Institution: University of South Wales

Unit of Assessment: B15

a. Overview

This submission involves 14.5 FTEs (including 4 early career researchers) who are based in the Faculty of Computing, Engineering and Science. The Faculty was established to encompass all STEM areas within the newly formed University of South Wales that was created by the merger of the University of Glamorgan and the University of Wales Newport. Research is organised through an overarching Energy and Environment Research Institute (EERI) and two contributing centres; the Sustainable Environment Research Centre (SERC) and the Engineering Research Centre (ERC). The work of these two centres encompasses the areas of energy, low carbon and environmental technology and monitoring and control. The Centres have established international reputations, have attracted research income of £10.3 million and have managed grants in excess of £20 million, received from a healthy mix of UK Research Council, European, industrial and other sources, over the REF period. Moreover, there is also ample evidence that this level of activity will be at least sustained over the next 5 years with activity having increased by approximately 100% since 2008.

The staff submitted include a well distributed cross-disciplinary mix of three mechanical, three electrical, three environmental, four bioprocess engineers and four materials chemists who have expertise in the areas of anaerobic digestion, energy efficiency and low carbon emissions, battery and fuel cell development, hydrogen energy systems, biopolymer (PHA) production from wastes and low value biomass and new materials for energy storage and efficient use. As lead for the H_2 and FC theme within the Low Carbon Research Institute, SERC plays a key role in directing H_2 and FC R&D within Wales and plays a nationally and internationally leading role in fermentative biohydrogen production and biological fuel cells/bioelectrochemical systems through the EPSRC SUPERGENs and IEA:Task 21 and in hydrogen storage in the EU cost action.

b. Research strategy

After 2008, the University implemented a strategy to invest in the work that was submitted to B15. The vision of the university was to augment its research activities in general engineering by investing in facilities and staff able to reinforce the existing scope of research. Strategic directions were established for ERC and SERC through consultation with key stakeholders including industry, government and other internationally leading research groups. These focused on research areas where the research centres had demonstrable international strengths, and sought to augment these with new areas of synergistic expertise within the broad areas of the production of low carbon energy carriers, mitigation of carbon emissions, energy from waste and environmental protection. Involving stakeholders and considering national and European funding strategies, an analysis was undertaken in respect of the identified areas of materials for energy systems and resource recovery/efficiency. An analysis of staff, facilities and capabilities associated with the research of ERC and SERC was conducted and an investment strategy was formulated. A recruitment exercise was initiated to attract key expertise in the identified strategic areas of research expertise. State of art facilities were proposed in the areas of bioprocess engineering, photonics, battery, hydrogen energy and fuel cell technologies.

Following the 2008 submission to UOA25 by the University of Glamorgan, the newly formed University of South Wales considers that B15; General Engineering and Mineral & Mining Engineering, remains the most appropriate UOA for the research presented. The submission builds on the strategy defined in 2008 with additional strength in general engineering emerging from organisational changes in the University as follows:

a) Significantly improved infrastructure with more than £130M invested in the University infrastructure, of which science and engineering benefited from more than £16M in laboratory facilities. Specifically, SERC has benefited from a hydrogen energy research facility and ERC from dedicated laboratories for work on battery and fuel cell technology and photonics.
b) Enhancement of capability by attracting internationally recognised (**Antonelli & Copner**) and early career (**Galea**, **Kedia, Laycock & Patterson**) researchers to expand the existing research portfolio.
c) Development of existing research leaders through the creation of a new research institute in

energy and environment led by **Guwy,** that brings together additional expertise from **Graham**, **Maddy** & **Thomas**.

d) Development of links with internationally leading research groups. For example, work has been, and is being undertaken in collaboration with organisations such as: Oxford University and Imperial College (**Dinsdale, Guwy & Premier**), Technical University of Munich and the University of Stuttgart (**Tan & Wilcox**), Vienna University of Technology (**Esteves**), Harbin University (**Liu**).

