



Belfast School of Architecture and the Built Environment

Annual Report for Research & Impact

August 2018 - July 2019



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1. Foreword:
Research Director
Dr Jayanta Mondol

In presenting the Annual Report for the Architecture, Built Environment and Planning for the academic year 2018-2019, I am happy to report a very successful year for our research activities with particular success in winning research grants, quantity of doctoral thesis completed, development of research collaborations nationally and internationally with renowned universities, research institutes and industries and also our involvement with outreach research activities.

Research and Impact activities within the school are carried out within five core centres: 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 the Built Environment Research (SABER). The main sections of the report provide details of the PhD projects and graduating PhDs, publications and new research grants.

This year, we have secured research grants totalling around £3M from prestigious funding bodies such as the Engineering and Physical Sciences Research Council (EPSRC) (£1.53M), the European Commission's Horizon 2020 programme (£590K), UKERC (£117K), government departments/agencies such as Department of Education (DfE), Northern Ireland Housing Executive (NIHE), Progressive Building Society and Dept of Foreign Affairs (£656K). In addition, our researchers have contributed in cross-faculty research projects with total grant around £1.35M funded through AHRC, ESRC and HSC R&D Public Health Agency.

In the reporting period, HySAFER's fundamental research in the area of hydrogen safety engineering has been further developed through the new HyTunnel-CS project which aims to perform pre-normative research for safety of hydrogen driven vehicles and transport through tunnels and similar confined spaces. In this project, the HySAFER research team is collaborating with twelve other research partners including leading European research institutes, industries and public organisations. HySAFER is continuously contributing in the theoretical investigation and training on the hydrogen safety and fuel cell technology in various other ongoing research projects. These projects include the H2020 funded projects 'NET-Tools: Novel Education and Training Tools based on digital applications related to Hydrogen and Fuel Cell Technology' and 'PRESLHY: Pre-normative research for safe use of liquid hydrogen'; Interreg project, HYLANTIC: Atlantic Network for Renewable Generation and Supply of Hydrogen to promote High Energy Efficiency. HySAFER is actively collaborating with Imperial College London; University of St Andrews; University of Bath; Newcastle University; University of Birmingham; University College London through SUPEGEN hub in EPSRC funded projects. HySAFER is a major contributor in delivering the joint European Summer School on Fuel Cell, Electrolyser and Batteries Technologies (17-21 September 2018). The centre has hosted the International School on "Progress in Hydrogen Safety" in Belfast (11-15 March 2019). The researchers within this centre are very successful in producing high level journal articles in this reporting period.

During the reporting period, the CST research team has been successful in securing major grant income amounting circa £2M funded through EPSRC, H2020, UKERC and other government organisations particular in the areas of Heat pump and storage, solar technologies and clean coal power technologies and carbon

capture. In collaboration with three UK based universities (Warwick University, Loughborough university, London South Bank University), the CST researchers are investigating the use of heat pump and thermal storage technologies for the heating and cooling needs of buildings from industrial waste heat within newly EPSRC funded 'Low temperature Heat Recovery and Distribution Network Technologies (LoT-NET)' project. In the 'SolaNetwork' project, funded by EPSRC-TSB, the CST solar energy team in collaboration with four industrial (dpSUN, Empowered Pty, SolaForm and DM Innovations Ltd) and one university (Botswana International University of Science and Technology) is developing cost effective standalone solar systems along with an innovative business model to provide electricity and hot water for off-grid households in rural sub-Saharan Africa. This project is the continuation of 'SolaFin2Go' project funded through Innovate UK Energy Catalyst programme. In the newly awarded 'Chemical looping gasification for sustainable production of biofuels (CLARA)' project funded by EU H2020, CST researchers are contributing in techno-economic analysis of a novel concept for the biofuel production based on chemical looping gasification of biogenic residues and is collaborating with twelve other partners including universities, research institutes and industries throughout Europe. CST has also hosted a series of workshops to engage a wide range of stakeholders to discuss opportunities and barriers towards low carbon heating systems in Northern Ireland as part of the UKERC funded research project entitled 'Pathways towards heat decarbonisation in Northern Ireland'. The other new UKERC funded project 'Gender, ageing and latency in the transition to low-carbon system: empowering women as decision makers', enables CST researchers to investigate the role of age and gender for empowering next generation elderly women for a transition to a low-carbon energy system through planned workshops and promotional activities.

