

BUILT ENVIRONMENT RESEARCH INSTITUTE

ANNUAL REPORT
1 AUGUST 2015 - 31 JULY 2016



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1. Foreword: Research Institute Director Professor Stanley McGreal

It is a great pleasure to present the Annual Report for the Built Environment Research Institute (BERI) for the academic year 2015-2016. I am happy to report a very successful year for our research activities with many new and prestigious research grants funded, with particular successes in winning awards through the European Commission's Horizon 2020 programme, but also from research councils with highly significant new funding from the Engineering and Physical Sciences Research Council (EPSRC) and government departments/agencies. Colleagues in BERI have again been prolific in publishing world-leading scientific papers in key journals within their discipline areas, presenting at conferences, seminars and workshops internationally as well as disseminating the outcome of their reach to local audiences in Northern Ireland. Importantly our research through industrial collaboration is continuing to bring added value to the local economy and make an impact on the global community.

In this foreword, we briefly review some of the activities of the five research centres within the Built Environment Research Institute: the Centre for Sustainable Technologies (CST), the Fire Safety Engineering Research and Technology Centre (FireSERT), the Hydrogen Safety Engineering and Research Centre (HySAFER), the Centre for Research on Property and Planning (RPP) and Studies Allied to Built Environment Research (SABER). The main sections of the report provide details of academic and research staff in the Research Institute, details of PhD projects and graduating PhDs, publications and information on our current research portfolio. Given the diversity of this research base, BERI's activities embrace many different constituencies, audiences and networks with users and beneficiaries embracing policy-makers, companies, the business sector and

the wider community. Limitations on space in this foreword mean that it is impossible to mention every activity hence the focus is more generic but designed to provide a flavour of our achievements over the academic year 2015-2016 and as such is a snapshot of our wider research which can be viewed on BERI's website.

During the period covered by this report, the Centre for Sustainable Technologies (CST) had successes in terms of grant income with Horizon 2020, EPSRC and local funding all contributing to the successful operation of the Centre. New H2020 projects include Inpath-TES (MSc and PhD level education for thermal energy storage), 'EENSULATE' (developing lightweight and highly insulating energy efficient building materials) and Chess-Setup (heat pumps and seasonal thermal energy storage). In addition H2020 RFCS- DIRPRIMCOAL (Direct Primary Coal Liquefaction via an Innovative Co-processing Approach with Waste and Petroleum Feedstocks) project aims at improving the viability and environmental performance of direct coal liquefaction without the need for extremely large-scale plant and the RS-China (NSFC) Cost Share project which aims to develop integrated distributed energy storage for reducing dependence on fossil fuel. New EPSRC funding included 4S-SHW (Developing advanced heat pumps for domestic hot water). Projects in bioenergy and solar energy funded from Northern Ireland sources reflect strong links with the energy sector locally and nationally CST was appointed the UK lead on two International Energy Agency Heat Pump Tasks, associated with domestic hot water and industrial heat pumps.

In FireSERT, each of the four core areas of research activity: fire dynamics and materials, structural fire engineering, fire protection and human behaviour in

fire advanced significantly over the year with funding successes from UK research councils, government, the European Union and industry. Live projects over the period of this report include the development of bulletproof doors with fire resistance for Essexford Joinery, Dundalk; experimental investigation on Sprinkler Performance Clear Space During Fire for Marks & Spencer; flash over and smoke movement on the Longboat Quay Development in Dublin. Research sponsored by the Korean Ministry of Public Safety and Security concerned the development of nanoclay dispersed intumescent polymer composition for application in the built environment and the automobile industry. The ELISSA project: Energy Efficient Lightweight Sustainable Safe Steel Construction FP7 is concerned with the development, testing, assessment and demonstration of nano-enhanced lightweight steel skeleton/dry wall systems and funding from the Atomic Weapons Establishment (AWE) examined the ignition probability of different types of commercial buildings. The final report of the LOCAFI project (FP7) was submitted to the European Commission with continuation of LOCAFI+ and dissemination of new design guidance for localised fires.

Reflecting FireSERT's international profile two Fire Engineering Seminars were organised by the School of Engineering at NTUA in collaboration with the Greek Fire Academy in Athens in May 2016. A partnership between FireSERT and Efectis is under discussion to work together in commerce, research and continuing development. In addition, FireSERT was successful in its bid to hold the 10th International Conference on Structures in Fire SiF'18 in Belfast 6-8th June 2018.

The focus in the Hydrogen Safety Engineering and Research Centre (HySAFER) over the period of this report was on the delivery of six projects funded from European programmes and EPSRC respectively. In particular, HySAFER participated in the European hydrogen emergency response training programme for first responders (www.hyresponse.eu) and also in safety analysis of hydrogen and fuel cell technologies (<https://iaikit-sp2.iai.kit.edu/susana>). In the former, three training sessions were performed at the Fire Academy in France to international participants with HySAFER responsible for educational, virtual reality and operational training.

During the year, significant collaboration was established with Shell through the GENFUEL project

through application of HySAFER's multi-phenomena deflagration model. HySAFER continues to champion hydrogen safety research and education in the UK through three on-going EPSRC projects: SUPERGEN Hydrogen and Fuel Cells Hub (www.h2fcsupergen.com), a Centre for Doctoral Training in Fuel Cells and their Fuels (collaboration with the University of Birmingham), and SUPERGEN Challenge: Integrated safety strategies for hydrogen storage. The CFD model developed at Ulster within the EPSRC H2FC Hub successfully reproduced experiments with high-pressure storage tanks (350 and 700 bar) performed in USA and Germany. The synergies and complementarities of funding through EPSRC Hub and EPSRC Challenge projects resulted in the development of innovative explosion-free technology for composite tanks. HySAFER's global reach is reflected in its continuing activities within the International Association for Hydrogen Safety, ISO TC197 Hydrogen Technologies, and the IEA Hydrogen Implementation Agreement Task 37 Hydrogen Safety.