c. People, including:

i. Staffing strategy and staff development

The University of South Wales is committed to sustaining and enhancing a thriving research culture, which is facilitated through a comprehensive programme of investment, professional administrative support and research staff and student development. The implementation of the University Research Strategy 2009-2014 has reinforced the continuing commitment to research and has provided a platform from which to drive the research agenda forward. The Deputy Vice Chancellor (Research and Student Experience) works with the Central Research Office to provide core support on all research-related matters, including proactive support with grant applications, the organisation of staff and student skills development and training seminars and research student administration. Traditionally, research at the University of South Wales has been structured into Research Centres and Groups. Recently research institutes have been established in the areas where the university already has a significant research profile and where the university has made a strategic decision to support the areas of research strength. Membership of the Energy and Environment Research Institute (EERI) is not automatic and is subject to a scientific annual review and this submission is drawn entirely from EERI. Members of EERI have protected research time to maximise their research outputs. This applies equally to early stage researchers as well as more established researchers. The University Research Investment Scheme (RIS) supports research within the University across all Faculties and is strategically allocated by the DVC (Research and Student Experience) and the professoriate.

Since RAE 2008 our B15 submission has increased in vitality and size (9.85 FTE in 2008 to 14.5 and £5.9M in 2008 to £10.2M) through recruitment of new staff in strategic areas and the development of researchers' careers. The research areas under the B15 submission are led by at least one of the professoriate with early stage researchers; bioprocess engineering (**Dinsdale, Guwy, Premier and Esteves**), energy efficiency and low carbon emissions (**Wilcox & Liu**), hydrogen and energy systems (**Antonelli**), and new materials for energy storage and efficient use (**Copner**). Overall the professoriate (**Antonelli, Copner, Dinsdale, Guwy, Lui, Premier & Wilcox)** has increased due to the promotion from reader of Dinsdale and Premier and the recruitment of new Professors in the strategic areas of hydrogen and photonics (**Antonelli & Copner**). In addition, Guwy was also awarded a five year HEFCW funded chair as lead of the hydrogen energy theme in the Low Carbon Research Institute. Research activity has also been underpinned via visiting Professors in the area of European links and industrial liaison (Fricker and Davies). The Professors lead research activities, mentoring other researchers, directing and leading research direction and agenda, not only in the field of energy and environment but across the Faculty and in the University professoriate. The University professoriate meets once a quarter, led by the Deputy VC and attended by other members of directorate.

There has been significant investment in new laboratories and research centres in the area of energy and environment over the assessment period. The professoriate was heavily involved in the justification, planning and deployment of these facilities, in particular the Hydrogen Centre at Baglan, Port Talbot, specialist laboratories for battery and fuel cell development and the £11 million new labs for the Sustainable Environment Research Centre, and the Anaerobic Digestion Centre. The appointments of Antonelli and Copner were also supported by investment in new facilities' i.e. the key areas of hydrogen storage and photonics. University PhD studentships have also been awarded to **Dinsdale, Esteves, Guwy, Premier & Tan** to support strategic areas either through application or through university wide initiatives such as the Centenary Scholarships. Guwy attended a week-long Senior Research Leaders Programme run by the Leadership Foundation for Higher Education in July 2013.

Through the provision of reduced teaching loads early stage researchers have also been supported. These early stage researchers have been recruited from post-doctoral research fellows internal and external to the University and also from industry. **Maddy** was recruited from BOC, and

has recently gained a lectureship position from his HEFCW LCRI research fellowship, whereas **Patterson** joined the University from Environ UK Ltd. Funding has also been utilised to support the attendance at conferences, RCUK events and sandpits and European funding events. The University is committed to the principles of the Vitae Concordat to Support the Career Development of Researchers and has applied for the HR excellence in Research Award. The University and its research institutes and centres strongly support equality and diversity in the recruitment of staff, for example, 13.7% FTE of the submission are women and 41% from ethnic minorities.

ii. Research students

The thirty research students that have graduated in the assessment period, a modest increase from 2008, have been in the main externally funded, often with industrial collaboration, through for example industrial CASE awards, with a reasonable split in supervision between the different areas of the UOA. The University's Graduate Research Office (GRO) provides a central monitoring and support structure which includes a calendar of events underpinned by the Researcher Development Framework (RDF) to ensure common skills needs of postgraduate researcher and supervisor are assured. Training is provided on research governance, collaboration, effectiveness and impact; referencing, conferencing and publications; thesis and transfer reporting and examinations; and opportunities are provided to showcase research at all stages. Furthermore, USW collaborates with other Universities to deliver Vitae's Effective Researcher courses and training. Knowledge Economy Skills Scholarship (KESS) students receive company partner specific training. An Annual Monitoring Survey and biannual Higher Education Academy's Postgraduate Research Experience Survey (PRES) are conducted and formal progress reporting is considered each year through Faculty and University instruments. Research Student Voice Representatives are members of both the Research Committee and the Research Programmes Sub Group. Studentships are advertised as widely as possible and filled on a competitive basis, with the process managed through the GRO.

