Institution: University of East Anglia

Unit of Assessment: 8 - Chemistry

a. Context

Research within the School of Chemistry at the University of East Anglia (UEA), which corresponds with UOA 8, is organised across three groups: *Synthetic chemistry*; *Physical & Analytical chemistry*; and *Biophysical & Biological chemistry*. The types of impact which arise from this research and the main beneficiaries are similar for all three groups.

The primary non-academic impact of our research is economic, both through **improvement in the performance of existing businesses** and through direct **creation of spin-out companies**. In addition, our research has an impact on society through extensive **public engagement** activities. A further route for impact is providing **direct advice to government**.

b. Approach to impact

As a pathway for delivering non-academic impact from its research, the School encourages all researchers to develop strategic relationships with potential end-users and beneficiaries.

For industrially relevant research, these relationships are fostered initially through activities such as invited research lectures from industrial partners, industrial input into undergraduate taught courses, and undergraduate placements with industry. The School runs a programme of 'Industry Days', during which visitors from industry give lectures, discuss research opportunities with faculty, and meet students. In several instances these initial relationships have resulted in: collaborative research projects; industrial CASE awards; specific pieces of contract research; or consultancy agreements. During the REF period, we have held 54 research projects, totalling >£1M, with 24 different industrial partners, including large pharmaceutical companies (for example, *Pfizer*, *Novartis*, *GlaxoSmithKline*) as well as SMEs. Consultancy agreements with 20 different external partners, totalling >£200K, are, or have been, held during the REF period.

In addition to realising impact through relationships with end-users and beneficiaries, we deliver impact through direct commercialisation of our research. An example of the success of this approach is the development by **Meech** and Reading (School of Pharmacy, UEA) of an instrument combining infrared species identification with the spatial resolution of atomic force microscopy. The instrument was developed as part of an EPSRC 'Adventure' grant and is now commercially available from *Anasys Instruments*. During the REF period, faculty have filed 15 families of patents across the range of research activity. These include patents for: materials for hydrogen storage; liquid crystals for security applications; virus detection; and nanotechnology for solar hydrogen production. In many instances, the IP is licensed to external organisations. For example, in the REF period, *Cancer Research Technology* (Cancer Research UK) licensed patents on the 'Nanoparticle delivery of photosensitisers', while the *Mitsui Chemical Corporation,* Japan, licensed patents on 'Polymerisation catalysts'. IP resulting from our research also forms the basis of spin-out activity. Chemistry faculty have established six spin-out companies. Two of these, *Chameleon Biosurfaces Ltd*. and *Intelligent Fingerprinting Ltd*., are the bases of two of our impact case studies.

To maximise the impact of our research on society, we have an extensive and varied programme of public engagement based on our research themes. To develop and promote engagement, in the period 2008–2012 UEA hosted the CUE-East Beacon for Public Engagement, one of only six such Community Engagement centres in the UK. CUE-East provided a focus for public engagement activity via a dedicated support service for staff and students, together with individual awards for excellence. A permanent Community University Engagement Office is now established. An engagement highlight is the work of **Ashworth**. In 2008 he was awarded his third EPSRC Public Engagement grant (£162K) for the Norwich Science Olympiad, and he won a CUE-East individual award for public engagement in 2009. Since 2008, Ashworth has been involved with South Africa's 'Scifest'. In 2013, Ashworth, supported by the Royal Society of Chemistry, delivered 140 invited lectures and workshops to a total audience of >10,000 between January-April as part of Scifest's outreach initiative. During the REF period, a further 9 Chemistry faculty have presented 29 public lectures, including 6 lectures for *Cancer Research UK* and *Big C* cancer charities on *Nanoparticles*

for cancer therapy, highlighting societal benefits of nanotechnology (**Russell**). Other public engagement highlights include: **Pickett** and **Wright**'s Royal Society Summer Exhibition (2011) *Solar Nanotec – putting sunshine in your tank*; and **Wildgoose**'s presentation at the Royal Society's 300th anniversary Café Scientifique discussion (2010).

Influence on government occurs through direct contact between individual faculty and the relevant department. For example, based on his research on the detection of drug residues in fingerprints, in 2012 **Russell** attended a closed Ministry of Justice workshop which brought together policy makers and experts to identify new research avenues for 'Drug detection in prisons'.

Executive and financial support for impact: There is a commitment at all levels within UEA to support impact from our high-quality research. At Institutional senior management level, there is a Pro-Vice Chancellor (PVC) for research, enterprise and engagement to ensure priority is given to maximising impact in all its guises. The PVC chairs the University Enterprise Executive, which comprises Associate Deans for Enterprise from each Faculty who cascade priorities and initiatives through Faculty Enterprise Executives and into Schools. Chemistry's Director of Enterprise advises faculty on ways to identify and exploit opportunities locally or through broader networks. Substantial financial support from a number of University sources is available to support enterprise and engagement activities. The University Enterprise Executive provides a Proof of Concept Fund (£120K pa) to help establish potential markets and commercial viability. Faculty in the School have been awarded >£75K for assessment of the initial commercialisation opportunities of nine projects. During this REF period, an additional Strategic Fund (£450K pa) for the next stage of development has been created. At the Faculty level, financial support is available via the Associate Dean for Enterprise who has funds to pump-prime aspects of small-scale enterprise activities, such as the support costs of meetings with industrialists and market research related to impact activities. Further support is available through UEA's participation in the ICENI Seedcorn Fund, which finances enterprise activities from the Universities of East Anglia and Essex and the Institutes of the Norwich Research Park. Three ICENI 'pathfinder' awards, totalling £70K, have been awarded to faculty, while the spin-out companies underpinning two of our impact case studies, *Chameleon Biosurfaces* and *Intelligent Fingerprinting*, benefited from early stage support of £250K each.