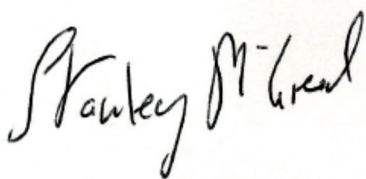
In the Centre for Research on Property and Planning (RPP) more success was achieved through confirmation of further European funding and two FP7 projects, COBACORE (Community Based Comprehensive Recovery Security) and HARMONISE (A Holistic Approach to Resilience and Systematic Actions to make Large Scale Urban Built Infrastructure Secure) were successfully completed. The latter involved a major conference on urban resilience, held as part of "Genoa Smart Week" on the 24th May 2016 as the culmination of the project. The conference combined a conceptual analysis of the emerging and dynamic challenges of Urban Resilience as a field of study and practice showcasing the HARMONISE Platform and Toolkit. More locally, RPP with funding from CHOBE (Council of the Heads of the Built Environment) hosted a seminar in Belfast on 'Marine Spatial Planning in Northern Ireland: Towards Productive Seas and Resilient Communities' on 23rd May 2016. Continuing the planning theme, a UPLAN seminar series, was initiated in February 2016 with the purpose of bringing together practitioners, researchers and students to promote good practice, exchange ideas and stimulate debate on planning, regeneration and development. In June 2016 colleagues in housing research hosted the prestigious conference of the European Network for Housing Research which attracted over 300 international delegates to Belfast. Also in the housing research area, the long-running research project the Northern Ireland Quarterly House Price Index was

pleased to welcome a new co-sponsor, the Progressive Building Society.

SABER, Studies Allied to Built Environment Research, embraces a wide diversity of research interests with sub-groups concerned with civic ecology and life infrastructure, highway engineering, hydraulics, geo-polymers and non-contact measurement. As the most recently formed research centre in BERI, SABER has focused upon developing networking and opportunities for research in the construction and civil engineering areas of the built environment. In this context there were several notable achievements over the year including hosting the CIB W099 Conference Benefitting Workers and Society through Inherently Safe Design in September 2015 and involvement in the organization of the 6th International Scientific Conference “Education, Science, Innovations” held in Pernik Bulgaria, June 2016.

Staff within SABER have been involved in extensive international collaboration over the year, some examples include the University of Wyoming in laboratory scale modelling the scour around bridge abutments, AECOM on a Highways England funded project concerned with innovation in high speed friction measurement, with University College Dublin and Trinity College Dublin on the Transport Infrastructure Ireland funded project on a probabilistic framework for improved roads management, with the University of Bologna on surfacing issues at Imola and Vallelunga race tracks and Texas A&M University (Doha) and Delft University on a Qatar Road Authority funded project on skid resistance in hot climates.

The above provides a short summary of some of the main achievements in built environment research over the year 2015-2016. Further details of research expertise at the Built Environment Research Institute can be found on Ulster University’s website or by contacting Mrs S Magee (Admin Support) at (028) 90368638.

A handwritten signature in black ink, reading "Stanley McGreal". The signature is written in a cursive, flowing style. The first name "Stanley" is written in a larger, more prominent script, while "McGreal" is written in a slightly smaller, more compact script. The signature is positioned on a light-colored, textured background.

Professor Stanley McGreal
Director Built Environment Research Institute

2. Research Institute: Academic Staff Members status at 31 July 2016

Surname	Forename	Title	Position	Institute Status
Adair	Alastair	Prof	Deputy Vice-Chancellor	Core
Ali	Faris	Prof	Professor of Structural Engineering	Core
Anderson	Mark	Mr	Lecturer	Associate
Berry	James	Prof	Professor of Global Real Estate & Planning Strategy	Core
Blair	Neale	Dr	Senior Lecturer	Core
Boyce	Karen	Dr	Senior Lecturer	Core
Brandoni	Caterina	Dr	Lecturer	Core
Brennan	Sile	Dr	Lecturer	Core
Choi	Seng-Kwan	Dr	Lecturer	Core
Davis	Peadar	Dr	Senior Lecturer	Core
Davison	Karen	Dr	Lecturer	Associate
Eadie	Robert	Dr	Lecturer	Associate
Griffiths	Philip	Prof	Head, School of the Built Environment	Core
Hemphill	Lesley	Dr	Lecturer	Associate
Hewitt	Neil	Prof	Professor of Energy/Director of CST	Core
Huang	Ming Jun	Dr	Reader	Core
Huang	Ye	Dr	Reader	Core
Hyde	Trevor	Dr	Reader	Core
Keenan	Michaela	Dr	Associate Head, School of the Built Environment	Associate
Lim	Lay-Cheng	Dr	Senior Lecturer	Core
MacIntyre	Sean	Mr	Senior Lecturer	Associate
Magee	Bryan	Dr	Lecturer	Associate
Mahon	Clare	Ms	Lecturer	Associate
Makarov	Dmitriy	Dr	Reader	Core
McConnell	Nigel	Dr	Lecturer	Associate
McCord	Michael	Dr	Lecturer	Core
McElduff	Linda	Dr	Lecturer	Associate
McGreal	Stanley	Prof	Professor of Property Research/ Director of BERI and RPP	Core
Millar	Phillip	Dr	Lecturer	Associate
Molkov	Vladimir	Prof	Professor of Fire Safety Science/Director of HySAFER	Core

