

## LETTERS

**HAVE SOMETHING TO SAY?**  
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## GRAPHENE IS MOVING INTO ITS 'TEENAGE YEARS'

Since the first isolation of graphene at the University of Manchester in 2004, there have been huge expectations for the use of the material in products and applications. From electronics and aerospace to bio-medical and many other markets, there are many areas in which it can be applied. Despite only 13 years since its discovery, and in reality only a few years since industry first became interested following its receipt of the Nobel Prize for Physics in 2010, there has been a huge increase in the number of patents being filed, including many from China and overseas.

As Dr Scott Steedman's editorial in the last issue pointed out ('A Cinderella material', *Ingenia* 69), expectations remain high in terms of commercialising graphene (and other related two-dimensional materials) and its applications. Despite graphene only being in its 'teenage' years, comparisons can be made to other materials such as carbon fibre and silicon, which took many years to reach initial application and many more years to reach wide-scale commercialisation. However, we are seeing some differences to the past and are currently, I believe, in the process of realising the technologies made possible

by the properties of graphene.

Here at the University of Manchester, we have established the National Graphene Institute (NGI) and the Graphene Engineering Innovation Centre (GEIC) is currently under construction. We are looking to develop the eco-system through partnership and collaboration between academia and industry to accelerate the development of real products and applications that create value through the supply chain in the UK.

There is no better example of this than the small consortium of academic and business collaborators who produced a graphene-enhanced composite wing on a small aircraft (unmanned aerial vehicle), which achieved a first flight at the Farnborough International Air Show in July 2016. The project has now led to a graphene in aerospace white paper being developed with the Aerospace Technology Institute, which is due to be launched in March 2017. Alongside this, a programme of work to realise a number of potential benefits to the aerospace sector and supply chain in the UK has begun. With the application of good engineering and manufacturing skills and capabilities, we can realise these potential

benefits through a collaboration between academia and industry. The involvement and collaboration on standards, measurement and characterisation is also key here and our partnership with the National Physical Laboratory is critical to maintain a UK leading position.

So, whereas some like to count patents as a measure of commercialisation and success, real progress can be measured through partnerships and the launch of new products and applications. While these initial applications are mainly through the addition of graphene to an existing product (known as the 'fast lane' of new product development as it does not generally need the development of new manufacturing process or tools and skills), we are already seeing some good progress across the UK supply chain. I expect to see this increase over the next few years as the NGI develops further relationships and the GEIC opens in 2018. We might just be starting to write our 'future histories'.

**James Baker**  
 Graphene Business Director  
 University of Manchester

## MODULAR DESIGN COULD BE KEY ADVANTAGE FOR SMRS

The article detailing the very significant advantages that flow from the introduction of modular design for manufacture and assembly in the nuclear sector could not be more timely ('Manufacturing power stations', *Ingenia* 69). It demonstrates just how much can be gained by paying attention to the non-nuclear aspects of nuclear plants. These potentially amount to a greater part of the overall costs than the very well-established and scrutinised nuclear steam supply system – the reactor, its coolant pumps and associated piping used to generate the steam needed to drive the turbine generator unit – which has been the traditional focus of attention.

In terms of off-site manufacture, massive gains have been made in the construction sector over the last 20 to 30 years. The article clearly shows the advantages of scrutinising all aspects of the construction process from the point of view of design for manufacture and assembly.

Modular construction (making many of the structural components off-site) has already revolutionised many sectors of the construction and infrastructure industry, reducing building times with safer operations during construction and improved quality. The article points out that a fleet of smaller, standardised and manufactured modular reactors could

significantly reduce costs and timescales. Equally importantly, the same tools, techniques and methodologies can be applied to the large plants also envisaged in the UK's first wave of new nuclear power plants.

Bringing modular construction techniques that are common in other industries into nuclear projects will remove risk and deliver cost and schedule certainty. Delays in onsite construction present the biggest risk of cost escalation for nuclear plants. Implementing advanced manufacturing, with an increase in off-site modular assembly, will revolutionise the way power stations are manufactured, making nuclear more attractive to investors and lowering the cost of electricity to consumers. As the article pointed out, it is possible that gains of some tens of pounds per megawatt hour could be realised.