The ongoing joint venture between FireSERT and Efectis Ltd. continues to open up new opportunities for collaboration in European projects, participation in the CPD activities and provision of workshops and training related to the latest development, strategies and solutions for key fire safety issues. FireSERT researchers are involved in number of ongoing projects funded through H2020 which includes 'Temperature assessment of a vertical member subjected to LOCALised Fire (LOCAFI+)'; 'Characterization of TRAVelling FIRes in large compartments (TRAFIR)'; Development of innovative lightweight and highly insulating energy efficient components and associated enabling materials for cost-effective retrofitting and new construction of curtain wall facades (EENSULATE). FireSERT organised an international workshop at Engineers Ireland, Dublin on 23rd November 2018 to disseminate research findings in the area of structural fire engineering provided cutting edge knowledge to clients on the fire design methodologies under localised fire.

The RPP's high impact research in the area of property market performance has received further funding through Northern Ireland Housing Executive for a project on 'House Price, Rents and Affordability'. The team has continued to secure core funding from Progressive Building Society for Northern Ireland Quarterly 'House Price Index project'. The RPP members are engaged in two new multidisciplinary research projects in collaboration with colleagues from School of Psychology. In collaboration with five other research partners, the RPP researchers are working in the H2020 funded 'Carbon Risk Real Estate Monitor (CRREM)' project in which the research team is defining science-based decarbonization targets and pathways for the commercial and residential real estate industry to reduce transition risks. In the ESRC funded 'UK Collaborative Centre for Housing Evidence (CaCHE)' project, the centre is also engaged in research to tackle the UK's housing problems at a national, regional, and local level.

SABER embraces a wide diversity of research interests concerned with civic ecology and life infrastructure, highway engineering, hydraulics, geo-polymers and non-contact measurement. Over the reporting year, research funding has been secured from Highways England, the National Roads Authority of Ireland and the Royal Society. SABER's researchers are working in cooperation with Colorado State University to explore the impact of flooding on the stability of masonry arch bridges. SABER ran a very successful workshop on the vulnerability and management of masonry arch bridges subject to major storm events in conjunction with Engineers Ireland. The event was designed to draw upon the experience and expertise of a wide range of

designers, contractors, statutory bodies and asset managers from the public and private sectors. SABER members are actively involved in organising national and internal conferences.

Academic staff within the Architecture discipline are actively engaged in interdisciplinary research projects. In the project 'Divided Pasts - Divided Futures' funded by AHRC, one researcher has collaborated with the colleagues from the School of Applied Social and Policy Studies to investigate the influence of historical and heritage data on the urban design. The team has successfully completed the project entitled 'Communities as constructs of People and Architecture' funded by AHRC. Plans are in place to formalise these Architecture activities as a fully recognised research group.

74 students are currently enrolled for PhD studies in the school. In the academic year 2018-19, 65% of these studentships are funded (VCRS, DfE etc) and the rest (35%) are self-sponsored. Our research has attracted many international students with nationals from Bangladesh, China, Egypt, France, Ghana, India, Iraq, Ireland, Jordan, Kuwait, Lebanon, Nigeria, Norway, Pakistan, Poland, South Korea, Spain, Switzerland, Uganda and Vietnam. In this reporting period, thirteen of our PhD researchers have successfully completed their PhD studies and have been awarded doctoral degree. A Postdoctoral Tutor has been appointed to guide PhD researcher for training and generic skills needed during their PhD study, to organise the progress seminars during the period of study and to provide mentoring support.

This brief overview presents our engagements and research and impact contributions in the in Architecture, Built Environment and Planning over the last year. I would encourage you to read through this Annual Report and follow up any queries with either myself or colleagues.

Further details of our research, facilities, staff profiles and research expertise can be found at www.ulster.ac.uk/research/topic/built-environment.

Or by contacting Mrs Irene Moreland (Academic Excellence Executive Assistant) at Email: i.moreland@ulster.ac.uk; Ph: +44 28 9036 6101.



Dr Jayanta Deb Mondol
Research Director- Architecture, Built Environment & Planning.

2. Research Students

The following research students were registered on research degree programmes during 2018-19.