Surname	Forename	Title	Position	Institute Status
Mondol	Jayanta	Dr	Senior Lecturer	Core
Murphy	Martina	Dr	Lecturer	Associate
Nadjai	Ali	Prof	Professor of Fire Structural Engineering/ Director of FireSERT	Core
Pimenidou	Panagiota	Dr	Lecturer	Associate
Rafferty	Gavan	Mr	Lecturer	Associate
Ritchie	Heather	Dr	Lecturer	Associate
Smyth	Mervyn	Dr	Reader	Core
Solan	Brian	Dr	Lecturer	Associate
Van der Krabben	Erwin	Prof	Professor of Real Estate	Core
Woodward	David	Dr	Reader/Director of SABER	Associate
Zacharopoulos	Aggelos	Dr	Lecturer	Core
Zhang	Jianping	Dr	Lecturer	Core

3. Research Institute: Research Staff Members status at 31 July 2016

Surname	Forename	Title	Position	Research Centre
Arya	Farid	Dr	Research Associate	CST
Colclough	Shane	Dr	Research Fellow	CST
Devlin	Steven	Mr	Research Associate	CST
Fateh	Talal	Dr	Research Associate	FireSERT
Haran	Martin	Prof	Professor of Real Estate and Urban Studies	RPP
Hinch	Martin	Dr	Research Associate	RPP
Kang	Sungwook	Mr	Research Associate	FireSERT
Keatley	Patrick	Dr	Research Associate	CST
Rolfe	Angela	Miss	Research Associate	CST
Shah	Nikhilkumar	Mr	Research Associate	CST
Shentsov	Volodymyr	Dr	Research Associate	HySAFER
Tian	Ning	Dr	Research Associate	FireSERT
Vorushylo	Inna	Dr	Research Associate	CST

4. Research Students

The following research students were registered on research degree programmes in the Institute during 2015-2016.

Student Name	Thesis Title
Alam, Naveed	Fire performance of FRP in reinforced concrete slabs
Allen, David	Innovative approaches to understanding business location factors
Atefi Aghayan, Hooman	Developing a numerical method for simulating intumescent materials in fire
Ballentine, Mark	Emergency planning and resilience theme: 'countering unmanned aerial vehicles'
Beattie, Michael Robert	A fracking good time? A planned approach to energy resilience in the island of Ireland
Benson, Jordan	Resilient relationships: an investigation into the nexus between spatial planning and community planning
Bidanset, Paul Edward	Decomposing the effect of foreclosure: using locally weighted regression with spatial, temporal and attribute weighting functions to understand the externalities of foreclosed single-family homes
Biglarbeigi, Pardis	Discovering the operating policies of a reservoir system considering the impact of climate change
Bogle, Gary	A cost versus benefit analysis of delay and disruption techniques in the risk management of construction projects
Bradley, Philip	A carbon valuation model for commercial buildings in a market downturn
Byrne, Raymond	Evaluation of energy storage with wind auto-production at an industrial site connected to the distribution grid
Casey, Thomas	Friction after polishing: A probabilistic framework for improved roads management on national roads in Ireland
Cassidy, Peter	Design and evaluation of community fire safety educational programmes
Chakroborti, Shauli	Design, development and experimental characterisation of an innovative solar building wall with thermal storage and heat transfer characteristics
Chotzoglou, Konstantinos	External flames on façade fires
Cirrone, Donatella MC	Hazards from catastrophic failure of high-pressure hydrogen storage
Clarke, Sorchá	Shaping resilient places and communities: Exploring expressions of planning theory and practice
Cotter, Donal F	The role of building simulation as an assessment methodology for new and existing dwellings
Crinion, Kate	Disaster recovery and reconstruction: harnessing capacity and improving resilience within affected communities
Cunningham, Gervase A	Business development and innovation in construction companies

Student Name	Thesis Title
Delargy, Bronagh	An examination of the adverse associations between housing circumstances and mental health in Northern Ireland
Dou, Mengmeng	Real estate valuation practice in China - An emerging market perspective
Eghbalighazijahani, Amir	Governance and planning policies to increase the resilience of urban areas to climate change
Elder, Kyle Mark	Business location factors: investigating regional development policy in the new economy
Fadeyi, Olawumi	Capital and real estate markets in global financial cities
Firth, Simona	Vacuum window performance evaluation and characterisation
Frey, Joe	Changing patterns of migration, labour markets and the growing demand for privately rented dwelling in Northern Ireland - the implications for planning and housing
Hall, Leaine Martine	Integrated constructed wetlands: performance and analysis
Hawe, Owen	Cross-community urbanism – How ‘new urbanism’ has a place in contested cities
Hossen, Ali Mahmood	Climate change and transport disruption: measuring risk and uncertainty
Isirima, Michael KE	Fire protection risk assessment: a study of offshore installations
Kahanji, Charles	Flexural and shear capacity of ultra high strength reinforced concrete beams under fire
Kang, Sungwook	Fundamental technologies for development of nanoclay dispersed intumescent polymer composition in applications for built environments and automobiles
Kashkarov, Sergii	Fire resistance of on-board high pressure storage tanks for hydrogen-powered vehicles
Lawson, Aaron	New tools to investigate the role of simple hygiene measures in communicable disease prevention, namely hand-washing practices
Le, Khoa	A proposal for control of domestic heat pumps with smart grid
Lim, Ohk Kun	Structural performance of shear fire
Lockhart, Danielle SE	An assessment of the impacts of air quality on public health within Northern Ireland
MacDonald, Colin M	Law enforcement perspectives on lone actor terrorism
Mahon, Clare	To develop an economic operator prequalification model to assist in the award of public contracts
Mahone, Nedra	Economic base and the impact on real estate returns
McElduff, Patricia	Low carbon and low impact building materials
McErlane, Andrew	A risk allocation model for public private partnerships
McKane, Mark	The contributions of Building Information Modelling (BIM) to improved Construction Industry performance in Northern Ireland
McKinstry, Colin	Development and validation testing of an advanced domestic air source heat pump
McMenamin, Deirdre V	Developing cultural-spatial representation of the interrelationship between landscape and human agency in rural Ireland/Northern Ireland: revealing the agency of landscape strategy in Irish vernacular architecture
Nowlan, William K	Modelling different ways of financing social housing in Ireland using private sector finance
O'Hare, Rachel Mary	NAMA: asset management on nonperforming real estate in a depressed economy

