Institution: University of Reading

Unit of Assessment: 13 Architecture, Built Environment, Real Estate and Planning

1. Unit context and structure, research and impact strategy

1.1 Overview and Context

Research within Architecture, Built Environment, Real Estate and Planning at the University of Reading aims to support and enhance the development and management of sustainable built environments within an environmental, socio-economic and policy context. Our objective is to contribute to the research base of our UOA13 disciplinary areas, set out in Figure 1, and to develop applied research that addresses policy, practice and societal issues, providing theoretically sound, evidence-based solutions.

Our research activity impacts four interlinked sustainable built environment priorities relating to 'Planet', 'Place', 'People' and 'Prosperity'. These reflect our research focus, to:

- reduce the pace of climate change and provide built environment solutions for the *planet*,
- enhance the design, management and use of property and *places*, and
- improve the quality of life and economic *prosperity* of *people.*

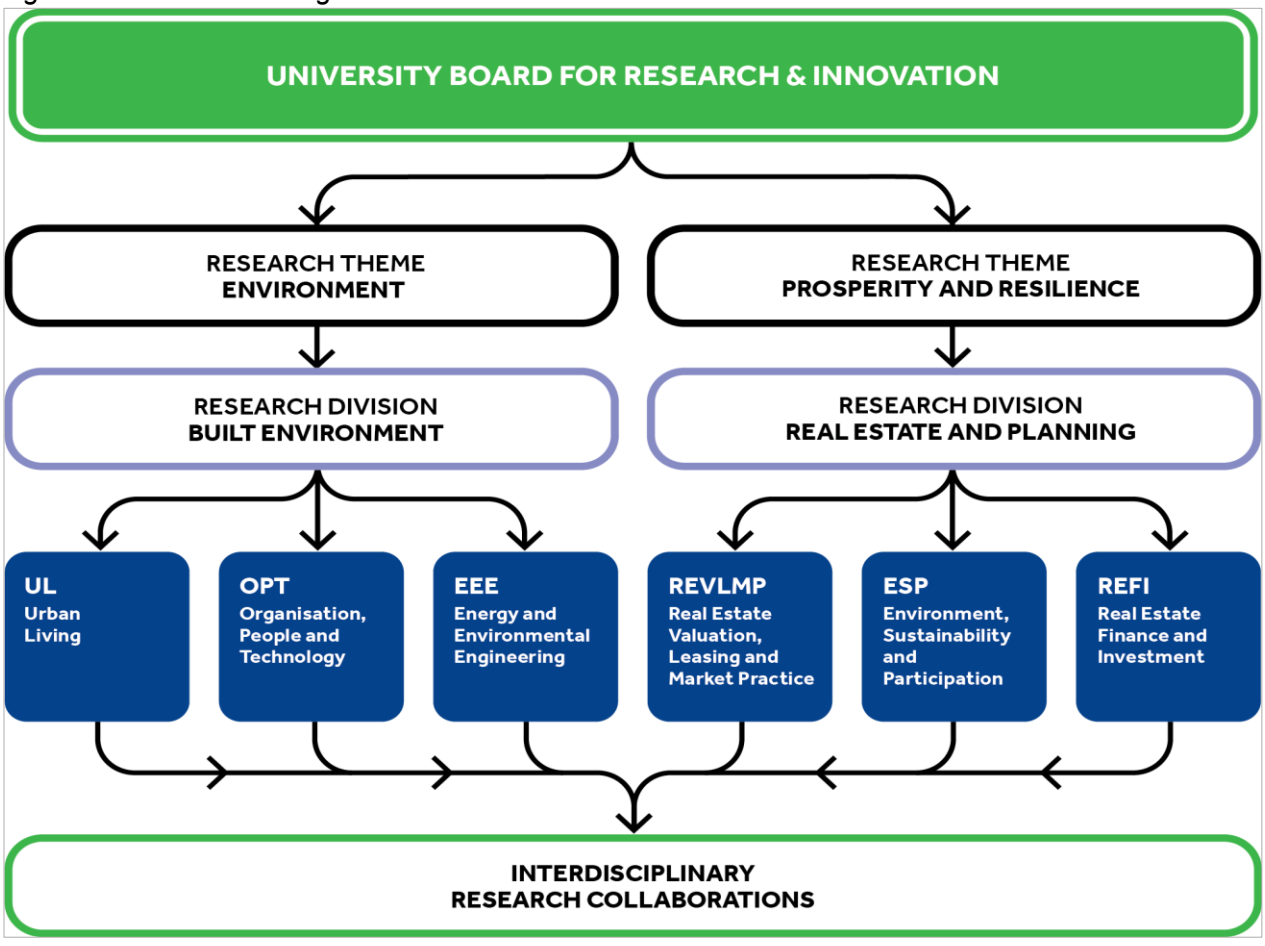
Figure 1. Research framework

With the establishment of the School of Architecture in 2014, the University has made a major investment into enhancing our research capacity relating to design within the built environment. This investment brings both critical mass and distinctive additional expertise including urban design, place-making, and social value of the built environment. We have continued to expand the Henley Business School (HBS), formed in the previous REF period. We have invested heavily in central impact resources, with both funding and personnel, supporting an important aspect of our UOA13 research strategy. We have expanded and improved our postgraduate research programme across all UOA13 sub-disciplines. We have been particularly successful in this endeavour, as evidenced by a threefold increase in completions.

