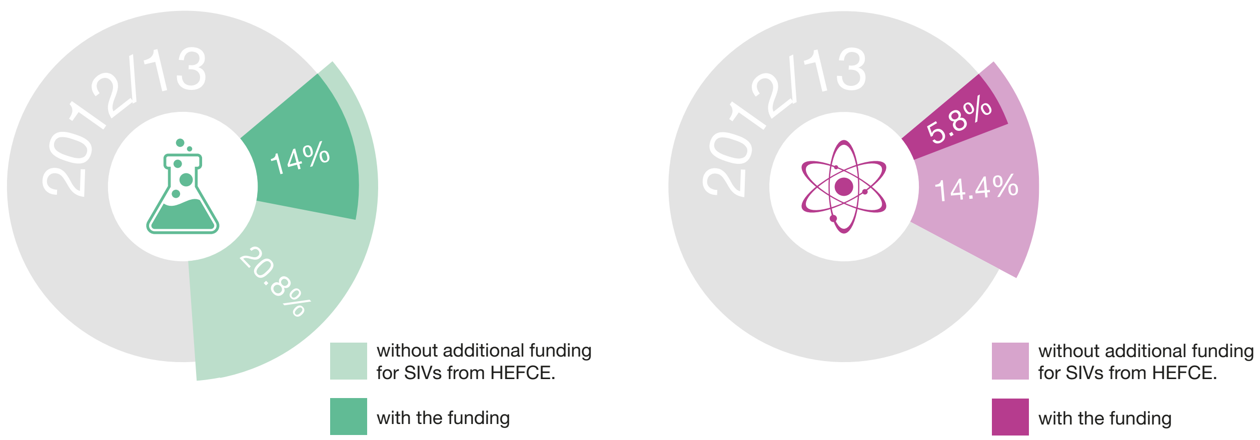
The following focuses on English universities, for which the data set is larger. Tuition fees do not cover the full cost of teaching in high-cost subjects; additional funding provided by the Higher Education Funding Council for England (HEFCE) is essential. The average teaching costs per student in 2012/13 in the eight English departments sampled in this study were £10,867 for chemistry and £9,839 for physics. This is significantly more than the average paid by undergraduate students after waivers and bursaries.[17]

The shortfall in teaching income per FTE student would be even larger without the separate additional public funding, available since 2007/08, for Strategic and Vulnerable Subjects (SIVS) like chemistry and physics. However, with the SIVS funding capped and numbers of chemistry and physics undergraduates growing, the value of this additional SIVS funding has fallen in cash terms by around £370 and £300 per FTE taught student in physics and chemistry, respectively, since it was introduced. A further fall in the income per student will push UK chemistry and physics departments further into deficit on teaching, which may affect their ability to delivery high-quality teaching and research.[e]

Teaching incomes and deficits

- The average deficit on teaching activities in chemistry departments was 14% of income, but would have been nearly 21% without additional HEFCE SIVS funding.
- In physics departments, the teaching deficit was 6% of income (which would have been 14% without HEFCE SIVS funding).
- In real terms, the average public funding per FTE Home and EU taught undergraduate and postgraduate student in English chemistry and physics departments fell by, 7% and 14%, respectively, between 2007/08 and 2012/13.

Average deficit on teaching activities in chemistry and physics departments.



The increased transparency brought about by the introduction of the new fees regime, alongside increasing pressure for universities to provide 'value for money' for students, is likely to make it more difficult for universities to cross-subsidise teaching deficits in high cost, laboratory-based subjects like chemistry and physics using surpluses generated elsewhere.

[e] *In the decade leading up to 2005 (when HEFCE first introduced their support for SIVS through efforts to raise demand in these subjects), many chemistry and physics departments closed due to insufficient funding to deliver teach these subjects, coupled with low student demand. Encouragingly, the recognised need for STEM graduates and positive initiatives like SIVS funding has seen the opening (re-opening) of several such departments in the period since 2005. It is essential that appropriate investment is made to ensure the sustainable provision of chemistry and physics in the UK.*

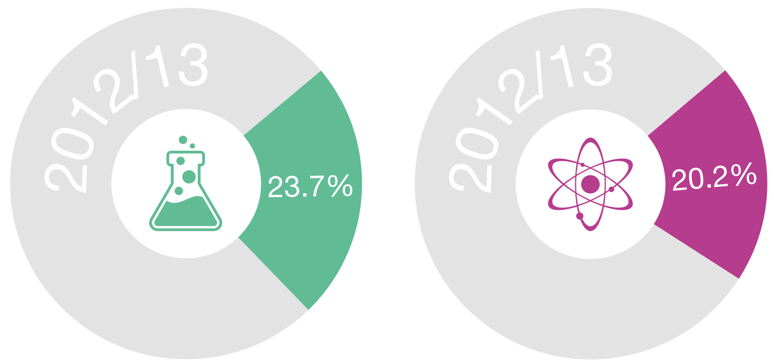
Research activity in university chemistry and physics departments is significantly under-funded.