Student Name	Thesis Title
O'Neill, Jennifer T	Emotional Mapping': exploring how participatory GIS can add value to knowledge on spatial identity, decision making and spatial planning
Pugsley, Adrian N	Development of hybrid photovoltaic/thermal (HyPV/T) facade solar collectors
Quigley, Mura	Enabling a resilient future: exploring the leadership and governance of urban design
Quinn, Richard	Quantifying the benefit of reduced carbon output in commercial property valuation
Rainey, Karina L	The air quality and health impacts of residential coal burning within Northern Ireland
Ramirez, Miguel	Design and development of a high temperature heat pump (HTHP) for district heating and industrial applications
Redpath, Gwyneth M	Risk mapping of minor ('B' class) roads in rural Northern Ireland, reasons for the high proportion of collisions resulting in death or serious injuries, especially to young drivers
Rice, Laura L	Planning judicial review reformation
Rogers, Jane B	Productivity benefits of green building occupancy
Sakr, Mohamed	Modelling and very large eddy simulation of large-scale hydrogen-air deflagration and deflagration-to-denotation transition
Salehi Kouhestani, Mohammad	Investigation on advanced heat pumps in domestic appliances
Shafie, Shahril	Synchronization of house price and buyer affordability: residential property in Malaysia
Shanks, Peter	A review of the corporate governance arrangements of the housing association sector in Northern Ireland
Stephenson, Jill	A study of the environmental implications and health impacts of floods in Northern Ireland
Stevenson, David M	Coastal environmental determinism. Parameters for land use planning
Tierney, Christopher A	Dynamic road/tyre Interaction
Waddell, Campbell	Variation of race track grip
Wijayanto, Arief	Property tax as a local tax in Indonesia
Wilkinson, Alistair	Development of resilient, energy efficient geo-polymer concrete road pavement solutions
Wilson, Christopher	Development of advanced heat pump and thermal storage systems capable of cost effective demand side management
Yates, David	Innovation solutions to reduce separation distance for hydrogen and fuel cell systems

Graduated December 2015

Student Name	Thesis Title
McQuaid, Grainne	Potholes in asphalt surfacing materials
Quigley, Denise	Achieving an optimum balance across capital, life-cycle and environmental costs
Shah, Nikhil K	Vapour compression heat pumps driven by advanced engine concepts and incorporating heat recovery

Graduated July 2016

Student Name	Thesis Title
Adi Maimun, Nural Hana	The economic value of green residential buildings
Clarke, Mervyn C	Strategic property performance management
Doyle, Conor	Investigation of household energy use and its effective reduction
Farnan, Emma MA	Evaluating community planning: towards better outcomes?
Henry, Keith	Planning and public spaces: a property rights perspective
Minic, Ivica	An experimental study of air-source heat pump defrosting using solar collector as heating source

5. Publications

Details of all publications by BERI staff are on the Ulster University's Institutional Repository <http://eprints.ulster.ac.uk/>. This section reports those outputs published over the period of this report and classified as either journal articles, books/chapters in books, research reports and published conference papers.

5.1 Journal Articles

- Aelenei, L, Smyth, M, Platzer, W, Norton, B, Kennedy, D, Kalogirou, S and Maurer, C (2016) Solar Thermal Systems – Towards a systematic characterization of building integration. *Energy Procedia*, 91 . pp. 897-906.
- Ali, FA, Nadjai, A and Goodfellow, N. (2016) Experimental and numerical study on the performance of hollow and concrete-filled elliptical steel columns subjected to severe fire. *Fire and Materials*, 40 (4). pp. 635-652.
- Blair, N and Manda, M (2016) A partnership-based model for embedding employability in urban planning education. *Urban, Planning and Transport Research*, 4 (1). pp. 46-63.
- Chaurasia, P, Yogarajah, P, Condell, J, Prasad, G, McIlhatton, D and Monaghan, R (2015) Biometrics and counter-terrorism: the case of gait recognition. *Behavioral Sciences of Terrorism and Political Aggression*, 7 (3). pp. 210-226.
- Chaurasiaa, P, Yogarajah, P, Condell, J, Prasad, G, McIlhatton, D and Monaghan, R (2016) Countering terrorism, protecting critical national infrastructure and infrastructure assets through the use of novel behavioral biometrics. *Behavioral Sciences of Terrorism and Political Aggression*, 8 (3). pp. 163-185.
- Colclough, S and Griffiths, P (2016) Financial analysis of an installed small scale seasonal thermal energy store. *Renewable Energy*, 86. pp. 422-428.
- Dave, A, Dave, M, Huang, Y, Rezvani, S and Hewitt, N (2016) Process design for H₂S Enrichment in physical solvent DMEPEG. *International Journal of Greenhouse Gas Control*, 50. pp. 261-270.
- Dave, A, Dave, M, Huang, Y, Rezvani, S and Hewitt, N (2016) Process design for CO₂ absorption from syngas using physical solvent DMEPEG. *International Journal of Greenhouse Gas Control*, 49. pp. 436-448.
- Eadie, R and McCavigan, M (2016) Random selection: winning the lottery in construction contracts. *International Journal of Procurement Management*, 9 (2). pp. 185-205.
- Gajjar, H and Mondol, JD (2015) Techno-Economic Comparison of Alternative Vehicle Technologies for South Africa Road Transport System. *International Journal of Sustainable Transportation*, 10 (7). pp. 579-589.
- Haran, M, McCord, M, Davis, P, McCord, J, Lauder, C and Newell, G (2016) European Emerging Real Estate Markets: Re-Examining Investment Attributes and Framing Opportunities. *Journal of Property Investment & Finance*, 34 (1). pp. 27-50.
- Huang, Y, Anderson, M, McIlveen-Wright, D, Lyons, GA, McRoberts, WC, Wang, Y, Roskilly, T and Hewitt, N (2015) Biochar and Renewable Energy Generation from Poultry Litter Waste: A Technical and Economic Analysis Based on Computational Simulations. *Applied Energy*, 160 . pp. 656-663.
- Hutchison, N, Squires, G, Adair, AS, Berry, J, Lo, DI, McGreal, S and Organ, S (2016) Financing infrastructure development: time to unshackle the

bonds? *Journal of Property Investment & Finance*, 34 (3). pp. 208-224.