1.2 University and UOA research structure and organisation.
As set out in the Institutional Environment Statement (IES), since 2015 the University's research activity has been structured around four **Research Themes**, each led by a Research Dean. Each theme comprises several Research Divisions which map onto Departments or large sub-units and are led by a **Research Division Lead (RDL)**.

UOA13 research operates principally within three academic units: Construction Management and Engineering, and Architecture (both situated within the School of the Built Environment, SBE), and Real Estate and Planning (REP, located within HBS)**.** As indicated in Figure 2, our research is organised through two Research Divisions (RDs): **Built Environment which** sits within the **Environment** Research Theme and **Real Estate and Planning**, which sits within the **Prosperity & Resilience** Research Theme. Research in each Division is organised through research groups which provide focus and critical mass and support interdisciplinary work.

Figure 2. Research Management Structure



Research Groups

In Built Environment (RDL Sexton) research is organised in three research groups as described below.

- ***Urban Living (UL)*** (lead Samuel): focuses on designing for healthy lives and wellbeing across a range of environments, using co-design approaches. Research areas include urban living labs, housing, foresight/futures studies and urban agriculture, mapping and evidencing value (including social and cultural value) and social sustainability, the experience of urban environments, data gathering and utilisation, technological change and smart cities, and the diffusion of innovation across scales in the context of climate resilience.

- ***Organisation, People and Technology (OPT)*** (lead Ewart): builds on a long history of construction management research at Reading. It focuses on applied research in global and national design and construction management including productivity and sustainability, construction economics and innovation, digital practices and immersive visualisation, cultural and gender diversity, migrant workers and employment, and business processes and professionalisation.

- ***Energy and Environmental Engineering (EEE)*** (lead Smith): applies combined expertise on energy and environment to research issues associated with energy transitions, climate mitigation and resilience, and environmental quality and health. The energy research is primarily within two themes: demand (activity, flexibility, economics, and technology) and systems (operation, control, and efficiency). The environment research covers issues of quality (air and thermal) and management (control systems, green infrastructure measures, etc.), working across scales (building to urban).

Research in Real Estate & Planning (joint RDLs Devaney and Pain) operates across the following three groups:

- ***Real Estate Valuation, Leasing and Market Practice (REVLMP)*** (leads Crosby, McAllister, Wyatt): concentrates primarily on commercial property market analysis, investment, development and appraisal/valuation, integrating housing research into its portfolio with work on affordable housing and viability. Specific examples include research on bank lending valuations, commercial leasing, sustainability impacts on value, land value taxation/capture and land tenure.

- ***Real Estate Finance and Investment (REFI)*** (lead Marcato): covers a wide variety of issues concerning direct and indirect real estate investment markets, finance, and alternative asset markets. The work in this group includes studies of housing, banking, and debt. There is also a cluster of work around public markets, Real Estate Investment Trusts, liquidity, risk and foreign investment. Cross-group investment research with REVLMP includes depreciation and performance measurement/indices.

- ***Environment, Sustainability and Participation (ESP)*** (leads Pain, Parker): research includes an array of sustainability challenges, including community engagement and neighbourhood planning, planning policy, economic change and resilience, healthy urban living, urban density, and the environment. It includes research in economic development, land use and spatial planning, governance, regulation, community planning, regeneration and smart and sustainable cities (with SBE).

1.3 Interdisciplinary Research

The Research Divisions constituting UOA13 are inherently interdisciplinary, including researchers with backgrounds in architecture, construction, engineering, town planning, real estate, business, economics, finance, management, geography, sociology, physics, chemistry; many with extensive industry experience. Research activity is structured around the aim of impacting the sustainability of the built environment through research into the topics set out in

our research framework: *Planet, People, Place, Prosperity.* Activity and collaboration within Research Divisions and with colleagues in other parts of the University, are guided by these priorities. Across the University Research Themes, we have expanded relationships with other disciplines, for example, extensive collaborations with the Meteorology Department (funded by NERC/Climate-KIC) and Archaeology (funded by AHRC) in research and PhD supervision, and output collaborations with, among others, Geography & Environmental Sciences; Food, Nutrition & Health; History; Psychology; Biological Sciences, and other Divisions within HBS.

Our interdisciplinary work is best illustrated by our research on energy, housing, and sustainability.

The extensive collaborations with Meteorology include joint research publications (Luo, Yao), research with the University's interdisciplinary Walker Institute for Climate Resilience where Nunes (REP) acts as one the Institute's five internal University steering group members and 'ambassadors'. EEE group collaborations with Meteorology include Luo, Lu, Coker, Smith, Dixon, Peters, Shao and Torriti (SBE) working with Barlow, Clark, Brayshaw and Grimmond (submitted to UOA7), and bring together Reading's research on climate with our work on energy systems. Examples include two NERC-funded projects on UK air pollution and overheating risk in Sri Lanka (£1.6m, SBE share £430,000, Lu, Luo, Smith from SBE with Grimmond, Meteorology).