Surname	Thesis Title
Abid, Muhammad	Variable speed heat pump compressor for demand side management and network stability.
Ademulegun, Oluwasola	Locational net benefit analysis for mass energy storage.
Agbonaye, Osaru	Development of Business Models of Community Energy Schemes.
Akagwu, Paul	Experimental & numerical study on performance of steel joints during fire.
Alam, Naveed	Response of slim floor systems in fire.
Alkadi, Sanaa	Sustainable design for autonomous development in hot environment.
Allen, David	Location, Location, Location: A Northern Irish, I.T. driven perspective.
Alnaseem, Nijood	Factors that impact on the achievement of value of money in public sector projects in the state of Kuwait.
Ansong, Joseph	Coastal Governance on the Island of Ireland: challenges and opportunities in a new era.
Ballentine, Mark	Protecting crowded places and critical infrastructure – understanding and mitigating the emerging threat of unmanned aerial vehicle systems.
Bani Mustafa, Motasem	Distributed energy storage models for DNO/DSO operations.
Bhutta, Rumeel	Personal protective equipment for accidentally high-risk circumstances under extreme conditions.
Biglarbeigi, Pardis	A climate change framework for global appraisal of reservoir performance and national adaptive capacity.
Bradley, Philip	The development of a conceptual framework to help achieve low carbon commercial office buildings in London by 2050.
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.
Chakraborti, Shauli	Design development and experimental characterisation of an innovative solar building wall with thermal storage and heat transfer characteristics.
Charlier, Marion	Characterization of travelling fires in large compartments.
Chartouni, Joseph	The erasure of modernity from Beirut's cultural/architecture heritage.
Clarke, Gary	Multi-function Building Integrated Solar Technologies using Optical Components.
Clarke, Sorcha	Protecting crowded places from terrorism.
Comiskey, David	The Quality Dimension (qD) – Improving quality assurance in relation to fire barriers in ventilated façade systems.
Coon, David	The interrelationship between noise and the physical wellbeing of inhabitants adjacent to major infrastructure such as transport routes.
Coyles, David	Spatial legacy of the Troubles: A historical assessment of security led ideology in the redevelopment of inner-city Belfast 1969-1994.
Czerwinska, Anna	Fuel Poverty - Retrofitting as a policy solution.
De Priall, Oisín	Performance Study and Validation of the Downdraft Biomass Gasification.
Dery, Wulme	High-pressure hydrogen storage tank rupture in confined space.
Diamond, Declan	Sustainable City Regeneration through Infrastructure Investment.

Donaghy, Leona	Optimum integration of a range of energy efficiency and renewable energy technologies under real conditions in occupied test houses.
Donkoh, Emmanuel	Improving project performance: Application of system dynamics modelling in managing construction stakeholders' influences and challenges.
Dou, Mengmeng	Real estate valuation practice in China - An emerging market perspective.
El Samra, Kristine	Downtown Beirut: A quest for urban regeneration frameworks of a city living in parallel to the living city.
Fadeyi, Olawumi	Capital flow and real estate office markets in global financial cities.
Ferguson, Jason	The detrimental effect of water on asphalt pavement durability.
Frey, Joe	The Growth of the Private Rented Sector in Northern Ireland: The implications for Housing Market Analysis and Planning for Housing Supply.
Fumey, Benjamin	Absorption based heat storage with NaOH, heat and mass exchanger development and system of integration.
Greaney, Deirdre	Calibrating government planning policies for Irish urban centres from culturally durable and environmentally sustainable urban design principles and strategies.
Hamill, Mark	Development of innovative management strategies to address proliferation of littering in the built environment.
Hawe, Owen	Planning for active living: Aligning policy, product, proactive and processes.
Hussein, Harem	Pressure peaking phenomenon for hydrogen jet fires and safety considerations of indoor releases.
Huynh, An	The characteristics of Fly ash based Geopolymer Concrete in Road Pavement.
Isirima, Michael	Fire protection risk assessment: A study of offshore installations
Islam, A K M Khabirul	Water-Energy Nexus: Developing Technology to Produce Hydrogen from Wastewater.
Jankowiak, Corentin	Optimal Integrated Solutions for Energy Storage, Electrification of Heat and Transport at a Domestic level.
Kearney, Matthew	Regeneration and Resilience: Practical Solutions to Real World Problems.
Kennedy, Robert	Legibility in Urban Design and Conservation Area Practice.
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.
Liang, Hongyuan	The Development of a Strategic Performance Measurement Framework for Assessing Xiongan New Area in China.
Lim, Ohk Kun	Structural performance of shear studs in fire.
MacDonald, Colin	Law enforcement perspectives in lone act terrorism.
MacIntyre, Sean	Solar PV in NI. An examination of the user profile and experience together with an assessment of its future potential for household generation and use via behavioural and technological changes.
Mahon, Clare	To develop an economic operator prequalification model to assist in the award of public contracts.
McAleenan, Aoife	Using Irish road infrastructure as a means of connecting essential pollinator habitat corridors.
McKinstry, Colin	Development and validation testing of an advanced domestic air source heat pump.