Joseph, P, Tretsiakova-McNally, S and Zhang, R (2016) Techniques for Assessing the Combustion Behaviour of Polymeric Materials: Some Current Perspectives and Future Directions. *Macromolecular Symposia*, 362. pp. 105-118.

Kakar, MR, Hamzah, MO, Akhtar, MN and Woodward, D (2016) Surface free energy and moisture susceptibility evaluation of asphalt binders modified with surfactant-based chemical additive. *Journal of Cleaner Production*, 112. pp. 2342-2353.

Kamruzzaman, MD, Hine, J and Yigitcanlar, T (2015) Investigating the link between carbon dioxide emissions and transport-related social exclusion in rural Northern Ireland. *International Journal Environmental Science and Technology*, 12 (11). pp. 3463-3478.

Kang, S, Choi, SK and Choi, JY (2016) View factor in cone calorimeter testing. *International Journal of Heat and Mass Transfer*, 93. pp. 217-227.

Khatami, R, Levendis, Y A. and Delichatsios, M (2015) Soot loading, temperature and size of single coal particle envelope flames in conventional- and oxy-combustion conditions (O_2/N_2 and O_2/CO_2). *Combustion and Flame*, 162 (6). pp. 2508-2517.

McCord, J, McCord, M, Davis, P, Haran, M and Rodgers, J (2015) Understanding delays in housing construction: evidence from Northern Ireland. *Journal of Financial Management of Property and Construction*, 20 (3). pp. 286-319.

Molkov, V and Bragin, M (2015) Hydrogen-air deflagrations: Vent sizing correlation for low-strength equipment and buildings. *International Journal of Hydrogen Energy*, 40 (2). pp. 1256-1266.

Molkov, V and Kashkarov, S (2015) Blast wave from a high-pressure gas tank rupture in a fire: Stand-alone and under-vehicle hydrogen tanks. *International Journal of Hydrogen Energy*, 40 (36). pp. 12581-12603.

Nadjai, A, Petrou, K, Han, S and Ali, F (2016) Performance of unprotected and protected cellular beams in fire conditions. *Construction and Building Materials*, 105. pp. 579-588.

Nase, I, Berry, J and Adair, A (2015) Urban design quality and real estate value: in search of a methodological framework. *Journal of Urban Design*, 20 (5). pp. 563-581.

Navarro, L, de Gracia, A, Colclough, S, Browne, M, McCormack, S, Griffiths, P and Cabeza, L (2016) Thermal Energy Storage in Building Integrated Thermal Systems: A review. Part 1. Active storage systems. *Renewable Energy*, 88. pp. 526-547.

Navarro, L, de Gracia, A, Niall, D, Castell, A, Browne, M, McCormack, S, Griffiths, P and Cabeza, L (2016) Thermal energy storage in building integrated thermal systems: A review. Part 2. Integration as passive system. *Renewable Energy*, 85. pp. 1334-1356.

Newell, G and McGreal, S (2015) The significance of hotel investment in global capital flows to real estate. *International Journal Built Environment and Asset Management*, 4 (1). pp. 293-306.

Paul, DI, Smyth, M, Zacharopoulos, A and Mondol, JD (2015) The Effects of Nonuniform Illumination on the Electrical Performance of a Single Conventional Photovoltaic Cell. *International Journal of Photoenergy*, 2015 (631953). pp. 1-10.

Pimenidou, P and Dupont, V (2015) Dolomite study for in situ CO_2 capture for chemical looping reforming. *International Journal of Ambient Energy*, 36 (4). pp. 170-182.

Pugsley, A, Zacharopoulos, A, Mondol, JD and Smyth, M (2015) Global applicability of solar desalination. *Renewable Energy*, 88. pp. 200-219.

Redpath, DAG, Dalzell, P, Griffiths, P and Hewitt, N (2015) Investigation of concentrating and nonconcentrating evacuated tube solar water heaters using 2D particle imaging velocimetry. *International Journal of Low Carbon Technologies*, 10 (3). pp. 283-287.

Ritchie, H, Sheppard, A, Croft, N and Peel, D (2015) Planning Education: exchanging approaches to teaching practice-based skills. *Innovations in Education and Teaching International*, 87 (1). pp. 53-70.

Shah, N, Huang, MJ and Hewitt, N (2016) Experimental study of a diesel engine heat pump in heating mode for domestic retrofit application. *Applied Thermal Engineering*, 98. pp. 522-531.

Shah, N, Huang, MJ and Hewitt, NJ (2016) Performance analysis of diesel engine heat pump incorporated with heat recovery. *Applied Thermal Engineering*, 108. pp. 181-191.

Squires, G, Hutchison, N, Adair, A, Berry, J, McGreal, S and Organ, S (2016) Innovative real estate development finance - evidence from Europe. *Journal of Financial Management of Property and Construction*, 21 (1). pp. 54-72.