Housing is an area of interdisciplinary research grounded in the place, people, and prosperity priorities of our research framework. The collaboration with Glasgow University and 12 other partners in developing the ESRC-funded UK Collaborative Centre for Housing Evidence (CaCHE), initially involving Clapham and Foye (REP) and Meen (Economics) and now Samuel (SBE), has involved staff across disciplines and given us further impetus bringing together our research across architecture, planning, housing economics and social policy. Issues explored include housing demand and supply levels, design, affordable housing, and social value. Outputs include the CaCHE report on Delivering Design Value (Co-author Samuel) and the land value capture and development viability funded research projects and outputs (Crosby, McAllister, Wyatt, Hughes, Street, Shepherd, Sayce).

The sustainability research agenda is an overarching priority for our UOA and for the wider University. In addition to climate-related interdisciplinary research, we have progressed this agenda over the period, with research across SBE and REP on smart and sustainable cities (Dixon, Pain) including the Reading 2050 vision project (Lead Dixon with Barton Wilmore and Reading Borough Council). This project is a good illustration of interdisciplinary research that encompasses the four parts of our research framework. It connects with the UK Government Office for Science Future of Cities Programme and has delivered strategy papers on Reading's future as a smart and sustainable city, and a series of public lectures (internal contributions from Coker, Dixon, Ewart, Coker, Mohareb, Nikolic, Pain, Perrotti, with Clarke and Lloyd-Evans from Geography & Environmental Sciences). It has developed architecture practice, with Broadway Malyan Architects, funding the development of a large-scale physical and virtual model of Reading town centre to aid the visioning of development. The project has extensive community engagement through workshops with school children and young people on the future development of Reading and was awarded an Impact and Engagement Award by the University in 2018.

1.4 Research and Impact Strategy

The strategic aim stated in REF2014 was to 'combine a strong orientation towards "real world" problems with a commitment to high-quality interdisciplinary research to sustain impact on practice'. Specific objectives included:

- Developing areas of core strength across our sub-disciplines, such as energy demand, indoor comfort, property valuation, and neighbourhood planning, and strengthened interdisciplinary collaborations between REP and SBE, and with researchers across the University.

- Embedding impact into our research culture building on the existing strength evidenced by the REF2014 research impact score (70% at 4*, 30% at 3*).
- Integrating the new School of Architecture into the UOA.
- Expanding the international focus of our research, particularly in South America.
- Investing in the next generation of Built Environment researchers by expanding our PhD programme.

We have made significant progress against these objectives. The strength of our core research areas is reflected in grants won and participation in major international networks and policy reviews (sections 3 and 4). Highlights include Torriti, Smith and Coker's major involvement in workstreams within the £19.4m Centre for Research on Energy Demand Solutions (**CREDS**); Samuel leading the 'Place' theme of the UK Collaborative Centre for Housing Evidence (**CaCHE**); and Crosby, McAllister, Wyatt and Parker working with the Ministry of Housing, Communities and Local Government on developer contributions and neighbourhood planning. We have also been able to attract a number of postdoctoral researchers in these areas (Wargent, Ramirez-Mendiola, Lo, Piano, Yunusov). As they have developed, sustainability has emerged as an overarching theme to much of this research. Examples include research into sustainable sociotechnical practices (Schweber), smart and sustainable cities (Dixon, Pain) and the impact on value of energy efficiency measures (McAllister, Wyatt, Van de Wetering).

Much of the research in the UOA is user-oriented, and inherently impactful. To instil a culture of impact, we have focussed on:

- strengthening our substantial existing engagement with policy and industry bodies including governments (in China, and with MHCLG and BEIS in the UK) and industry (RIBA, RICS, RTPI, IVSC), working with them to shape international and national priorities (see Section 4)
- engaging and extending our user communities in the research process, including the co-production of research. Examples include projects with industry partners on land values and the Community Infrastructure Levy, collaborations within Reading 2050 and with devolved Combined Authorities within an MRC-funded project (Prevention Research Partnership for Tackling the Root Causes Upstream of Unhealthy Urban Development, **TRUUD**).

Engagement has been supported by significant University investment in an impact team with an impact manager for each Research Theme, and in the wider support system for impact, including the Knowledge Transfer Centre and Research Communications team. The success of this has been reflected in the multiple awards from professional bodies for research generated by the UOA, including four RTPI Research Awards and Commendations and two Nick Tyrrell industry prize papers (see Section 4).

The establishment of the School of Architecture has been the most significant academic investment by the University during this REF period, with 12 new academic posts, including two professorial appointments. The School has integrated quickly into the University with the support of the existing SBE staff, including through joint supervisions of PhD projects. Immediate successes include the provision of five funded PhD studentships per year for three years through an agreement with the University of Santo Tomas, the highest ranked Architecture School in the Philippines. Evidence of both the integration and ambition of Architecture is the Urban Living group's contribution to a multi-million pound bid to create an AHRC Creative Economy Hub, bringing together academics from across the University and over 40 industry partners.

Both Divisions have focussed on developing partnerships and projects in Latin America, with Murray (REP) operating as the major liaison point for research in the region, leading a new cross-University network, Reading Latin America and Caribbean network. Collaborative projects that have developed out of the network include the UKRI-funded Study of Obesity, Nutrition, Genes and Social Factors in Peru (SONGS), a £900,000 project led by the University's Institute for Food, Nutrition & Health, and involving co-investigators from REP (Nunes, Murray) examining

the role of environmental effects. Other research on Latin America includes Plaza's work on the intersections between politics, culture, architecture and urban space in Venezuela.