McMenamin, Deirdre	Developing cultural-spatial representation of the interrelationship between landscape and human agency in rural Ireland/NI: Revealing the agency of landscape strategy in Irish Vernacular Architecture.
Muhumuza, Ronald	Solar cogeneration for access to energy in off-grid rural households in developing countries.
Nair, Ajay	Phase Change and Alternative Materials for Domestic Thermal Energy Storage.
Nakkasunchi, Shalini	Water and energy nexus in water utilities.
Nielsen, Anne Mette	SAFEWATER - Integrated water and sanitation in architectural design for sustainable housing in developing regions
Oakes, Luke	Development and evaluation of innovative, fibre-reinforced geopolymer composite solutions as permanent formwork for geopolymer cement concrete structures.
Oriaifo, Wilfred	Investigating the role of public buildings in the acculturation process.
Patton, Marcus	Building Northern Ireland 1945 to 1980.
Quigley, Mura	Enabling a resilient future: exploring the leadership and governance of urban design.
Ramirez, Miguel	Design & development of a High Temperature Heat Pump (HTHP) for district heating and industrial applications.
Ratajczak, Leonia	Regeneration and Resilience: Practical Solutions to Real World Problems.
Rice, Laura	Declining public value within contemporary public management: A UK planning, JR and urban regeneration narrative
Sakr, Mohamed	Modelling and large eddy simulation of large-scale deflagration-to-detonation transition
Sheldon, Lisa	Community resilience, health and wellbeing - exploring community resilience in flood prone areas considering the increase in flooding prevalence.
Tierney, Christopher	Dynamic road/ tyre interaction.
Waddell, Campbell	The grip of motorsport surfaces.
Wang, Shurui	i.SEM, DS3 and GB/Fr Interconnection Electricity Marketing Modelling.
Wilson, Christopher	Development of advanced heat pump and thermal storage systems capable of cost-effective demand side management.
Yue, Wenhe	The Impact of Demographic Structure and Changing Government Policies on Urban Housing Demand in China.

Graduated December 2018

Student Name	Thesis Title
Chotzoglou, Konstantinos	Burning behaviour of liquid pool fires in corridors and thermal characteristics of resulting externally venting flames
Cirrone, Donatella	Hazards from catastrophic failure of high-pressure hydrogen storage
Crinion, Kate	Disaster recovery and reconstruction: harnessing capacity and building resilience within communities affected by flooding
Magowan, Danielle	The impact of traffic related air pollution in Northern Ireland
McErlane, Andrew	Stakeholder collaboration in United Kingdom (UK) public-private partnerships (PPP) social infrastructure provision
Molloy, Andrew	Myths of Belfast: The process of poetic experience
O'Neill, Jennifer	Emotional mapping: exploring how mapping of emotion can add value to knowledge on decision making in contested spaces

Graduated July 2019

Student Name	Thesis Title
Ballentine, Mark	Protecting crowded places and critical infrastructure – understanding and mitigating the emerging threat of unmanned aerial vehicle systems
Biglarbeigi, Pardis	A climate change framework for global appraisal of reservoir performance and national adaptive capacity
Fadeyi, Olawumi	Capital flow and real estate office markets in global financial cities
Rice, Laura	Declining public value within contemporary public management: A UK planning, JR and urban regeneration narrative
Waddell, Campbell	The grip of motorsport surfaces
Wilson, Christopher	Development of advanced heat pump and thermal storage systems capable of cost-effective demand side management

3. Publications

Details of all Publications by the School of Architecture, Built Environment and Planning are on the Ulster University's Institutional Repository- PURE <https://pure.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.

3.1 Journal Articles

Alam, N, Nadjai, A, Maraveas, C, Tsarvdaridis, K & Ali, FA 2018, 'Response of Asymmetric Slim Floor Beams in Parametric-Fires', Journal of Physics: Conference Series, vol. 1107, no. p.032009.

Alam, N, Nadjai, A, Maraveas, C, Tsarvdaridis, K & Kahanji, C 2018, 'Effect of air-gap on response of fabricated slim floor beams in fire', Journal of structural Fire Engineering.

Alam, N, Nadjai, A, Vassart, O & Hanus, F 2019, 'A detailed investigation on thermal behaviour of slim floor beams with web openings at elevated temperatures', Journal of structural Fire Engineering, vol.10, no. 4, pp. 446-467

Arya, F, Hyde, T, Henshall, P, Eames, P, Shire, S & Moss, R 2018, 'Vacuum enclosures for solar thermal panels Part 2: Transient testing with an uncooled absorber plate', Solar Energy, vol. 174, pp. 1224-1236.

Arya, F, Hyde, T, Henshall, P, Moss, R, Shire, S & Eames, PC 2018, 'Vacuum enclosures for solar thermal panels Part 1: Fabrication and hot-box testing', Solar Energy, vol. 174, pp. 1212-1223.

