Institution: Cardiff University

Unit of Assessment: 16 - Architecture, Planning and Built Environment

a. Context

Research at the Welsh School of Architecture impacts on policy makers, legislators, industry, design practitioners, construction professionals, communities, and users of the built environment. The diversity of its research, embracing physical sciences, social sciences, humanities, and design, leads to the following main types of impact:

- policy guidance on sustainability, low carbon futures and health and well-being;
- innovative and rigorous methods for building performance evaluation;
- designs for buildings that make significant technical and cultural contributions; and,
- an expanded theoretical and historical understanding of architecture that informs professional debate and future design.

These impacts register at geographical scales ranging from international (Europe, China, India and the Middle East) to national, and regional, and apply to building components, individual buildings, urban places and entire cities. This broad range of impacts emerges from the School's three research groups: the Architectural Science Group (ASG); the Architectural History and Theory Group (AHTG); and, the Design Practice Research Group (DPRG). Impact from Architectural Science arises mainly from research on low carbon futures and energy transitions, building performance evaluation, and health and well being in the built environment. The research results in knowledge and understanding that impact on future policy, guidance and design of the built environment. The impact of research in Architectural History and Theory flows from detailed understanding and knowledge of contemporary issues and historical precedent in architecture to inform new design. The DPRG integrates findings of the other groups with an agenda for exploring contemporary themes in architecture, such as novel forms of construction and place-making, thus locating the experience of architecture in the broader contexts of sustainability and culture. The DPRG makes tangible impacts through delivering finished buildings.

b. Approach to impact

Impact has been part of the School's research ethos for many years, as reflected in longstanding strategic relationships with the Welsh Government, local authorities, BRE and industry. The School's approach to impact uses engagement and dissemination. Engagement works in two directions. Firstly, researchers are involved with key policy making bodies such as government and related organisations in Wales, the UK and Europe. Examples include: Pearson's role as Chair of the Carbon Trust Standard Advisory Board (2009-); Jones' role as Chair of the Welsh Building Regulations Advisory Committee (2011-); and Tweed's role as Chair of the Sustainable Living workstream of the Wales Low/Zero Carbon Hub (2009-2012). From the other direction, stakeholders are engaged in research at the earliest stages, and continue by serving as members of research teams. Notable examples of direct industrial collaboration include Tata Steel in the Low Carbon Built Environment project (Jones), *EOn* in EPSRC projects EP/F022832/1 (Pearson) and EP/G000395/1 (Tweed), *EDF*'s (Électricité de France) in EP/H051082/1 (Tweed) and various European industrial partners in EU funded projects HARMONAC (Knight), SUSREF (Tweed) and iSERV (Knight). The other main route for engaging with external organisations is through project advisory boards, for example, in the EPSRC funded *Retrofit 2050* project (Eames), which engages with representatives from The Carbon Trust, BRE, Scottish and Southern Energy, Cardiff City Council, Manchester City Council and Arup Associates.

Dissemination embraces the communication and distribution of knowledge and understanding through workshops, conventional print-based media, software tools, and designs for buildings. Notable software includes the School's development of low carbon assessment tools on smartphone platforms. The School has developed the impact gained from design research through designs for a new Hoysala Indian temple, made possible by Hardy's research into historical precedents, and Forster's application of the *Ty Unnos* timber construction system, which allows homegrown timbers to be used structurally.

Impact is delivered through each of the School's research centres, with the Centre for Research in

the Built Environment (CRiBE), providing support to the other centres by acting as a gateway to industry. In its 15-year history, CRiBE has assisted over 80 businesses in Wales and the UK and from 2009 received Academic Expertise for Business (A4B) funding of nearly £400k. CRiBE led the "Delivering Low Carbon Buildings Cymru—from Policy to Practice" Knowledge Transfer and Collaborative Industrial Research project. CRiBE has engaged with clients, such as GlaxoSmithKline, Arup Associates (London), Alsop Architects, Atkins, Michael Hopkins & Partners, Percy Thomas Partnership (Cardiff), Buro Happold (London), Kopitsis BauPhysik (Zurich) and Warm Wales. The design for the exemplary low carbon REGAIN building in Ebbw Vale won the 2012 Constructing Excellence Wales Low Zero Carbon Award and the Confederation of Local Authorities in Wales Building of the Year Award 2012. CRiBE offers a client-centred approach to administration and project management, allowing staff to concentrate on delivery. CRiBE provides CPD activities in Wales and recently received a Dewi-Prys Thomas Prize (2012) for its pioneering work, contributing to quality of life, identity and regeneration of Wales.

The School leads the **Low Carbon Research Institute** (LCRI), established in 2008. The LCRI coordinates research and industry partnerships across six Welsh Universities, with an overall research income of around £80M, from RCUK, industry, government, FP7, and EU structural funds. There is strong involvement from companies and government with clear pathways to impact through projects, such as the Low Carbon Built Environment (LCBE), an annual conference and workshops organised by individual work packages. It provides staff and facilities to work with industry to carry out collaborative research and helps generate economic growth. For example, the LCBE Sustainable Building Envelope Centre (SBEC), funded by Tata Steel and the Welsh Government (£4M), provides a research facility for research staff to work alongside Tata staff on innovative integrated energy generating facades. There are around 150 research staff associated with the LCRI across its university partners. The LCRI has established four research centres in China: Chongqing, Nanchang, Tianjin and Guangzhou. The LCRI is cited in the Welsh Science Policy and the Wales Energy Strategy.