Our Doctoral programme has gone from strength to strength, with a significant increase in enrolments and completions since 2014 (see Section 2) and we played a major role in the establishment of the Human Geography pathway of the ESRC SeNSS DTP (led by Pain; SBE liaison Schweber). The strength of our training and careers support for doctoral students is reflected in the career trajectories of our PhD graduates, with nine having been appointed by the University as either permanent or fixed-term staff; and another 39 taking up academic appointments at UK or international universities.

Supporting these strategic objectives are a number of processes and activities to both enrich the research environment in the UOA and its constituent units, and to support individual researchers. This has included in particular the provision of formative feedback on research outputs to enhance their quality through each Division's internal peer review group. Additional advice is given to ECRs on the production of outputs and bids, supplementing an updated mentoring system to support ECRs.

Other mechanisms include:

- A weekly research seminar series organised by each Division with both external and internal speakers, supplemented by seminars in other Divisions (e.g. HBS, Meteorology, Maths). During the COVID-19 pandemic, these were held online, enabling us to invite more international speakers and increasing staff and doctoral student attendance.
- Major one-off collaborative industry/policy events (e.g., symposia on Housing Land and Future of Planning, 2019); Viability in Planning (with Economics; 2017); Argentinian Housing Markets, 2017); and the Future of Planning (part of the UK/Ireland Planning Research Conference, 2020, held online).
- Hosting international academic conferences (e.g. American Real Estate and Urban Economics Association International Conference, 2014; European Real Estate Society Conference, 2018).
- Activities within and across research groups to support the development of researchers, and connections between them – e.g., REFI group ECR emerging papers series; EEE group fortnightly discussion on research opportunities and emerging issues on specific research projects; and SBE RG technical seminars supporting postgraduate research students (PGRs) and ECR research skills.

Research Integrity

Both Divisions accord fully with the Concordat on Research Integrity and believe in the use of ethical, legal and professional frameworks, good governance and the support of ECRs. Both have strong research integrity processes, including training and support (with research ethics training embedded into our research mentoring processes), and School Ethics Committees review of staff and student research applications, with escalation of complex applications to the University Research Ethics Committee.

Research integrity is further supported through internal peer review of proposals. Both SBE and REP have protocols such as the inclusion of acknowledgements of all contributions on papers, listing doctoral students before supervisor on joint papers, and through formal University procedures including compliance audits of individual Schools.

Both Divisions are committed to open research and engage with the University's Open Research Plan promoting research which is open, transparent and reproducible; though there are issues of commercial confidentiality with the use of confidential and/or private subscription data within some industry-funded applied research. Openness may be unavoidably limited in some areas. There is a commitment to a minimum of green open access for publications. There is full engagement with the University repository (CentAUR) with monthly reminders and support to upload items. Open data access for examination and replication of results is encouraged, examples being the data produced by the ADEPT project and the DEGW Archive (Section 3).

1.5 Research Strategy for next five years

An important part of our strategy is to address research questions that flow from the dominant developments in recent years – such as the climate emergency, COVID-19, the financial crisis and construction risk, e.g. Grenfell. These are actual or potential catalysts for significant changes to our built environment with resulting risks to sustainable environments. In a user-focussed, applied discipline such as ours, this presents dynamic challenges, new priorities and research opportunities. We aim to bring together our wide-ranging and diverse perspectives on the built environment to help identify and research the likely consequences of these challenges. We have established experience in contributing to changes in policy and practice within commercial real estate financial stability, housing policy and practice, energy supply and demand management, and sustainable buildings, all evidenced within our impact case studies (Leads: Crosby, Torriti, Wyatt, Yao). These are in response to the Global Financial Crisis, the housing affordability crisis, and the climate emergency. In response to Grenfell, Hughes has given advice to MHCLG on procurement issues. In response to COVID-19, Street has bid to the Regional Science Association for work on post-COVID town centre recovery/regeneration, Dixon has given evidence to Oxford University's COVID-19 Evidence Service Team, and Pain has researched the spatial spread of Covid-19 in the Wuhan region.

To augment our flexible response to events, both Divisions have specific objectives for the next REF period. **SBE** aims to maintain and develop activity 'across the scales' as an interdisciplinary centre of excellence that addresses:

- societal aspirations relating to the built environment.
- the intersection of physical, biological and social environments that affect people's lives, including quality of life, sustainability of communities, and wealth generation.
- the resilience of the built environment sectors to threats such as long-lasting structural change (climate/energy) or periodic events such as COVID-19 and the Global Financial Crisis.

Specific objectives over the next five years include expanding and broadening interdisciplinary construction-related research, fully integrating architecture and design studies into Reading's overall research agenda, growing research activity on urban sustainability, and building on existing strengths in energy systems, energy supply and energy demand as they relate to the built environment.

The **REP** stated vision is to 'undertake world-class research that makes a positive impact on business, policy and society'. An over-riding objective is to develop the existing interdisciplinary research programme which examines the sustainability of the built environment through resilient and equitable development, investment, management and financing of both commercial real estate and housing. This will include developing research agendas around global and UK cities, the planning, design and governance of places, including the revitalisation of town centres, the financialisation of planning, including the capture of development land value and the provision of affordable housing.