Subject specific needs for training and support are identified through the supervision process. PDRAs are frequently the first line of support as has been the case in SUPERGEN, ERDF, EU FP and Carbon Trust Projects. Training invariably includes laboratory inductions, COSHH, Risk Assessment and H&S training; in house training on specialist tools and instrumentation and specialist software applications, GC, Ion Chromatography and Impedance Spectroscopy and Molecular Techniques. Training by third parties is provided as necessary, such as Anodic Stripping Voltammetry training from Modern Water, and web based training for COMSOL™, Ansys and Agilent Technologies Seminar 2013 - Measuring Complex Materials and their Components. Students are encouraged and facilitated to attend conferences and workshops wherever possible, as a key learning mechanism. For example, students have attended and contributed to 11th to 14th European Biosolids and Organic Resources Conference, Automation 2009, ECMS2010, Electrochemical Horizons 2011, EU ISMET 2012, AD13 and several SUPERGEN SHEC and Biological Fuel Cell consortium meetings. Also students are encouraged to present at major international conferences and funding has been utilised to pay for travel, subsistence and conference registration.

An open door policy and regular (weekly) review meetings with supervisors are used to maintain direction and motivation. Weekly workshops where students propose key papers for review are important in stimulating interactions between students, PDRAs and supervisors and improving student's own publishing. The majority of students have the opportunity to interact with external collaborators. Students have worked in and with external collaborations labs (e.g. UEA, UWE, Newcastle University, Pusan National University), with papers submitted and further publications expected. Supervisors are required to undergo regular training updates in higher degree regulation, supervisor, examiner and viva chair training. Members of the submission take an active role in the PhD oversight mechanisms such as Faculty Research Programmes committee, dispute resolution and PhD student admittance and transfers form MPhil/PhD.

The efficacy of these measures are supported by PRES and CROS surveys for the whole of USW, in which 90% of the respondents believed that the programme had developed their research skills; similarly 90% believed they had been given adequate access to training and development opportunities; 85% confirmed they had the opportunity to attend conferences and external meetings; almost 77% collaborated in research with external organisations, including outside the UK; and a similar percentage engage with policymakers and end users.

d. Income, infrastructure and facilities

Income to the research group is a substantial and healthy mix of national, EU and industrial funding. The value of eligible research income in the REF period was £10.3million, with 15% from RCUK, and 37% EU sources, the remainder coming from National Government and industry. Some of the projects are highlighted below in each of the core competencies;

Bioprocess Engineering: In the eight year funded EPSRC SUPERGEN Consortium "Biological Fuel Cells programme (EP/D047943/1 £304k & EP/H019480/1 £667k) **Premier** leads the microbial fuel cell theme. A FP6 Marie Curie TOK Fellowship Project (MTKD-CT-509821) was led by **Dinsdale**, to investigate the bioprocess optimization. **Premier** led the biomass conversion by bioprocesses in the TSEC–BIOSYS integrated analysis of bioenergy demand and supply dynamics (EPSRC, BBSRC NERC & ESRC NE/C516287). **Esteves** leads a £2M Welsh Government and ERDF funded programme that supports the Wales Centre of Excellence for Anaerobic Digestion, delivering industrial research and providing technical support with specialist equipment, for example, digesters, gas sensors, metal analysis equipment and biodegradability test equipment. The Centre is currently a partner in the IEE Biomethane Regions (£120k IEE/10/130, a 15 partner consortia) where **Esteves** leads the R&D in monitoring, control and optimisation of full scale AD plants. The Centre is also industrially funded (£250k) through Collaborative R&D led by **Esteves** with AMEC, Projen Bioenergy, NCH, Welsh Water and Insource Energy. Additional funding was acquired through a £1.2M ERDF-A4B project "SuPER^{PHA} Systems and Product Engineering Research for Polyhydroxyalkanoates" (HE 1416 1001) led by **Esteves** in collaboration with 12 companies, including, Kautex-Textron, Scitech (supported by BASF), Excelsior and Waitrose.