The **BRE Centre Sustainable Design of Buildings** (SuDoBE)**,** funded by BRE, the Welsh Government and Cardiff University, was established in 2007 and provides routes to impact via the BRE and the Modern Built Environment Knowledge Transfer Network (MBEKTN). Research is mainly focused on how people interact with built environment technologies, and how this determines their successful performance, e.g. through comfort studies. This has created opportunities for the Centre to advise DECC on heating controls and the Wales Low/Zero Caron Hub on sustainable living. SuDoBE publishes its work in the annual BRE Review, which is circulated widely within the construction industry in the UK and elsewhere.

The **Design Research Unit Wales** (DRUw) was established in 1999 and engages in research-led architectural projects that are realised through finished buildings. The research, underpinned and explored via the design work, focuses on the use of local materials, especially timber, on low energy designs, often through CRiBE, on aesthetic concerns such as how buildings relate to the landscape, and on social issues such as the future of market towns and care provision. The impact of this research is both palpable and esoteric. Real buildings demonstrate the results of the research for those who experience direct contact with them, and impinge on architectural debate through publication in professional and industry journals.

The **Practice, Research and Advancement in South Asian Design and Architecture (**PRASADA) centre is a vehicle for deepening the understanding of the traditional architecture of India and South Asia and provides opportunities to make contributions to the rich culture of this region through live projects. The Centre's consultancy activities operate alongside research projects and postgraduate programmes, leading to new temple designs.

More generally, the School's Innovation and Engagement Committee encourages and collates information on staff activities that lead to impact. The Committee, chaired by Professor Sarah Lupton, is the main vehicle for promoting and sustaining engagement and outreach for both teaching and research. It is able to identify and promote linkages across diverse engagement activities which—particularly in a school of architecture with an emphasis on live projects—are often fruitful. The Director of Research serves on the Innovation and Engagement Committee and provides a link between research and general engagement activities.

Training programmes led by the School such as the Built Environment Sustainability Training project (BEST) have secured structural funds of £7 million to work with industry to identify the sustainability training needs of the Welsh construction industry and to initiate courses across

Higher Education and private sector training. The LCRI's Welsh Energy Sector Training project (WEST) has £1.35 million for disseminating the outputs from LCRI to industry through CPD and Masters courses. The School also runs summer schools for industry.
The School has engaged with ***network activities***, in Wales through the LCRI and its industry liaison group, across Europe through a series of COST Actions, and internationally, e.g. its China Centres. The School's annual magazine MADE describes its engagement activities alongside research and teaching articles. The School supports research staff in the pursuit of impact through a core and project based administrative structure consisting of 14 staff.
The University Strategic Plan for Research, Innovation and Engagement and the Pro Vice Chancellor, International and Engagement provide a network for communicating and discussing engagement, promote a culture of engagement to benefit research; encourage collaboration with other universities, particularly the Great Western Four. The University Directory of Expertise establishes direct media access to researchers' expert knowledge.

c. Strategy and plans

The School will seek to develop and promote impact through its research by partnering with others in Wales and internationally. We will build on our links with Cardiff and other Welsh local authorities to engage with the built environment and communities, and through companies, such as *Warm Wales* and *BRE*, on improving the existing building stock and quality of life in Wales. We see this as an effective way to pioneer impact, using Wales as a testbed for low carbon research, which is already part of the Welsh Government's policy commitments, for wider impact in the UK and beyond. The School has four strategic plans for developing future impact:

- To use the LCRI as a hub to coordinate Welsh universities' applications and industry collaboration and lead proposals in Horizon 2020. Leveraging the LCRI's established connections to government and industry, and working within the University's new College structure, it will be able to influence government policy and help industries and communities respond to government aspirations for a low carbon economy.
- To align and expand the work on health, well-being and comfort with key challenges arising from the changing energy landscape and its impact on people, for example, through Wales' commitment to reduce fuel poverty and to improve the quality of life in housing. Welsh Government is already involved in a project advisory group.
- To establish a comprehensive new experimental facility for 'making' and deploying low carbon and related built environment technologies in full scale models within in a controlled workshop setting, which could serve testing requirements of industry. This would be an obvious route for impact from the existing expertise in building performance evaluation.
- To establish a research end-user panel to bring together researchers with beneficiaries in a formal arena. This will draw on existing project-based industry and non-academic advisors and target new groups with interests in low carbon, sustainable communities, health and well-being in the built environment and energy in buildings. The existing Innovation and Engagement Committee in the School will develop mechanisms for gathering impact related evidence.

d. Relationship to case studies

The case studies have been chosen from two of our main impact activities. Firstly, informing government policy on low carbon buildings, Knight's European funded research on building energy performance from 2009 to 2013 has fed directly into the EU Energy Performance of Buildings Directive***.*** This is the framework within which EU member states develop their national standards to meet carbon reduction targets. This work has been supported at School level through CRiBE and the University's Research, Innovation & Enterprise Services. Secondly, informing building design, simulation tools at building and urban scale, developed at the School, have been used worldwide to help designers predict the energy and environmental performance of buildings. These include, the building energy model ***HTB2***, the environmental design tool, ***Ecotect***, and the urban energy and environment prediction tool ***EEP***. This impact was largely enabled through collaboration with industry coordinated by CRiBE.