Arya, F, Hyde, T, Trevisi, A, Basso, P & Bardaro, D 2018, 'The Effect of Glass Thickness on Stress in Vacuum Glazing', International Journal of Energy and Environmental Engineering, vol. 12, no. 9, pp. 685-689.

Asimakopoulou, E, Chotzoglou, K, Kolaitis, D, Zhang, J & Delichatsios, MA 2019, 'Numerical investigation of externally venting flame characteristics in a corridor- façade

configuration', Fire Safety Journal, Vol. 110, 102912.

Bocci, M, Sangiuliano, SJ, Sarretta, A, Ansong, JO, Buchanan, B, Kafas, A, Caña-Varona, M, Onyango, V, Papaioannou, E, Ramieri, E, Schultz-Zehden, A, Schupp, MF, Vassilopoulou, V & Vergílio, M 2019, 'Multi-use of the sea: A wide array of opportunities from site-specific cases across Europe', PLoS ONE, vol. 14, no. 4.

Brandoni, C, Shah, N, Vorushylo, I & Hewitt, N 2018, 'Poly-generation as a solution to address the energy challenge of an aging population', Energy Conversion and Management, vol. 171, pp. 635-646.

Brennan, S & Molkov, V 2018, 'Pressure peaking phenomenon for indoor hydrogen releases', International Journal of Hydrogen Energy, vol. 43, no. 39, pp. 18530-18541.

Brennan, S, Hussein, H, Makarov, DV, Shentsov, V & Molkov, V 2019, 'Pressure Effects of an Ignited Release from Onboard Storage in a Garage with a Single Vent', International Journal of Hydrogen Energy, vol. 44, no. 17, pp. 8927-8934.

Choi, S 2019, 'Experimental Studies on the Behaviour of Headed Shear Studs for Composite Beams in Fire', Steel and Composite Structures, vol. 32, no. 6, pp. 743-752.

Ciaran McAleenan 2018, 'The ethics deficit in occupational safety and health monitoring technologies.', Proceedings of the ICE - Management, Procurement and Law, vol. 172, no. 2, 1800027, pp. 1-8.

Cirrone, DMC, Makarov, DV & Molkov, V 2019, 'Simulation of thermal hazards from hydrogen under-expanded jet fire', *International Journal of Hydrogen Energy*, vol. 44, no. 17, pp. 8886-8892.

Cirrone, DMC, Makarov, DV & Molkov, V 2019, 'Thermal radiation from cryogenic hydrogen jet fires', *International Journal of Hydrogen Energy*, vol. 44, no. 17, pp. 8874-8885.

Coffee, N, Lockwood, T, Rossini, P, Niyonsenga, P & McGreal, WS 2018, 'Composition and Context Drivers of Residential Location Value as a Socioeconomic Status Measure', *Environment and Planning B: Urban Analytics and City Science*, pp. 1-18.

Cooper, S, Hammond, G, Hewitt, N, Norman, J, Tassou, S & Youssef, W 2019, 'Energy saving potential of high temperature heat pumps in the UK Food and Drink sector', *Energy Procedia*, vol. 161, pp. 142-149.

Dooher, T, McGarrigle, C, Dixon, D, McIlhagger, A, Harkin-Jones, E & Archer, E 2018, 'Novel thermoplastic yarn for the through-thickness reinforcement of fibre-reinforced polymer composites', *Journal of Thermoplastic Composite Materials*, vol. 31, no. 12, pp. 1619-1633.

Fang, Y & Arya, F 2019, 'Evacuated glazing with tempered glass', *Solar Energy*, vol. 183, no. 183 (2019) 240-247, 183, pp. 240-247.

Friel, S & Woodward, WDH 2019, 'High Friction Surfacing Systems Using Blends of Natural Aggregate and Calcined Bauxite', *Coatings*, vol. 9, no. 3, 177.

Gong, L, Duan, Q, Sun, J & Molkov, V 2019, 'Similitude analysis and critical conditions for spontaneous ignition of hydrogen release into the atmosphere through a tube', *Fuel*, vol. 245, pp. 413-419.

Guo, H, Xu, Y, Guo, C, Chen, H, Wang, Y, Yang, Z, Huang, Y & Dou, B 2019, 'Thermodynamic analysis of packed bed thermal energy storage system', *Journal of Thermal Science*, pp. 1-15.

Hewitt, N, MacArtain, P, Byrne, R & Ruth, C 2019, 'Electricity autoproduction, storage and billing: A case study at Dundalk Institute of Technology, Ireland', *Sustainable Energy Technologies and Assessments*.