Off-site assembly in a clean manufacturing environment gives greater control over the quality of final products. It gives the ability to work with a stable workforce and drives down costs, particularly for nth-of-a-kind components. When integrated with design and manufacturing, modular construction will be a game-changer in assuring delivery to time and cost of major nuclear projects.

Innovative large-scale assembly and

manufacturing solutions must be integrated with design to generate a cost-effective manufacturing plant for large nuclear assemblies. A UK commitment to a fleet of small modular reactors (SMRs) as part of a long-term nuclear sector plan provides the opportunity for significant UK engineering innovation, building on the investments made in the design for manufacture and assembly (DfMA) project and in the Nuclear Advanced Manufacturing Research Centre at the University of Sheffield. As part of its *Final Report* recommendations to government, the Nuclear Innovation Research Advisory Board (NIRAB) indicated that supporting UK involvement in 'design for manufacturing and construction' and fuel supply presents an opportunity to develop exploitable design and manufacturing intellectual property, providing direct benefit from export sales as well as UK deployment. The SMR market presents a route to exploitation for a large portion of NIRAB's research and development recommendations, and the development of SMR technologies is a stepping stone to involvement in Generation IV reactor collaboration programmes for the longer term.

**Dr Dame Sue Ion DBE FEng FRS**  
 Chair, NIRAB

# RESPONDING TO THE BONFIELD REVIEW

The *Each Home Counts* report (also known as the Bonfield Review) was published in December 2016 (see page 7), with endorsements from then Department for Business, Energy and Industrial Strategy Minister, Baroness Neville-Rolfe DBE CMG, and Department for Communities and Local Government Minister for Housing and Planning, Gavin Barwell. The reaction from the residential energy efficiency industry and other stakeholders was almost universally positive or neutral, with many realising that the 27 recommendations would lead to a more professional industry when adopted. The full support of consumer representatives and emerging financial institutions in the sector were both highly significant.

By the time the report was published, its scope had widened to include the smart meter rollout and associated energy efficiency opportunities, social housing and the potential funders of energy efficiency upgrades. It genuinely covered the whole of the industry, allowing all technologies, installations, housing types and ownership models to be treated in the same way. This should take the whole industry forward, not just some parts, delivering a much greater level of service for the end consumer and a larger energy efficiency industry, leading to increased business and jobs.

However, the publication of the review is only the start of the transformation of the

industry. The establishment of a new quality mark is perhaps the biggest challenge over the next months, but the coordination of energy advice for consumers, installers and the wider industry, and the formation of a database of all energy-related information on UK dwellings will also take significant efforts from across the industry.

Timescales are important, as future government funding of energy efficiency improvements through the Energy Company Obligation programme, plus upgrades for housing association dwellings, will be only based on the implementation of the review recommendations. Industry groups need to be fully involved in the next steps organised by the workstream leads, and develop the relevant changes to their part of the industry needed to meet the review's recommendations.

The private sector housing market will not be left out of this new future, with very significant finances potentially available from the market. These new investors in the industry will only be in a position to release funds if the full recommendations of the report are adequately implemented. This is a very different model than was adopted in the past, not being reliant on government-based financial schemes.

For the suppliers of energy efficiency equipment, the review and its implementation provides a number of

opportunities. High among these is the elimination of non-compliant equipment from the market: "a high-quality installation relies on the use of high-quality and fully compliant equipment." For the majority of the manufacturing industry, this will come as very good news; for those not delivering compliant equipment, an initiative to become compliant, or lose market share.

The role of standards now and in the future will become more important. This is particularly the case as a result of the developing residential refurbishment standard, currently under review by the BSI working group. Upon completion, this standard has the possibility to be the framework for the industry. As many industry stakeholders as possible need to engage with the development of the standard.

The publication of the *Each Home Counts* report is a significant step in the professionalisation of the residential energy efficiency industry. All stakeholders have the opportunity to contribute to the development of the new industry, for the benefit of consumers, their energy bills, the wider environment and the energy efficiency industry.

**Howard Porter**

CEO

BEAMA (British Electrotechnical and Allied Manufacturers Association)