Tretsiakova-McNally, S and Joseph, P (2015) Melt-Flow Behaviours of Thermoplastic Materials under Fire Conditions: Recent Experimental Studies and Some Theoretical Approaches. *Materials*, 8 (12). pp. 8793-8803.

Vinayagamoorthy, S, Anderson, C, Solan, B, Rankin, B and Mackinnon, P (2015) Influence of testing on permeability of compacted fine soils. *Geotechnical Engineering*, 168 (GE5). pp. 422-438.

Wang, Q, Hu, L, Yoon, SH, Lu, S, Delichatsios, M and Chung, SK (2015) Blow-out limits of nonpremixed turbulent jet flames in a cross flow at atmospheric and sub-atmospheric pressures. *Combustion and Flame*, 162 (10). pp. 3562-3568.

Woodward, D, Millar, P, Lantieri, C, Sangiorgi, C and Vignali, V (2016) The wear of Stone Mastic Asphalt due to slow speed high stress simulated laboratory trafficking. *Construction and Building Materials*, 110. pp. 270-277.

Yang, K, Basheer, M, Magee, B, Bai, Y and Long, A (2015) Repeatability and Reliability of New Air and Water Permeability Tests for Assessing the Durability

of High Performance Concretes. *Journal of Materials in Civil Engineering*, 27 (12). pp. 1-11.

5.2 Books/Chapters in Books

Lamnatou, C, Mondol, J, Ghosh, A, Nikolic, S, Bojic, M, Kologirou, S and Chemisana, D (2015) Review on modelling and simulation of building-integrated solar thermal systems. In: *Overview of BISTS State of the Art, Models and Applications: Cost Action TU1205 (BISTS)*. Cyprus University of Technology, Department of Mechanical Engineering and Materials Sciences and Engineering, pp. 62-135.

Woodward, D (2016) Wet skid resistance. In: *HIGHWAYS The location, design, construction and maintenance of road pavements*. (Eds: O'Flaherty, C and Hughes, D), ICE Publishing, pp. 529-548.

Woodward, D, Millar, P, McQuaid, G, McCall, R and Boyle, O (2016) PSV tyre / test specimen contact. In: *8th RILEM International Symposium on Testing and Characterisation of Sustainable and Innovative Bituminous Materials*. (Eds: Canestrari, F and Partl, MN), Springer RILEM Bookseries, pp. 447-457.

5.3 Research Reports

Adair, AS, McGreal, S and Hinch, M (2016) Northern Ireland Quarterly House Price Index for Q1 2016 Report Number 126. Northern Ireland Housing Executive and Progressive Building Society. Ulster University. 10 pp.

Adair, AS, McGreal, S and Hinch, M (2016) Northern Ireland Quarterly House Price Index for Q4 2015 Report Number 125. Northern Ireland Housing Executive. Ulster University. 9 pp.

Adair, AS, McGreal, S and Hinch, M (2015) Northern Ireland Quarterly House Price Index for Q3 2015 Report Number 124. Northern Ireland Housing Executive. Ulster University. 9 pp.

Adair, AS, McGreal, S and Hinch, M (2015) Northern Ireland Quarterly House Price Index for Q2 2015 Report 123. Northern Ireland Housing Executive. Ulster University. 9 pp.

McGreal, S, McCord, J and Hinch, M (2016) Performance of private rental market in Northern Ireland: Summary Research Report July - December 2015. Northern Ireland Housing Executive. Ulster University. 29 pp.

McGreal, S, McCord, J and McAnulty, U (2015) Performance of private rental market in Northern Ireland: Summary Research Report January - June 2015. Northern Ireland Housing Executive. Ulster University. 22 pp.

5.4 Published Conference Papers

Allen, D, Blair, N, McIlhatton, D and Bond, R (2015) Innovative approaches to understanding business location factors. In: Irish Human Computer Interaction, Dublin. iHCI. 1 pp.

Boyce, K and McConnell, NC (2015) A study of human behaviour during evacuation of licensed premises. In: 6th International Human Behaviour in Fire 2015 Symposium. InterScience Communications. 12 pp.

Brandoni, C and Bošnjaković, B (2015) Geopolitical analysis of the water and renewable energy nexus for urban areas of water-stressed African river basins. In: 10th Conference on Sustainable Development of energy, water and environment systems, SDEWES, Dubrovnik. 11 pp.

Comiskey, D, McKane, M, Eadie, R and Goldberg, D (2015) Providing Collaborative Education with an International Dimension. An Ulster University and Pennsylvania State University Case Study. In: CITA BIM Gathering Conference 2015, Dublin. The Construction IT Alliance. 8 pp.

Comiskey, D, McLernon, T, Fleming, A and Harty, J (2015) Applying Lean Principles to Higher Education via a Collaborative Delivery Approach. In: CITA BIM Gathering Conference 2015, Dublin. The Construction IT Alliance. 11 pp.

Eadie, R and Potts, S (2016) Will Civil Engineering and Construction SME's benefit from the changes to the 2014 European Procurement Directives. In: Fourth International Conference on Advances in Civil, Structural and Mechanical Engineering- CSM 2016, Birmingham City University. Institute of Research Engineers and Doctors, USA. 5 pp.

Lamantau, C, Chemisana, D, Mondol, JD, Maurer, C and Buonomano, A (2015) Validation of developed codes, thermal and optical, for building-integrated solar thermal systems. In: Proceedings of COST Action TU1205 Symposium, Guimaraes, Portugal. Cyprus University of Technology. 10 pp.

McDermott, R and Stong, A (2015) Health, safety & welfare: excuses used to argue, fuss & to get away with doing little or nothing? In: Benefitting Workers and Society through Inherently Safe(r) Construction, Ulster University Jordanstown. EEI Publishing. 8 pp.

McLernon, T and McClements, S (2015) Comparing and evaluating the contractual provisions of two analogous construction contracts for the management of cost. In: COBRA 2015, Sydney, Australia. RICS. 9 pp.