In 2012/13, all chemistry departments in the study operated with deficits on their research activities, with an average deficit of 24% of research income. The corresponding average deficit for the physics departments was 20%. This reflects a trend across the university sector, with research activity in most subjects operating at a deficit when compared with research income.[18]

Research incomes and deficits

- In 2012/13, all the chemistry departments sampled were operating a deficit on their research activities, with an average deficit of 24% of departmental research income.
- In 2012/13, all but one of the physics departments were operating a deficit on their research activities, with an average deficit of 20% of departmental research income.

Average deficit on research activity in chemistry and physics departments.



Chemistry and physics departments are particularly vulnerable to changes in the economic climate and in the levels of public investment in research and development.

The nature of chemistry and physics research means that these departments are heavily reliant on public sources of income to support their research activities. Public funding accounted for 84% (chemistry) and 90% (physics) of the total research income in the departments featured in this study. This is in line with the national picture across all chemistry and physics departments.[19]

CHANGES TO THE FUNDING LANDSCAPE

The research for this briefing was conducted against the backdrop of the new teaching funding regime introduced for English universities from September 2012. Under this new regime, English universities are able to charge maximum fees of £9,000 per annum to Home and European Union (EU) undergraduate students but, at the same time, corresponding reductions in Funding Council teaching grants were introduced. Different funding arrangements for teaching apply in each of the Home nations.

The heavy reliance of chemistry and physics departments on public funding[f] makes them particularly vulnerable as Government spending is set to be increasingly constrained in the current Parliament. Outstanding teaching and internationally-competitive university education require proper and consistent levels of investment. In light of current and prospective budgetary restraints, it is imperative that all Funding Councils maintain support for initiatives that prioritise the STEM subjects[g] – including chemistry and physics – that underpin UK economic growth and have a positive impact on wider society.

In England, the announcement made in July 2015 by HEFCE[20] of £150m in-year cuts to university funding is very concerning, as it will inevitably affect the ability to invest in STEM subjects. The majority of these cuts will come from HEFCE teaching grants and are thus of particular concern for high-cost subjects like chemistry and physics. The additional SIVS funding from HEFCE will therefore be more important than ever.

Alongside this, it is essential that the Government prioritise the maintenance and protection of existing public funding mechanisms for research. Quality-related funding and research council grant funding are both essential to the stability of successful departments.[21]

RECOMMENDATIONS

- Protect and prioritise funding streams for teaching and research in physics and chemistry departments to ensure their continued contribution to UK economic growth.
- Explore opportunities for the additional investment required not just to maintain but to increase the capacity of chemistry and physics departments.
- Maintain the Strategically Important and Vulnerable Subjects (SIVS) status and associated funding from HEFCE for chemistry and physics in England. Explore similar initiatives in the devolved nations to protect internationally renowned university teaching across the UK.

[f] Public sources of income include Home and EU undergraduate tuition fees; Funding Council funding for "high cost" subjects; Funding Council quality-related (QR) performance related and subsidiary grants; research grant and contract income from other public sources; Home and EU postgraduate research student fees and other support for postgraduate research supervision and training, including Centres for Doctoral Training (CDTs).

[g] These include initiatives such as the Higher Education Funding Council for Wales (HEFCW) support for Subjects of Broader Importance.

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[2] Parliamentary briefing: Science & innovation in the UK, Royal Society of Chemistry (2015)
[3] The importance of physics to the UK economy, Institute of Physics (2012)
[4] Inspirational chemistry for a modern economy, The Royal Society of Chemistry (2015) and Inspirational physics for a modern economy, Institute of Physics (2015)
[5] In the Balance: the STEM human capital crunch, The Social Market Foundation (2013)
[6] A guide to the removal of student number controls, Higher Education Policy Institute (2014)
[7] Global innovation index (2014)
[8] The economic significance of the UK science base, UK- Innovation Research Centre (2014)
[9] Insights from international benchmarking of the UK science and innovation system, Department for Business, Innovation & Skills (2014)
[10] Collaborative R&D, Innovate UK (2015)
[11] Legacy of the 2010 science budget cash freeze, Science is Vital (2013)
[12] The importance of physics to the UK economy, Institute of Physics (2012)
[13] Research Excellence Framework (REF) 2014 Panel report, Higher Education Funding Council for England (2015)
[14] Financial health of the higher education sector, Higher Education Funding Council for England (2015)
[15] Follow-up Study of the Finances of Chemistry and Physics Departments in UK Universities, Nigel Brown Associates for the Institute of Physics and Royal Society of Chemistry (2010)
[16] The sustainability of learning and teaching in higher education, Financial Sustainability Strategy Group (2015)
[17] The sustainability of learning and teaching in higher education, Financial Sustainability Strategy Group (2015)
[18] Financial health of the higher education sector, Higher Education Funding Council for England (2015)
[19] Higher Education Statistics Agency (HESA) data
[20] Reductions to HEFCE teaching grant for 2014-15 and 2015-16 academic years, Higher Education Funding Council for England (2015) http://www.hefce.ac.uk/pubs/year/2015/CL,192015/
[21] A Review of QR Funding in English HEIs, Higher Education Funding Council for England (2014)

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