Hinch, M, McCord, M & McGreal, WS 2019, 'LIBOR and interest rate spread: sensitivities of the Australian housing market', *Pacific Rim Property Research Journal*, vol. 25, no. 1, pp. 73-99.

Hussein, H, Brennan, S, Shentsov, V, Makarov, DV & Molkov, V 2018, 'Numerical validation of pressure peaking from an ignited hydrogen release in a laboratory-scale enclosure and application to a garage scenario', *International Journal of Hydrogen Energy*, vol. 43, no. 37, pp. 17954-17968.

Huynh, A, Magee, B & Woodward, WDH 2019, Porous reclaimed asphalt pavement with geopolymeric grouting. in *Proceedings of International Conference on Smart Cities (ICSC-2019)*. pp. 1-7.

Inna, V, Keatley, P, Shah, N, Richard, G & Hewitt, N 2018, 'How heat pumps and thermal energy storage can be used to manage wind power: a study of Ireland', *Energy*, vol 157, pp. 539-549

Kang, S, Choi, JY & Choi, S 2019, 'Mechanism of Heat Transfer through Porous Media of Inorganic Intumescent Coating in Cone Calorimeter Testing', *Polymers*, vol. 11, no. 2, 221, pp. 1-26.

Khakzad, N, Dadashzadeh, M & Reniers, G 2018, 'Quantitative assessment of wildfire risk in oil facilities', *Journal of Environmental Management*, vol. 223, pp. 433-443.

- Lamnatou, C, Smyth, M & Chemisana, D 2019, 'Building-Integrated Photovoltaic/Thermal (BIPVT): LCA of a façade-integrated prototype and issues about human health, ecosystems, resources', *Science of the Total Environment*, vol. 660, pp. 1576-1592.
- Lovreglio, R, Kuligowski, E, Gwynne, S & Boyce, KE 2019, 'A Pre-Evacuation Database for Use in Egress Simulations', *Fire Safety Journal*, vol. 105, pp. 107-128.
- Mccann, L, Hutchison, N & Adair, A 2019, 'External funding of major capital projects in the UK Higher Education sector: issues of demand, supply and market timing?', *Journal of Property Research*, vol. 36, no. 1, pp. 97-130.
- McCord, M, Davis, P, Bidanset, P, MacIntyre, J & Lo, D 2018, 'Examining the Spatial relationship between environmental health factors and house prices: NO2 problem?', *Journal of European Real Estate Research*, vol. 11, no. 3, pp. 353-398.
- McCord, M, Davis, P, McCluskey, WJ, Bidanset, P, McCord, J, Haran, M & MacIntyre, S 2018, 'House Prices and Neighbourhood amenities: Beyond the Norm?', *International Journal of Housing Markets and Analysis*, vol. 11, no. 2, pp. 263-289.
- McDermott, R, Strong, A & Griffiths, P 2019, 'Solid Transfer in Low Flow Sewers, the Distance Travelled So Far Is Not Enough', *Journal of Environmental Protection*, vol. 2, pp. 164.
- McIlhatton, D, Berry, J, Chapman, D, Christensen, P, Cuddihy, J, Monaghan, R & Range, D 2018, 'Protecting Crowded Places from Terrorism: An analysis of the current considerations and barriers inhibiting the adoption of counter terrorism protective security measures', *Studies in Conflict and Terrorism*, pp. 1-22.
- McIlhatton, D, Monaghan, R, Berry, J, Cuddihy, J, Chapman, D & Christensen, P 2019, 'Protecting Commercial Real Estate and Crowded Places from Terrorism', *Journal of Real Estate Literature*, vol. 27, no. 1, pp.103-116.
- Moini, M, Olek, J, Youngblood, J, Magee, B & Zavattieri, P 2018, 'Additive Manufacturing and Performance of Architected Cement-Based Materials', *Advanced Materials*, vol. Adv. Mater. 2018, no. 1802123, 1802123, pp. 1-11.
- Molkov, V, Dadashzadeh, M & Makarov, D 2019, 'Physical model of onboard hydrogen storage tank thermal behaviour during fuelling', *International Journal of Hydrogen Energy*, vol. 44, no. 8, pp. 4374-4384.
- Mondol, J & Jacob, G 2018, 'Commercial Scale Solar Power Generation (5MW to 50 MW) and its Connection to Distribution Power Network in the United Kingdom', *Journal of Solar Energy Research Updates*, vol. 5, pp. 25-38.
- Moss, R, Shire, S, Henshall, P, Arya, F, Eames, PC & Hyde, T 2018, 'Performance of evacuated flat plate solar thermal collectors', *Thermal Science and Engineering Progress*, vol. 8, pp. 296–306.
- Muhumuza, R, Zacharopoulos, A, Mondol, J, Smyth, M & Pugsley, A 2018, 'Energy consumption levels and technical approaches for supporting development of alternative energy technologies for rural sectors of developing countries', *Renewable and Sustainable Energy Reviews*, vol. 97, no. 2018, pp. 90-102.
- Murphy, M & Eadie, R 2018, 'Socially responsible procurement: A service innovation for generating employment in construction', *Built Environment Project and Asset Management*, vol. 9, no. 1, pp. 138-152.