Palomares, I, Browne, F, Wang, H and Davis, P (2015) A Collaborative Filtering Recommender System Model Using OWA and Uninorm Aggregation Operators. In: 10th International Conference on Intelligent Systems and Knowledge Engineering (ISKE), 2015. IEEE. 6 pp.

Palomares, I, Galway, L, Haran, M, Woods, C and Wang, H (2015) A Knowledge Management and Need-Capacity Matching Approach for Community-Based Disaster Management and Recovery. In: The 10th International Conference on Intelligent Systems and Knowledge Engineering, Taipei, Taiwan. IEEE. 8 pp.

Shah, N and Hewitt, N (2015) High temperature heat pump operational experience as a retrofit technology in domestic sector. In: IEEE International Conference on Engineering, Technology and Innovation/ International Technology Management Conference (ICE/ITMC), Belfast. IEEE Explore. 8 pp.

Tretsiakova-McNally, S, Maranne, E, Verbecke, F, Bertau, S, Zanoto, A, Li, Z, Makarov, D, Kashkarov, S, Molkov, V, Aly, AE, Dey, R and Lopez, M (2015) Towards the development of the European hydrogen safety training platform for first responders. In: WORLD OF ENERGY SOLUTIONS, Messe Stuttgart, Stuttgart, Germany. Peter Sauber Agentur Messen und Kongresse GmbH. 27 pp.

6. Research Funding: Portfolio of Research Grants active during period 1 August 2015 - 31 July 2016

Research Institute Member	Title of Award	Funding Body	Value
Choi, Dr SK	Protective clothing under extreme fire conditions	Korean Ministry of Public Safety	£146,842
Haran, Prof ME McCord, Dr M Davis, Dr P	INSPEC2T: Inspiring Citizens Participation for Enhanced Community Policing	CEC-H2020-SC Security	£146,850
Hewitt, Prof NJ	HE/EU Support Fund	DEL	£173,521
Hewitt, Prof NJ Griffiths, Prof PW Huang, Dr M	Chess-Setup-EE-02	CEC-H2020 –SC – EE – 02 - 2015	£168,635
Hewitt, Prof NJ	Small Smart Sustainable Systems for future Domestic Hot Water (45-DHW)	EPSRS – Thermal Energy Challenge	£376,555
Huang, Dr Y Huang, Dr M Hewitt, Prof NJ	Distributed Energy Storage Systems	The Royal Society	£11,850
McGreal, Prof WS McCord, Dr M Hinch, Dr M Adair, Prof AS	House prices, rents and affordability	NIHE	£300,000
McGreal, Prof WS Adair, Prof AS Hinch, Dr M	Northern Ireland Quarterly House Price Index	Progressive Building Society	£90,000
Nadjai, Prof A Ali, Prof FA	Experimental investigation on sprinkler performance during fire in M&S commercial stores	Marks & Spencer Ltd	£28,146

Research Institute Member	Title of Award	Funding Body	Value
Nadjai, Prof A	Experimental investigation on typical residential apartment subjected to natural fire	MSA Dublin	£13,250
Nadjai, Prof A McCutcheon, Mr N	Experimental investigation on sprinkler performance during fire in M&S commercial stores – Part 2	Marks & Spencer Ltd	£12,250
Rafferty, Mr G	Community Participation in Planning: Learning and Skills Framework	C.E.C. Erasmus+	£182,954
Ritchie, Dr H McElduff, Dr L	Marine Spatial Planning in Northern Ireland: Towards Productive Seas and Resilient Communities?	Council of Heads of the Built Environment	£500
Woodward, Dr WDH Millar, Dr P	A probabilistic framework for improved roads management	NDP – National Roads Authority	£97,008
Zhang, Dr J	Scaling and modelling of soot, heat feedback and burning rate of large-scale hydrocarbon pool fires	Royal Academy of Engineering – NRCP Newton Res	£108,900
Anderson, Mr M	Pelletisation (READ)	Invest NI	£108,184
Hemphill, Dr L Lim, Dr LC	International Residential Property Measurement Approach and Practice	RICS	£16,518
Hewitt, Prof NJ Huang, Dr Y	TEMPO: Total Energy Management for Production Operations – Stage 3	Enterprise Ireland	£247,772
Hewitt, Prof NJ Anderson, Mr M	KTP Programme between the Ulster University and Delta Print and Packaging Ltd	TSB/INI and Delta Print & Packaging Ltd	£107,200
Huang, Dr Y Hewitt, Prof NJ	SCARLET: Scale-up of Calcium Carbonate Looping Technological for Efficient Co2 Capture	CEC - Framework 7 - Energy	£188,096
Huang, Dr Y Hewitt, Prof NJ	TEMPO: Total Energy Management for Production Operations - Stage 2	Enterprise Ireland	£263,143
Lloyd, Prof MG	Communities as constructs of people and architecture	AHRC	£312,276