Energy efficiency and low carbon emissions: European Research Fund for Coal and Steel (RFCS) project (RFSR-CT-2005-00009, **Wilcox & Tan**) on intelligent monitoring and control of gas-fired burners. RFCS project (RFSR-CT-2008-00009) coordinated by **Wilcox** (2.4M€) on the monitoring and control of co-firing utility power stations. RFCS project Dynamo (RFS-PR-11026 PI **Tan & Wilcox**) on 3D zone models of steel reheating furnaces. FP7 project ORION (FP7-SME-2011-282693 **Wilcox & Esteves**) that is developing novel combustion systems for small scale anaerobic digestion in collaboration with 35 SMEs. FP7 project CRAFEM (FP7-ENERGY-2011-2-296042 **Tan & Wilcox**) NOx Reduction in Combustion processes. FP7 project RELCOM (FP7-ENERGY-2010-2-268191 9.7M€) coordinated by **Wilcox** that is developing the fundamental underpinning to enable modelling and monitoring to be demonstrated at a commercial scale for the first generation of oxy-coal utility power stations.

Hydrogen and energy systems: In a separate EPSRC SUPERGEN, UKSHEC Consortium (EP/E040071/1 £556k) **Dinsdale** led the hydrogen production theme. **Guwy** led the biohydrogen production theme within the 22 EU partner **FP6** project "REMOVALS" (CN018525). **Guwy** led the Hydrogen and Fuel cell theme in the HEFCW funded Low Carbon Research Institute (LCRI £5.1M) and **Guwy** leads a £6.3M ERDF funded programme CymruH2Wales, in which significant investments have been made to enhance hydrogen production, storage, refuelling and end use hydrogen technology at the Hydrogen Research Centre laboratories. Innovative H_2 electrolysis equipment has been added to the facilities at the Hydrogen Research Centre through the TSB funded Eco-island project in collaboration with ITM-Power (**Maddy** TSB-101292). This work is complemented by a collaborative **ERDF** funded project SOLCER (USW portion £315k) in which **Maddy** leads the energy storage theme. In addition, significant industrial funding has been attracted from the automotive sector in collaboration with companies such as Johnson Matthey, McLaren Automotive, Zytek Automotive, Drayson Racing, TATA, Yuasa and Atraverda to undertake specialist testing and development work.

New materials for energy storage and efficient use: **Antonelli** in collaboration with UCL has secured funds to investigate Proton Conducting Mesoporous composites for energy applications such as fuel cell membranes (EPSRC EP/I004688/1, £303k) and **Antonelli** has also recently secured a 1.6 Million USD grant from Chrysler and Hydro Quebec for novel hydrogen storage research. Technology Strategy Board Grant (TP/6/EPH/6/S/K2515A) based on IP (US2004131093) held by **Copner** that has the potential to significantly enhance frequency doubling efficiency by deploying narrowband multimode laser radiation. EPSRC funded project (EP/I029613/1 £450k **Copner**) to explore novel frequency tuneable laser sources for multiple, synchronous and accurate distance measurement. Renishaw funded (**Copner**) to explore the new tuneable laser concept described in WO2009081160. A4B project CIRP (HE 05 ROI 0821 **Copner**) to develop the new laser tuning concept described in WO2009081160. Industry and Carbon Trust

funded project (10C031, 10C032 & 0810-173 £1.5M **Copner**) to explore and research novel and robust organic materials, and structures for stable OLED emission. NHIR grant (II-LS-0511-21004 £600k) awarded through collaboration between **Copner** and Cymtec ltd and where the project seeks to innovative new techniques for LED endoscopic illumination. EADS (Job Number: 12R001; PO Number: IW203780 £1M **Copner**) grant to look at novel free space laser communications to unmanned aerial vehicles (UAVs).