The priorities outlined do not just reflect the expertise of senior staff in the UOA, but also areas of strengths where we have recruited significant numbers of talented ECRs. Over a quarter of eligible staff in the submission are ECRs and supporting their development as research leaders will be one of the critical priorities of our research strategy, to maintain the sustainability and vitality of our research. To that end, we will continue to support ECRs in their development and to bring them into positions of research leadership where they will effectively shape future critical research agendas.

2. People

2.1 Staff

The aim of our staffing strategy is to enable us to deliver both research and research-informed teaching across a broad range of activity while providing a depth of expertise commensurate

with our interdisciplinary research-intensive Schools. Both Divisions follow University-wide inclusive, equitable and transparent policies in relation to staffing (IES, Section 3). In addition, each School has dedicated HR professionals to provide guidance and advice for staff recruitment, management, and support. Teaching and research (TR) and research-intensive (RI) contracts dominate but teaching-intensive (TI) contracts are used to underpin research time release and cover specific professional syllabi teaching requirements. TI staff are part of our wider research environment and add to funded research, scholarly activity, research culture, outputs and industry engagement (e.g. Sayce, Lees, Nicholls, D'Arcy).

The Unit comprises 58.9 eligible FTEs of which 64% are in SBE and 36% in REP. Overall 25% are ECRs.

SBE comprises 34 full-time and seven part-time eligible staff, in addition to eight TI staff. To support the introduction of Architecture and expansion of research in areas such as energy and environment and digital technology, two Architecture professors and 16 TR lecturers have joined SBE since REF2014, with six TR staff departures (including retirements). Of all eligible staff in SBE, nine are ECRs.

REP comprises 20 full-time and two part-time eligible staff, together with 10 TI staff. Staffing levels in the current REF period have been relatively stable, with 13 TR staff in post throughout. Eight new TR/RI staff have arrived including a new BA Fellow, while six TR staff departed (including retirements). Of all eligible staff in REP, six are ECRs.

Departures and retirements had limited impact across both Divisions due to the strong succession structure in place and the improving balance of staff across different levels of experience. Impending/current retirements from leadership roles are well covered by experienced professorial staff who in turn are supported by earlier career staff already experienced in research leadership roles.

Induction through to promotion

All new research staff participate in a structured induction programme, including orientation in policies and procedures (health and safety, finance, etc.). They are allocated senior research mentors, meeting them regularly to provide feedback on progression, draft outputs and funding proposals, as well as career planning. ECRs have a three-year probation period, and expectations and specific probation targets are discussed and agreed with the Head of School to ensure they can establish themselves as independent researchers. ECRs are afforded a reduced teaching/administration load during probation to help build research momentum and pump-priming resources for specific ECR activities are also available from the Research Deans.

Promotion requires achievement of a minimum of ten criteria across academic citizenship, leadership, research, and teaching and learning excellence. TR staff are expected to complete the University's Academic Practice Programme, leading to associate/fellowship of the Higher Education Academy which is a requirement for promotion. Trained promotion mentors from the senior staff guide applicants through the upgrade process and trained assessors apply detailed scoring criteria. Since 2014, there have been 11 internal promotions from TR lecturer to Associate Professor, including six ECRs (42% of ECRs), and six promotions from Associate Professor to Professor.

Staff development

All staff develop a five-year rolling Personal Research Plan (PRP). PRPs are discussed with RDLs on an annual basis, feeding into the annual formal Personal Development Review (PDR) process with the Head of School or designate. All reviewers receive mandatory training. PRPs and PDRs enable staff and the Head of School to identify development needs and plan support accordingly. The University provides a wide range of training opportunities for researchers at different career stages and delivers internal School transferable skills seminars.

Funding is available to support any staff development needs identified within PDRs, and to develop grant applications (Section 3). In addition, both Divisions have a staff sabbatical system and can use School-funded sessional lecturers to facilitate teaching release. Examples of prominent full- and part-time staff absence periods at other universities or working with industry and policy partners are, Parker (Royal Town Planning Institute), Crosby (Bank of England) and Marcato (LSE).

Within SBE, a £1,000 allowance for probationary lecturers for their first three years is placed into a Staff Development Account (SDA) which can be used to support their research. SBE also allocates a 3% portion of the grants Full Economic Cost overhead to research groups in order to fund activity, and 5% to the PI/Co-I paid into their SDAs. In REP, all staff receive a £400 p.a. staff development allocation and full funding of academic conferences (budget £2,500 p.a. per FTE), together with journal submission/professional association fees paid by the School. PI/Co-Is are awarded 20% of any staff costs allocated to their time within funded research budgets, paid into their SDAs.

2.2 Research Students

The community of postgraduate students contributes significantly to, and benefits from, a vibrant research culture and represents the future research base. The University's Graduate School, SBE and REP have developed their PGR programmes, nurturing the next generation of academics (especially within some professional built environment disciplines with shorter academic traditions). Improvements include:

- a more proactive recruitment strategy
- increased internal funding/studentships
- joint supervision to improve the experience of both PGR students and new supervisors
- enhanced future career support processes.