Research Institute Member	Title of Award	Funding Body	Value
Makarov, Dr D Molkov, Dr V	EPSRC Centre for Doctoral Training in Fuel Cells and their Fuels: Clean Power for the 21 st Century	EPSRC	£135,000
Makarov, Dr D Molkov, Prof V	GENFUEL: Addressing fundamental challenges in the design of new generation fuels	CEC – Framework 7 – MC (IAPP)	£17,471
McCord, Dr M Haran, Prof ME Davis, Dr PT Hewitt, Prof NJ McGreal, Prof WS	INTACT: Impact of Extreme Weather on Critical Infrastructure	CEC - Framework 7 SEC-2013-1.6-3	£186,148
Pimenidou, Dr P Hewitt, Prof NJ Huang, Dr Y Shah, Dr N Mondol, Dr J	Performance and emission studies on biofuel blended with high oxygen storage capacity nanoparticles using an indirect injection engine	UKIERI	£22,050
Solan, Dr B	Short-span bridge scour under submerged flood flow conditions	The Royal Society – International Exchange Scheme	£8,900
Zhang, Dr J	High Performance Computing Support for UK consortium of Turbulent Reacting Flows (UKCTRF)	EPSRC	£27,851
Zhang, Dr J	Experimental and Modelling Large-Area Fires - Phase 2	Atomic Weapons Establishment	£131,080
Davis, Dr PT Ali, Prof FA Boyce, Dr KE Haran, Prof M Hyde, Dr TJ McCord, Dr M McGreal, Prof WS	HARMONISE: Holistic Approach to Resilience and Systematic Actions to make Large Scale Urban Built Infrastructure Secure	CEC – Framework 7 Security	£284,761
Griffiths, Dr PW Huang, Dr M Hewitt, Prof NJ	MERITS – More Effective use of Renewables Including Compact Seasonal Thermal Energy Storage	CEC – Framework 7	£233,296

Research Institute Member	Title of Award	Funding Body	Value
Haran, Prof M Davis, Dr PT Ali, Prof FA Lloyd, Prof MG McGreal, Prof WS McCord, Dr M	COBACORE – Community Based Comprehensive Recovery Security	CEC – Framework 7 -	£414,560
Hewitt, Prof NJ	Higher Education EU Support Fund - Theme Leader Energy (NICP)	DEL	£197,013
Hewitt, Prof NJ Huang, Dr M Huang, Dr Y	POREEN: Partnering Opportunities between Europe and China in Renewable Energies and Environmental Industries	CEC – Framework 7- Marie Curie RTN	£62,273
Hewitt, Prof NJ Huang, Dr M	Interdisciplinary Centre for Storage, Transformation and Upgrading of Thermal Energy (i-STUTE)	EPSRC/ESRC	£831,903
Hyde, Dr TJ	High Performance Vacuum Flat Plate Solar Thermal Collectors for Hot Water and Process Heat	EPSRC	£270,608
Makarov, Dr DV Molkov, Prof V	SUSANA: Support to Safety Analysis of Hydrogen and Fuel Cell Technologies	CEC – Framework 7- Fuel Cell Hydrogen	£249,640
Makarov, Dr DV Molkov, Prof V	Integrated safety strategies for on-board Hydrogen Storage Systems	EPSRC	£970,514
Molkov, Prof V	HyResponse	CEC – Framework 7 – Fuel Cell	£269,923
Nadjai, Prof A	LOCAFI: Temperature assessment of a vertical steel member subjected to localised fire	CEC – Coal and Steel	£78,185
Smyth, Dr MA Mondol, Dr J Zacharopoulos, Dr A McLarnon, Mr D	Hybrid Photovoltaic/Solar Thermal (HyPV/T) Façade Module	Invest Northern Ireland – Proof of Concept	£105,792
Zacharopoulos, Dr A Mondol, Dr J Smyth, Dr MA Hyde, Dr TJ	Concentrating Photovoltaic Evacuated Glazing (CoPEG) multi-functional building façade element	Invest Northern Ireland - Proof of Concept	£105,382
Zhang, Dr J	Flame behaviours from enclosure fires over facades in tall buildings	The Royal Society	£12,000
Zhang, Dr J	ELISSA: Energy efficient lightweight-sustainable-safe-steel construction	CEC – Framework 7	£285,996

Research Institute Member	Title of Award	Funding Body	Value
Zhang, Dr J	Fire hazards of exterior wall assemblies Research Foundation	Fire Protection	£9,641
Adair, Prof AS Berry, Prof JN Haran, Prof M McGreal, Prof WS	Northern Ireland Commercial Property Index	Belfast City Council, and Estate Agency Practices	£40,800
Choi, Dr SK Zhang, Dr J	Fundamental Technologies for Development of Nanoclay Dispersed in tumescent polymer composition in Applications for Built Environments and Automobiles	Korea Evaluation Institute of Industrial Technology	£174,000
Choi, Dr SK Nadjai, Prof A	Development of advanced PBD method for structural fire protection using innovative insulation material	Korean Ministry of Knowledge Economy	£139,606
Hewitt, Prof NJ Griffiths, Dr PW Huang, Dr M	EINSTEIN: Effective Integration of Seasonal Thermal Energy Storage Systems in Existing Buildings	CEC - Framework 7	£429,415
Hewitt, Prof NJ Huang, Dr Y	TEMPO: Total Energy Management for Production Operations	Enterprise Ireland	£196,722
Hewitt, Prof NJ Griffiths, Dr PW Anderson Mr M	CESAR: Cost Effective Solar Air Conditioning	CEC - Framework 7	£119,787
Hewitt, Prof NJ Griffiths, Dr P Hyde, Dr T Smyth, Dr M	Charles Parsons Energy Research Awards	Science Foundation Ireland	£2,895,714
Molkov, Prof V Brennan, Dr SL Makarov, Dr DV	Integrating European infrastructure to support science and development of Hydrogen and Fuel Cell Technologies	CEC - Framework 7	£460,899
Molkov, Prof V Makarov, Dr DV	Hydrogen and Fuel Cell Supergen Hub	EPSRC	£182,231

Research Institute Member	Title of Award	Funding Body	Value
Mondol, Dr JD Smyth, Dr M Zacharopoulos, Dr A Anderson, Mr M Huang, Dr M Hewitt, Prof N	UKIERI Thematic Partnership (UK India Education and Research Initiative). Solar accelerator design for small scale bio-gas production	British Council	£39,901
Smyth, Dr MA Anderson, Mr M	KTP Programme between Ulster University and Copper Industries (Ireland) Ltd	Momenta & Copper Industries (Ireland) Ltd	£107,200