The USW has excellent research facilities that focus on novel biohydrogen production, novel hydrogen storage, gas clean-up and utilisation systems, networked control, photonics and combustion monitoring and modeling. Since 2008, the General Engineering submission has seen an increased investment of over £16 million in new research facilities and industrial engagement centers. In 2010, the University opened the new £16 million Applied Sciences laboratories, which included a set of 13 new dedicated research labs (increased from 250 m^2 to 500 m^2), as well as an electron microscopy and NMR suite (**Dinsdale, Esteves, Guwy & Premier**). Specific additional equipment provision has come from HEFCW, WG, and industry and University funds to the value of £2M. Targeted equipment investment was made in hydrogen storage and nanomaterials (**Antonelli**), along with a £300k investment in the photonics area (**Copner**) The Universities cumulative investment of £3 million Hydrogen Research Centre was opened at Baglan, Port Talbot (**Dinsdale**, **Guwy**, **Maddy**, **Premier**) in 2008.

This investment has seen the development of substantive floor areas of high quality research space, with the provision of advanced analytical and test equipment to support a number of strategic and key research specialisms. These include: High quality research photonic facilities situated in two dedicated laboratories that house a range of vibration isolated optical tables. Specialist equipment includes: Innova Frequency-Doubled lasers to produce continuous-wave laser emission in the 229 to 264 nm wavelength range, compact tunable Laser Source with Continuous Sweep Mode, 1520nm to 1630nm, Lightwave Component Analyzer, thermal evaporator and fusion splicing capabilities. Eleven individual specialist laboratory areas are used to support the unique and world leading activities in anaerobic process optimisation; these include biohydrogen and biomethane production systems and microbial fuel cells/bioelectrochemical systems, as well as wastewater treatment processes. A full suite of analytical facilities are dedicated to this area including GC/MS/MS, HPLC/MS/MS, headspace GC/FID,GC/TCD, GC/FPD, elemental analysis for non-metals (CHNSO), ICP for metals with NanoDrop, DDGE and RT-PCR for molecular biological analysis. Fully instrumented bioreactors for batch and continuous operation ranging from 1 to 100 litres for the study of biohydrogen, biomethane and microbial fuel cell operation are studied in state of the art research facilities. Larger pilot plant systems are hosted off site. The Hydrogen Research Centre focuses on industrial research and experimental development of hydrogen energy systems and is a well-equipped platform for this scale of R&D, including PEM and Alkaline electrolysis, and PEM fuel cell test facilities, as well as hydrogen and CNG/H_2 vehicle refueling equipment. This activity is also supported by the laboratory provision at Glyntaff, in particular the Hydrogen Storage and Nanomaterials laboratories which includes a Micromiretics ASAP 2020 for surface area and porosity analysis and a state of the art Setram PCT Pro gas adsorption analyzer and C-80 calorimeter for hydrogen and methane adsorption studies. It is also equipped with an M Braun glove box and solvent purification system for synthesis of air sensitive compounds. The power train research is well equipped for research and development of alternative electric powertrain configurations that has subsequently developed into battery and overall low carbon systems analysis.

e. Collaboration and contribution to the discipline or research base

A key element of the group's research strategy has been to engage and collaborate with internationally leading researchers and industry in targeted areas and to lead, influence and contribute to the dynamism of these selected research areas, nationally and internationally. Collaboration with Welsh Universities through the Low Carbon Research Institute (LCRI) has led to a number of collaborative R&D projects such as CymruH2Wales (**Guwy**) & SOLCER (**Maddy**)**.**

Bioprocess Engineering: The contribution of **Premier, Guwy** and **Dinsdale** in the field of energy production from wastewaters was also recognised by funding under two rounds of the (EPSRC) SUPERGEN V Consortium "Biological Fuel Cells programme, (EP/D047943/1 and EP/H019480/1) and currently involves seven leading university research groups. **Premier** at USW lead the Microbial Fuel Cells (MFC) theme, one of two with Enzymatic Fuel Cells, the second led by Oxford. Joint papers have been published with UCL and Universities of Glasgow and Surrey, as