Support and incentives for staff: Enterprise and engagement activities are considered key for all faculty. Bespoke training through the University's Centre for Staff Education and Development is available for all researchers in line with the National Researcher Development Framework. Courses include: 'Engagement and Research Impact Workshops', 'Generating Impact from Intellectual Property', and 'Pathways to Impact', which are delivered by external experts as well as University staff. The importance attached to wider impact activity is reflected in the University's probation and promotions criteria where impact is a key component. The School actively encourages faculty to use the University's study leave system to provide the time and opportunity to exploit the results of their research to secure future benefits. Through annual staff appraisal and the School's workload model, impact activities of all faculty are regularly reviewed, with the aim of ensuring that sufficient time is available to exploit impact opportunities. For example, **Russell** was relieved of administrative and teaching duties for 50% FTE for two years (2009-2011) to enable him to concentrate on establishing *Intelligent Fingerprinting Ltd.* as a viable spin-out company.

Administrative support for impact activities: The University has a dedicated Research and Enterprise Service that provides: Business Development Managers who assist academics to identify research commercialisation opportunities; Commercialisation Managers who develop these opportunities further by protecting IPR, negotiating licences and supporting spin-out companies; and Consultancy Managers who negotiate contracts between external partners and individual faculty. UEA has a proactive Marketing and Communications team who work with the School to publicise the results of our research, ensuring that it reaches the widest possible audience.

c. Strategy and plans

A cornerstone of the School's future strategy is its membership of the Norwich Research Park (NRP), which comprises six partners: UEA; three BBSRC-supported research institutes (John Innes Centre, Institute of Food Research, and The Genome Analysis Centre); the Sainsbury Laboratory, and the Norfolk and Norwich University Hospital. This unique clustering of expertise offers the School opportunities for developing impact across each of its three research groups. In

addition to the mechanisms described above, enterprise activity at UEA is supported through membership of the *Norwich Research Partners LLP*, which links the University with its strategic partners on the Norwich Research Park.

To drive future growth of commercial activity, >£40M is being invested across the NRP. A new £14M *Enterprise Centre*, located on the UEA campus and funded by the European Regional Development Fund, the Department for Business Innovation and Skills and UEA, will provide a hub for the development of new start-up commercial activity arising from research. Successfully launched companies are based in the existing *Norwich Bioincubator* or the *NRP Innovation Centre* (for example, *Intelligent Fingerprinting Ltd.*). Larger-scale commercial activity will be located in a new *Centrum Building*, funded as part of £26M investment in the NRP from H.M. Treasury. These four hubs are the focus of an overall strategy that aims to: encourage innovation; stimulate enterprise; enhance skills; promote employment; and support business.

A major recent development, which will underpin our impact strategy for the next five years, was the creation of the Norwich Research Park Translational Fund. The £1.7M fund comprises funding from BBSRC, UEA, the NRP institutes, Norwich City Council and Norfolk County Council. This fund will support priority areas of translational science across the NRP. Additionally, the University was awarded both BBSRC and NERC Impact Funds to further develop societal and economic impact from research funded by these Councils and to strengthen the interactions between our research and the business community. The UEA Enterprise Executive distributes these funds through a competitive process, making awards to projects identified as having significant potential. **Le Brun** has already received an £18K award from the BBSRC Impact Fund to develop an enzymatic synthesis of unnatural amino acids as building blocks for new-to-nature compounds.

Building on the mechanisms that have been put in place and utilising the exciting new infrastructure and financial opportunities provided through the Norwich Research Park, the School of Chemistry will further develop impact from high quality research over the next five years. Several projects have already been identified as having potential to generate future impact, including: **Wildgoose**'s concept of the "electrocatalytic frustrated Lewis pair" that holds promise of a breakthrough in fuel cell technology; **Butt**'s research on the development of light-driven microbial fuel cells; and **O'Connor**'s work on the production of biologically active plant derived natural products in more tractable, easy to access organisms such as yeast. Key to success will be the School's commitment to support the lead researchers with the space and time to develop the science and, ultimately, the impact that follows.

d. Relationship to case studies

The three chosen impact case studies demonstrate the flexibility of the School's approach to, and delivery of, impact from its research.

Industrially relevant olefin polymerisation catalysis at UEA is an example of industrially funded research with outcomes of direct relevance to the commercial activities of the funder. Patents have been filed and maintained by industrial partners, and the innovative catalysis research exploited, leading to significant improvements in catalyst activity with concomitant decreases in manufacturing costs.

Intelligent Fingerprinting Ltd. – a spin-out company from the School of Chemistry provides an example of the creation of a direct spin-out company based on EPSRC funded research developed at UEA, and the establishment of a viable business. Financial and expert support from UEA was provided from the conception of the company, beginning with filing and maintaining patents through proof of concept funding, and subsequently by providing laboratory space in the School and granting the inventor relief from other duties during initial company development.

Medical implants with biocompatible electropolymer surfaces is an example of the uptake and further exploitation of UEA research by an external commercial enterprise. The initial research sought to build electrocatalysts. It was recognised that the electropolymers arising from this research could have a wider application as biomedical coatings and *Chameleon Biosurfaces Ltd*. was formed to exploit this potential technology. The School supported the on-going development of the company until the IP and other assets were bought by *Biotectix LLC* (Michigan, USA) in 2011.