Unlocking the future

It is time for the UK to embrace the limitless potential of the chemical sciences, believes Dr Richard Pike, Chief Executive of the Royal Society of Chemistry…

A major report issued on 28th September 2010, entitled 'The economic benefits of chemistry research to the UK', shows that the chemicals industry and chemistry-using sectors contribute 21% of the Gross Domestic Product (GDP) of this country, and support over six million jobs. Funded by the Engineering and Physical Sciences Research Council (EPSRC) and the Royal Society of Chemistry (RSC), the report has been prepared by Oxford Economics, and paints an extraordinary picture of both the diversity and depth in the application of chemistry, from the short to the long term. It provides a long-awaited advertisement for a sector and subject that many are aware of, but which are both so all-pervasive that few sit down to consider the specific contribution these make to the products and services around them.

Lest readers query the numbers, an additional feature of the report is that it uses a methodology of economic analysis that is consistent with that adopted within the Department of Business Innovation and Skills (BIS), and indeed has been warmly received by David Willetts, Minister of State for Universities and Science within BIS itself. In identifying commercial value added throughout the industry, and providing examples of case studies, the document highlights the role of chemistry in leading or underpinning advances in, particularly, climate change, energy, security, food supply and health. The specific areas supporting these, and where the UK is strong, are chemical biology, green chemistry, catalysis, materials chemistry, supramolecular and nano-science, organic synthesis and computational methods.

These are the broad priority areas, and advances to date represent the outcome of many years' research, which may well have originated in one field of chemistry but found application in a possibly unrelated area elsewhere through creative thinking, imaginative communication and the innovation process of bringing ideas to market. The report stresses that ongoing fundamental research is essential, not only to ensure a continuing flow of scientific and technological breakthroughs, but also to see that the UK maintains a highly skilled and, indeed, innovative workforce. This will make sure that the country is well-placed to adopt and advance new ideas, to exploit successfully new technologies, and to develop better commercially focused outcomes.

The challenge is significant. Outside the US, the UK has the largest overall national deficit in the world in merchandise trade, with the gap in the month of July 2010 alone widening to a highest-ever £8.7bn, although the chemicals industry itself delivers a significant surplus. Furthermore, almost one-quarter of all public spending (itself nearly half the national economy) is based on borrowed funds, and 7.8% of the working population is unemployed. The way ahead has to consider how the financial cloth is to be cut, and resources applied effectively to enhance delivery throughout the skills supply chain, from primary school to university and industrial research, and engagement with customers at the individual or corporate level.

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That has to be done against an international backdrop of markedly diverse national ambitions, resources and governmental mechanisms. There is a clear correlation between government spending on research and development (R&D), as a proportion of GDP, and the ratio of scientists and engineers to the total population in the country. The US dominates spending in absolute terms and allocates 2.8% of GDP to R&D, with nearly 5,000 in every million of its population indicated to be in this latter category. The UK figures are 1.7% and 3,000 respectively, while Japan is the economic giant that has advanced furthest up the curve, with 3.6% and close to 6,000.

But it is China, which in absolute terms of R&D spending ranks equal second with Japan, that is growing most rapidly. Its figures of 1.5% and 1,000 disguise the fact that in local, industrialised areas it is becoming a powerhouse of leading-edge research and innovation. By next year, China will become the world's pre-eminent source of published peer-reviewed research papers in chemistry. India, too, is expanding and has announced ambitious plans to deliver a step change in the provision of tertiary education and research to drive the innovation process.

These two countries provide contrasting decision-making mechanisms, from the highly centralised to the proudly democratic. But there is a common understanding of the key success factors, which also hold in the UK – clarity of vision, leadership, rigour, quality assurance, and openness in communication and challenge. There is also the recognition that university research cannot be undertaken in isolation, like an oasis in the desert, but needs vehicles to extend the bridge to industry and government, and a wider population that is intellectually curious about science. After all, barely 11% of the 18 year old cohort in the UK go on to study full science, technology, engineering or mathematics (STEM) courses at university, and yet ultimately they will have to engage with many of the remaining 89%, from creating ideas to generating a customer base, and collaborating in delivery.

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Such bridges exist, and there may be a case for more. There are public private partnerships such as the Energy Technologies Institute, trade bodies like the Chemical Industries Association, as well as learned societies and professional bodies, of which the RSC is the largest in the field of the chemical sciences. Additionally, there are numerous regional entities which bring together the local activities and ideas of industry, academia and government, with Humber Chemical Focus being one prominent example.

Moreover, the Chemistry Innovation Knowledge Transfer Network and other similar bodies draw on government funding to seed new developments and spread best practice. Universities have also spawned spin-out companies to commercialise their research, which have strengthened links with The City. Some observers have suggested that the UK should have more establishments based on the Fraunhofer institutes in Germany, but others have indicated a much more fundamental reason for the relatively low ranking of the UK in the international competitiveness stakes – the quality of our secondary education, and the limited problem-solving skills this imparts.

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Building the bridges between research, industry and government is pivotal

understand the chain of decision-making and its consequences, challenge assumptions and priorities, and place questions and answers within the wider context and quantifiable scale, which distinguishes successful industries or organisations from the also-rans. No-one, for example, queried beforehand the decision last year to subsidise motorists £250m to buy electric cars, despite the fact that this would have negligible impact on the UK carbon footprint (because of the power station fuel mix), and most of the funds would flow ultimately to overseas manufacturers. Placed in perspective, this sum represents around one-third of the annual funding available from the EPSRC, which tellingly includes supporting the low-carbon economy through evidence-based scientific research.

Underlying this, we now have national science examinations at secondary level (GCSEs) where government-funded reports show some papers with no underpinning mathematics, questions with no science, and significant non-compliance with guidelines and regulations. The regulator Ofqual has declared the 2009 and 2010 papers 'too easy', and rejected future proposed changes from all the awarding bodies, who set the curricula and examinations. This has been the unintended consequence of (until recently) weak regulation, market-driven competition between these awarding bodies and the response by schools and individual pupils to league tables and grade dominated entrance requirements into higher education. That has to change – and the quality of learning from primary to tertiary unequivocally reassessed.

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