Nadjai, A, Colombiano, J, Drean, V, Rogaume, T, Richard, F, Batiot, B, Fateh, T & Guillaume, E 2018, 'Experimental and numerical investigations in order to model the fire development and propagation for fire safety engineering studies', *Journal of Physics: Conference Series*, vol 1107, no. 4, pp. 1-6.

Nolan, H, Sun, D, Falzon, BG, Chakrabarti, S, Padmanaban, DB, Maguire, P, Mariotti, D, Yu, T, Jones, D & Andrews, G 2018, 'Metal nanoparticle-hydrogel nanocomposites for biomedical applications – An atmospheric pressure plasma synthesis approach', *Plasma Processes and Polymers*, vol. 15, no. 11.

Oakes, L, Magee, B, McIlhagger, AT & McCartney, M 2019, 'Strength prediction and mix design procedures for geopolymer and alkali-activated cement mortars comprising a wide range of environmentally responsible binder systems', *Journal of Structural Integrity and Maintenance*, vol. 4, no. 3, pp. 135-143.

Pimenidou, P, Shanmugapriya, N & Shah, N 2019, 'Performance and emissions study of diesel and waste biodiesel blends with nanosized CZA2 of high oxygen storage capacity', *Fuel*, vol. 239, pp. 1072-1082.

Pugsley, A, Zacharopoulos, A, Smyth, M & Mondol, JD 2019, 'Performance evaluation of the synergy polycarbonate and asphalt carbon nanotube solar water heating collectors for building integration', *Renewable Energy*, vol. 137, pp. 2-9.

Rolfe, A, Huang, Y, Haaf, M, Pita, A, Rezvani, S, Dave, A & Hewitt, N 2018, 'Technical and Environmental Study of Calcium Carbonate Looping versus Oxy-fuel Options for Low CO₂ Emission Cement Plants', *International Journal of Greenhouse Gas Control*, vol. 75, pp. 85-97.

Shah, N, Wilson, C, Huang, M & Hewitt, N 2018, 'Analysis on field trial of high temperature heat pump integrated with thermal energy storage in domestic retrofit installation', *Applied Thermal Engineering*, vol. 143, pp. 650-659.

Smyth, M, Mondol, J, Pugsley, A, Zacharopoulos, A & Besheer, A 2019, 'Experimental performance characterisation of a Hybrid Photovoltaic/Solar Thermal Façade module compared to a flat Integrated Collector Storage Solar Water Heater module', *Renewable Energy*, vol. 137, pp. 137-143.

Tabakovic, A, O'Prey, D, McKenna, D & Woodward, WDH 2019, 'Microwave Self-healing Technology as Airfield Porous Asphalt Friction Course Repair and Maintenance System', *Case Studies in Construction Materials*, vol. 10, pp. 1-9.

Taltavull de la Paz, P & McGreal, WS 2019, 'A re-assessment of house price indices: evidence from the Spanish market', *International Journal of Strategic Property Management*, vol. 23, no. 1, pp. 23-35.

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3.2 Books/Chapters in Books

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3.3 Research Reports

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3.4 Published Conference Papers

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Huang, Y, Rolfe, A, Vorushylo, I, Keatley, P, Byrne, R, MacArtain, P, Flynn, D & Hewitt, N 2018, 'Integration of compressed air energy storage with wind generation into the electricity grid', in IOP Conference Series: Earth and Environmental Science: The 3rd International Conference on New Energy and Future Energy System, 21–24 August 2018, Shanghai, China.

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Wang, S, Vorushylo, I, Huang, Y, Keatley, P, Xu, Y, Chen, H, MacArtain, P & Hewitt, N 2019, 'Benefits of demand side response in regional and interconnected Integrated Single Electricity Market (I-SEM)', The International Conference on Innovative Applied Energy (IAPE'19) , Oxford, UK, 13/03/19 - 15/03/19, pp. 31-31.