The result is significant increases in both recruitment and completions and in the number of graduates obtaining academic posts. Overall, the number of completions was 135 (FTE 126.3) compared to 40 in REF2014, including joint interdisciplinary student supervisions in Biomedical Science/Engineering, Food Sciences & Nutrition, Weather, Global Development, Sustainable Agriculture, Informatics, Mathematics, Law.

Table 1. PhD and Professional Doctorates breakdown (Headcount)

	2013/14	2014/15	2015/16	2016/17	2017/8	2018/19	2019/20	Total
SBE PhD	12	12	7	11	10	3	5	**60**
EngD	1	4	5	7	4	7	2	**30**
REP PhD	7	3	10	3	6	10	6	**45**
Total	**20**	**19**	**22**	**21**	**20**	**20**	**13**	**135**

The other major change is the balance of UK and overseas students and the increased diversity of those students. In 2013/14 the PGR cohort was 54% non-UK national, 35% female and 55% BAME. In 2019/20 it was 74% non-UK national, 34% female and 67% BAME.

Application, recruitment and completion trends

SBE: Between 2009 and 2018, the EngD completions were the product of the EPSRC-funded £6m Technologies for Sustainable Built Environments Centre (TSBE). Since 2017, as the TSBE Programme ran its course, a number of initiatives have been developed to ensure maintenance of a healthy level of PGR recruitment. These include:

- development of SBE's part-time and distance PhD training routes, encouraging more professional (industry based) and international applications.
- the posting of subject-specific PhDs on Find-A-PhD.
- sourcing a wider variety of funding, e.g. CaCHE and the Marie Curie Innovation Network.

In addition to the University of Santo Tomas studentships, Architecture also won the University Anniversary PhD studentship award. These initiatives have increased enrolments since 2016 and currently there are 39 full-time and 10 part-time doctoral students.

REP: There are 14 full-time and two part-time students currently enrolled. The major objective over the last two REF periods was to increase the number and quality of PGR students. This has been achieved in the present period, with 45 completions compared to seven in REF2014. The completion rate within four years for 2009/10 to 2014/15 entrants was 79% with only two withdrawals. This all-round improvement has been achieved through a more structured approach to recruitment, supervision and training within the Graduate School, HBS and REP and the internal funding of PGR studentships.

Recruitment and supervision
Application procedures are similar in both Divisions and include feedback on, and joint development of, proposals from/with staff, as well as on-line interviews.

SBE's PGR students are funded externally mainly from Research Councils, the University of Santo Tomas scholarships and overseas government agencies. Around one-third of students are self-funded. REP offers five PhD studentships per year, matching ESRC award levels plus one Reading Real Estate Foundation (RREF) bursary of £15,000 per annum for three years. RREF is a registered charity that aims to strengthen the links between REP and industry. REP has used internal income, industry support (e.g. funding or in-kind data resources from BNP Paribas and others) and the annual RREF grant to support the significant increase in both recruitment, retention and completions.

SBE also offers internal scholarships, and both SBE and REP offer Reading Alumni discounts. REP has also established the RREF-funded Research Excellence Fund in memory of Peter Byrne (former Head of REP who died in 2015), which can be used to support PhD students purchasing data or undertaking fieldwork.

Students are allocated two or occasionally three supervisors. This policy has the benefit of ensuring continuity of supervision in the event of retirements/departures and providing a support mechanism for less experienced supervisors. It also facilitates the provision of valuable interdisciplinary support where appropriate. SBE also holds a periodic training forum for ECR PhD supervisors in addition to central training provision.

There are two main types of assessment:

- Annual reviews, which include two independent academic assessors. In SBE assessors may also recommend a six-monthly review.
- Confirmation of registration occurs between 12 and 18 months which includes a presentation and 'mini' viva. Success in this process is a condition for continuation.

Research training
Induction programmes are delivered by both the Graduate School and the Schools. Compulsory training needs are delivered through the Graduate School's Reading Researcher Development Programme, which offers 100 sessions based around four domains:

- knowledge and intellectual abilities
- personal effectiveness
- research governance and organisation
- engagement, influence and impact.

International students also have English academic language support. Additional resources include the Statistical Advisory Service and career guidance/development courses. Three-day leadership skills development training is delivered across the University by HBS.

School-level inductions include:

- introduction to specific school procedures and resources

- a compulsory Learning Needs Assessment within four weeks of starting, updated at each annual review and upon confirmation of registration.

SBE delivers three workshops to support basic skills needed for a PhD including reading and critiquing, research methods and academic writing, and also organises an annual PhD conference where pre-confirmation students prepare a poster and post-confirmation students give presentations. It produces conference proceedings and awards prizes.

PGR students in SBE can participate in graduate skills development modules run by the Faculty of Science and Life Sciences, are integrated into SBE research groups, and take part in the weekly SBE research seminar series.

REP has integrated its PGR students into the HBS MRes-based doctoral programme and has been awarded ESRC doctoral training compliance, both for the SeNSS pathways Business and Management (led by Marcato) and Human Geography (led by Pain), endorsing REP's significant interdisciplinary depth and breadth. The formal HBS PGR training programme directed until 2020 by Marcato, includes a suite of eleven doctoral modules, which cover technical research methods support, and an annual one-day research student conference.

Attendance by REP PGRs is required at the weekly term-time research seminars and at the monthly HBS research seminar series, which have been run on-line during the pandemic.