well as Pusan National University (via BIS UK Korea-STIP Energy and Environment Programme). **Esteves** is the Director of the Wales Centre of Excellence for Anaerobic Digestion and has had an EPSRC CASE studentship with Thames Water. **Esteves** (IEE/10/130) has been able to double biogas production at a full-scale plant (Insource Energy), corroborated by laboratory investigations, and has defined strategies for bioconversion efficiency increases of 30-100% at AMEC and Welsh Water digestion sites. This project is delivered in collaboration with Vienna University of Technology (biogas upgrading), and the accumulated knowledge is being disseminated directly to energy agencies across 12 European countries. The Centre is an active member of the ADBA and REA Biogas Group and the close interactions with these industrial groups has informed the development of the Centre's R&D strategy. In bioprocess optimisation **Dinsdale** has hosted three Marie Curie Fellowships. **Esteves** leads the 15 partner consortia project EDRF-A4B SuPER^{PHA} (HE 1416 1001) where biopolymer yield from organic wastes has already been increased by nearly 3-fold. This project delivers impact and innovations for 12 companies within the wastewater and waste, instrumentation as well as packaging, automotive and retail sectors.

Energy efficiency and low carbon emissions: Significant international leadership is demonstrated in combustion modelling and monitoring, where **Wilcox** has coordinated EU projects: RFSR-CT-2008-00009 that developed a monitoring and control system for burners in co-firing utility power stations in collaboration with partners such as Gas Natual Fenosa and Indra Systems and a FP7 project RELCOM. This is the only EU funded project in the area of oxy-combustion (FP7-ENERGY-2010-2-268191); it is currently being coordinated by **Wilcox** to develop the fundamental underpinning to enable oxycoal combustion to be demonstrated at a commercial scale for the first generation oxy-coal utility power stations. This project involves major EU stake holders including; Doosan Power Systems, International Flame Research Foundation, University of Stuttgart, Technical University of Munich, Catholic University of Leuven, EDF, EON and ENEL with the University of South Wales leading and developing new instrumentation to monitor oxycoal flames and zone modelling techniques to enable the next generation of oxycoal boilers to be designed. A further FP7 project (FP7-ENERGY-2011-2-296042) led by **Tan** is part of a long term project that GDF Suez, Global Combustion Systems and the ERC have been collaborating on which is focussed on the demonstration of a novel patented technique able to reduce NOx emissions by in excess of 60% whilst simultaneously achieving efficiency increases of 3 to 4%. Additionally, international collaboration with the Energy and Resources Institute in Delhi has been undertaken in the form of invited presentations which has resulted in a memorandum of understanding and two British Council funded researcher exchanges.

Hydrogen energy systems: **Dinsdale**, **Guwy** and **Premier**, were funded through the EPSRC SUPERGEN Sustainable Hydrogen Energy Consortium (EP/E040071/1) which was led by the Universities of Oxford and Bath in collaboration with eight other UK universities. The papers in the field of biohydrogen production have had significant impact on the research area with over 1300 ISI citations. Collaboration in the area of biogas production from grasslands was also initiated with Donisson (Aberystwyth University) and a member of the EPSRC Bioenergy Consortium resulting in a joint paper and a UKERC funded PhD by **Dinsdale. Guwy, Dinsdale, Esteves and Premier** were investigating partners in the FP6 project REMOVALS which built on a CASE studentship award with Thames Water investigating the hydrogen production from sewage biosolids (**Dinsdale** & **Guwy**). The wider implementation of hydrogen energy systems has been led by **Guwy** & **Maddy**, including a number of industrial demonstration scale, collaborative hydrogen energy projects. These include the hydrogen refuelling stations at Baglan, Port Talbot (with Air Liquide), Glyntaff USW Campus and Honda at Swindon (with Air Products) and on the Isle of Wight (with ITM Power).

The LCRI funding has also led to numerous collaborative industrial research projects with, for example, Shell on novel biogas/bio-liquid reforming and ITM Power on advanced electrolysis systems. The importance attached to the industrial relevance of the research activities is further evidenced by the 25 Teaching Company/Knowledge Transfer Partnerships, which have been managed over the assessment period. Our PhD candidates are examined not only by UK based examiners but internationally leading academics from outside the UK and our researchers have been invited as PhD examiners to a number of national and international institutions.