4. Research Funding

Ongoing and Active Research Projects, notably:

Unit of Assessment Member	Title of Award	Funding Body	Value
Prof V Molkov Dr D Makarov	NET-Tools: Novel education and training tools based on digital applications related to hydrogen and fuel cell technology	CEC-H2020-JTI-FCH	£236,602
Dr TJ Hyde Dr J Zhang	EENSULATE: Development of Innovative Lightweight and Highly Insulating Energy Efficient Components	CEC-H2020-IL-NANOTECH	£592,311
Prof N Hewitt Prof PW Griffiths Dr A Zacharopoulos Dr C Brandoni Dr M Huang Dr P Keatley Dr Y Huang Mr S Devlin Mr D McLarnon	SPIRE 2	INTERREG VA	£2,307,838
Prof M Haran Dr P Davis Dr M McCord Dr D Lo Prof S McGreal Prof J Berry Prof P Griffiths	CRREM - Carbon Risk Real Estate Monitor	CEC-H2020-SC ENERGY	£196,343
Prof V Molkov Dr DV Makarov	Composite tank prototype for onboard hydrogen storage based on novel Ulster's leak-no-burst safety technology	Invest NI - Proof of Concept	£105,980
Prof A Nadjai	TRAFIR: Characterisation of travelling fires in large compartments	CEC - Coal and Steel	£120,316
Dr J Mondol Dr A Zacharopoulos Dr M Smyth	SolaFin2Go - Solar Finance to Go	EPSRC	£136,538
Prof N Hewitt Dr MJ Huang Dr N Shah	CHESTER - Compressed Heat Energy Storage for Energy from Renewable Sources	CEC-H2020-LCE-2016-2017	£203,599
Prof V Molkov Dr DV Makarov	PRESLHY: Pre-normative Research for Safe Use of Liquid Hydrogen	CEC-H2020-LCE-2016-2017	£204,181

Portfolio of new Research Grants awarded during period 1 August 2018 - 31 July 2019

Unit of Assessment Member	Title of Award	Funding Body	Value
Dr L McElduff Mr G Rafferty Prof N Hewitt	Models of spatial planning and development in a post-Brexit landscape: collaborating across external borders	Dept. of Foreign Affairs	£4,989.00
Dr A Grant Prof B Hamber Mr D Coyles	Divided Pasts - Divided Futures	AHRC	£202,388.00
Dr C Brandoni Dr I Vorushylo Dr Y Huang Prof N Hewitt	Gender, ageing and latency in the transition to low-carbon system: empowering women as decision makers	UKERC	£59,556.80
Prof G Leavey Dr M Rosato Dr M Loane Prof M Tully Prof AJ Moore Dr M McCord Prof D O'Reilly, QUB	ADRC 2018	ESRC	£905,432.00
Dr Y Huang Prof N Hewitt	Cost effective conversion of lignite & waste to liquid fuel	CEC Coal and Steel	£119,427.00
Prof N Hewitt Dr M Huang Angeles Rivero Pacho, Warwick University Bob Critoph, Warwick University David Ealmes, Warwick University Graham Maidmont, London South Bank Phil Eames, Loughborough University Sarah Davies, London South Bank Uni Stan Shire, Warwick University Steven Metcalf, Warwick University Vicky Haines, Loughborough University	Low temperature Heat Recovery and Distribution Network Technologies (Lo-NET)	EPSRC	£1,321,470.00

Dr Y Huang	CLARA	CEC-H2020-SC ENERGY	£131,129.00
Prof V Molkov Dr DV Makarov	HyTunnel-CS	CEC-H2020-FCH	£338,910.00
Dr M Hinch Prof Alastair Adair	Northern Ireland Quarterly House Price Index	Progressive Building Society	£100,000.00
Dr I Vorushylo Dr C Brandoni Prof N Hewitt	Pathways towards heat decarbonisation in Northern Ireland	UKERC	£58,374.00
Prof N Hewitt	Collaborative Research Support Fund - theme Leader Energy (NICP)	Department for the Economy	£119,748.00
Prof G Leavey Dr M Loane Prof M Tully Prof AJ Moore Dr M McCord Prof D O'Reilly, Queen's Uni Belfast	R&D Office contribution to Link - The NI Administrative Data Research Centre 2019	HSC R&D Public Health Agency	£205,766.00
Prof N Hewitt Dr B Solan Dr N McConnell Dr WDH Woodward Prof A Nadjai Prof V Molkov	Infrastructure Compromise Avoidance	Department for the Economy-HERC Funding	£144,000.00
Dr J Mondol Dr A Zacharopoulos Dr MA Smyth	SolaNetwork	EPSRC - Technology Strategy Board	£211,716.00
Dr M McCord Dr J McCord Dr M Hinch Dr PT Davis Mr SC MacIntyre Prof ME Haran	House Prices, Rents and Affordability	NIHE	£287,750.00