Student feedback is based on a termly PGR research community meeting for students in SBE and elected student representatives in REP.

Student support. SBE allocates up to £800 pa per student (expenses in excess of that figure can be obtained from the University Travel Grant Fund). Industry funded SBE students have a conference fund allocated by their sponsor. REP budgets £21,000 pa for PGRS to attend and present at major international conferences (actual spend was over £40,000 in the last three years).

Career destinations

Active support both internally and from the Graduate School is available for academic and industry post-graduation careers. The career destinations are known for 73 SBE/REP PhDs completing between 2014 and 2019, including:

- Over 70% of the PhD graduates have taken up academic careers.
- 24 of 46 PhD students in SBE went on to academic posts and three to jobs in research institutions. Two of the 18 TSBE EngD programme graduates are in academic posts with one other in research. Overall, 22 are employed in industry and four in government or similar.
- 20 out of 29 PhD students from REP are working in academic posts with two in research institutes, two in government and five in industry.

In summary, the realignment and expansion of the PhD programme since 2014 has been a success for the UOA as evidenced by the number of enrolments, completions and first career destinations. Improvements to all aspects of the PGR training process started in the previous REF period has resulted in a threefold increase in completions, averaging 18 per annum with around six from REP and 12 from SBE. Recruitment has also increased significantly with six new students per annum in REP and, since 2017, an average of 20 in SBE.

2.3 Diversity and Inclusion

The University of Reading holds an Athena Swan Silver Award in recognition of its work towards advancing gender equality. SBE and REP promote Athena values, with a strong commitment to gender equality among all staff and students. Our strategy throughout the REF period has been to implement the Athena SWAN principles and promote representation, progression and success for all.

We have put several formal and informal mechanisms in place to improve our diversity and inclusion (D&I). Firstly, we work in line with University-wide initiatives put forward by the institutional Diversity and Inclusion Strategy Group, under the leadership of the Dean of Diversity & Inclusion, to implement and evaluate relevant actions. In doing so, we ensure the implementation of all actions relevant to the Equality Act (2010), for example with regards to care responsibilities, parental leave and cover. Secondly, we ensure diversity in our recruitment panels and require panel members to undertake unconscious bias training.

Thirdly, we have ensured that there is local leadership to drive the D&I agenda and that this is formalised in the governance structure. SBE has appointed co-directors of D&I who are members of the School Senior Management and Research Committees. The SBE document 'Values for working together' details D&I working practices within the School. SBE has been awarded Athena Swan Silver on three consecutive occasions (2009, 2013, 2017). REP D&I strategies are set within HBS arrangements. HBS established a D&I committee in 2017 to oversee all relevant issues within the School, and was awarded Athena Swan Bronze in 2020.

The HBS D&I Committee and the D&I Directors in SBE regularly request feedback from staff via focus groups in addition to annual surveys of staff and students. This feedback provides evidence of whether policies and practices are working and informs actions and the further development of long-term strategies. Over the period we have:

- formalised ECR support, offering specific and targeted support towards their career progression in line with the requirements of the UK Concordant to Support the Career Development of Researchers and the University's Code of Good Practice in Research.
- supported the transition back to the workplace for returning staff following extended periods of absence due to personal circumstances, such as maternity, adoption or shared parental leave, or ill health. All staff can request flexible working arrangements and two staff returning from maternity leave benefitted from a flexible contract, while five others moved to flexible part-time working during the period.
- monitored staff wellbeing through annual University and School surveys (as well as PDRs).

Direct action on appointments and promotions has resulted in increased diversity across UOA13, as reflected in our submitted staff profile. Across the UOA, the share of female staff has increased from 31% (2014) to 41% (2020). This share has been above 30% since 2012. The number of female full professors is 30% (2020). These are both considerably higher than the approximately 13% of female construction professionals in industry. Over 40% (seven out of 17) of the research-related management positions across both Divisions are held by women: Head of Department, RDL, research group lead, Director of D&I (2), Director of PGR Studies (2), in line with the proportion of all female staff.

With regard to BAME staff, the proportion has remained almost unchanged for British staff at 8% (7% in 2014) but has significantly grown for non-British staff (57%, up from 47% in 2014). The proportion of fixed-term contracts has halved from 10% to 5% over the period. Our non-British academic staff account for over 45% and non-British full professors account for 30% of our professorial staff.

D&I considerations in the construction of the submission

RDLs and UOA leads attended two D&I training sessions to discuss unconscious bias in REF-related processes and to ensure that due consideration is given to D&I issues.

For outputs, quality-assessment processes included internal allocation of papers based on appropriate subject expertise and ran in accordance with the guidelines of the University's peer review framework (ROSS). A calibration exercise was undertaken in 2018 across the two Divisions to ensure similar processes and outcomes, including an external review exercise, using a sample of papers from both SBE and REP. No significant internal scoring differences were revealed. The University undertook an Interim Equality Impact Assessment in 2020 and a

bias analysis of the final outputs selection, revealing no statistically significant differences between protected characteristics for the available and selected output pool.

The UOA Lead developed the submission portfolio based on quality assessments only, with final recommendations supported by objective criteria including discrete use of metrics in line with the University policy for responsible use of metrics, reporting regularly to the UOA steering group and the University REF Planning Group.