New materials for energy storage and efficient use: **Antonelli** is collaborating with University College London (UCL) on computational modelling of novel hydrogen storage materials, a project that has already led to papers in the journal of the American Chemical Society ACS. As the

principal investigator of an EPSRC project with the University of Warwick and the Universidade Federal do Rio de Janeiro (UFRJ) and Universidade do Estado do Rio de Janeiro (UERJ) in Brazil on NMR and physical studies of proton and electron conducting composites. He is also working with National Renewable Energy Laboratory (NREL) and University of Santa Barbara/University of South Florida on physical characterisation of novel hydrogen storage materials. **Copner** is currently working with EADS and Oxford University on establishing major innovations for free space optical communications to unmanned aerial vehicles. This breakthroughs in highly efficient LED multiplexing technology enabled major collaborations with Digital Projection, Karl Storz and Imperial College London in the fields of display and endoscopy.

Leadership in the Academic Community:

Antonelli represents the UK's interests in the EU COST action on nanostructured materials for solid state Hydrogen Storage (Action MP1103).

Copner is founder of Cymtec and CTO and technical advisor to the board of Optoplex Corporation (Fremont, Ca), Sirrus Technology (Santa Rosa, Ca) and Chromogenexs Ltd (Llanelli, Wales). He has been an evaluator for the Irish Smart awards and has a visiting Chair position at Xian University in China.

Dinsdale led the EPSRC SUPERGEN UKSHEC hydrogen production research theme, has acted as referee for professorial and reader promotional panels for UK based and overseas Universities, has represented the UK on EPSRC sponsored UK:China Nanotechnology Workshops Water Engineering, EPSRC sponsored UK/China workshop in Bioelectrical Systems and as acted as reviewer for RCUK, and Polish Science Ministry grant awarding panels.

Esteves has conducted research, which has led to work with a number of industrial and regulatory stakeholders and developed guidance, best practice and regulations applied to the emerging AD industry. This has included: ABP Regulations; Environmental Permitting; the PAS 110:2010 and revision; and Utilisation of Biogas from Non-Conventional Sources (with direct relevance to any changes to the Gas Safety (Management) and the EA AD Permitting Guidance). She also collaborates with University Tenaga Nasional (Malaysia) and is an invited speaker at yearly seminars related to AD and biogas for academics, government and Industry in Malaysia; these are delivered in partnership with the Sustainable Energy Development Authority Malaysia.

Guwy was an invited editor for a special issue of the Bioresource Technology Journal dedicated to papers on biohydrogen, the UK representative for IEA HIA Task 21: Biohydrogen and will become operating agent for the task in 2013, and is the UK representative for the International Water Association Anaerobic Digestion Specialist Group. He was the lead Scientist in 2008 for the British Council's "Dialogue on Decentralised Low Carbon Technologies with India" which was filmed for India TV. Guwy also led the Wales-India "Low Carbon Technologies" programme in 2009, which involved Cardiff, Bangor and Swansea Universities with Indian partners from The Energy Research Institute (TERI), IIT Karapour, Solar Energy Centre, part of the Ministry of New and Renewable Energy, the School of Energy Studies, Jadavpur University, the Indian Institute of Science, Indian Institute of Technology Kharagpur.

Premier is Chair of the World Renewable Energy Conference/ Network Biomass and Energy from Waste Theme and is an Associate Editor of International Journal of Automation and Computing. He has acted on the International or Technical committees of AD13, IWA ICA2013, SEB2012 to 2014 conferences and was an invited speaker at the past two WREC XI and XII and the WREN Seminars in Britain since 2009. He has represented the SUPERGEN Biological Fuel Cell Consortium at annual High Level Group review events.

Thomas together with A J Thomas at Cardiff University, and G T Waters from GTW Developments Limited won the Queen's Award for Innovation in 2013.

Wilcox was the organiser of a symposium on Condition Monitoring and Diagnostics held as part of the ASME International Design Engineering Technical Conferences that were held in San Diego during August & September 2009, Washington DC in August 2011 and Chicago in 2012. He was appointed to act as an evaluator of research proposals submitted to: i) the European Commission Research Fund for Coal and Steel programme in December 2008, November 2009, October 2010 and November 2013; ii) the European Commission FP7 SME and ITN programmes in February 2013; iii) the Qatar foundation in 2011, 2012 & 2013. He was also invited to be a member of the Technical Steering Group for Casting and Direct Rolling for the European Commission Research Fund for Coal and Steel in 2009 and has been re-elected in 2013.