For impact case studies, a continuing process of potential impact case study discovery was undertaken, with seven shortlisted for development by the internal UOA steering group in 2018. The final choice of five was made by the University's REF Planning Group, informed by reviews undertaken by the Division impact leads and by staff external to the Unit.

3. Income, infrastructure and facilities

3.1 Research Income

A revised strategy has been introduced since REF2014 in response to changes in the funding landscape, including a reduction in evidenced-based Government policy research. During the period we sought to:

- diversify our sources of external income
- enhance the support provided to staff to develop grant applications.

As a result, SBE and REP have maintained a strong and diverse research funding portfolio from 51 different sources with an overall research spend of well over £10m in the period 2013/14 to 2019/20.

Awards from five **Research Councils** account for 70% of the total income and remain a very important source, particularly for SBE. EPSRC funding totalled £3.1m including an award of >£1.21m in 2017/18 to fund the Reading element of the UK Centre for Research into Energy Demand Solutions (CREDS), a REF2014 strategic priority area (Torriti, DEePRED, REDPeAk, see impact case study) and £530,987 for the InfruTreeCity project (Li Shao). Other funding included ESRC (Sexton, Samuel, Clapham, Nunes, £460,000), AHRC (Samuel/Ewart, £255,000), NERC (Luo, Lu, £290,000) and MRC (Pain, £293,000 for the TRUUD project; Nunes, Murray, £26,000). These awards range across housing, the food/energy/water nexus, issues affecting the environment (such as environmental crime and the infrared radiative performance of trees), virtual reality environments creating virtual museums, multi-scale mapping, anti-microbial resistance, and architectural practice. Sustainability figures prominently in these awards.

Other prestigious awards include the Leverhulme Trust (Chettiparambil, £16,000) and the British Academy Fellowship (Wargent, £260,000) for work on migrant networks and local planning.

Examples of funding awards with **new sources** illustrate the widening breadth of the research activity across the UOA. They include awards from the UK Department for Transport-funded Association of Directors of Environment, Economy, Planning and Transport's (ADEPT) SMART Places Live Labs competition (£315,000), part of Reading Borough Council's successful £4.75m bid to use digital innovation technology linking traffic-detection, mobile-phone and air-quality data to produce a public health exposure model; Foreign and Commonwealth Office funding (Nanda, £65,000) for projects on sustainable transport and property market transparency in Panama and Iskandar; Scottish Land Commission (Shepherd, £26,000) for research on Scottish land taxation systems; UN Food and Agriculture Organization (Wyatt, £64,000) for research on land tenure and valuation systems; and Big Lottery Fund (Nunes, £7,500) for research into community gardening.

Success in securing funding from **European sources** include European Institute of Innovation and Technology; Climate-KIC, Europe's largest public-private innovation partnership (Smith, Dixon, Hanna, £46,000) for work on innovation to mitigate and adapt to climate change;

Architects' Council of Europe (Farrelly, £16,000) for work on sustainable districts and smart buildings; and Danish Working Environment Authority (Tutt, £12,000) for work on how cooperation between Danish and foreign workers affects the working environment and safety on construction sites.

International and national government funding represented around 25% of our total awards. Direct funding from UK Government Departments includes MHCLG (Wyatt and Parker, £80,000) for work on the Community Infrastructure Levy and Neighbourhood Planning, and the FCO and ADEPT-funded work mentioned above. The Technology Strategy Board has been a consistent source of funding for innovation and sustainability research across both Divisions (Sexton, Coker, Harty, Potter, Nanda, £187,000). Projects include smart charging systems and BIM. In addition to Big Lottery and SLC funding identified above, other Government sources included Local Authority (Crosby, Sayce; Islington Borough Council; and Street, Black; Reading Borough Council), related to land values and urban design and cycling, and the London Mayor's Office for Policing and Crime (Shao, £28,000) to investigate live occupant location tracking to improve police service estate security.

UK industry and professional charities are important sources of funding to underpin our impact strategy. REP secured over £200,000 of funding from the Investment Property Forum and the Royal Institution of Chartered Surveyors Research Trust across seven REVLMP/REFI projects such as liquidity, depreciation, valuation, development viability and leasing/rent, involving eight REP staff. Funding from professional institutions including the Chartered Institute of Building and the RICS Research Trust have contributed to over £400,000 of industry funding in SBE, which has also successfully leveraged funding from companies such as Berkeley Homes, Countryside, Social Life, Skanska and Balfour Beatty (Dixon, Harty, Connaughton, £130,000), from the Building Research Establishment (Sexton, £25,000) on the benefit of sustainable homes, from CrossRail (Nikolic, £80,000) for work on Design Reviews, and from Fleetdrive and CMS industries (Coker, Potter, £90,000) for various projects related to electricity charging capacity.

Reading has been involved in several larger **networks and collaborative projects**. One example of an interdisciplinary, collaborative project was CycleBoom, an EPSRC funded RTPI award winning project completed in 2016 run out of Oxford Brookes University in collaboration with the Universities of Reading, Cardiff and West of England. The Reading team included Street (REP) with Van Reekum and Leyland from Psychology. Other funded research collaborations include CREDS, TRUUD and CaCHE, described in Section 4.

As a newcomer to our UOA13, funding successes in Architecture reflect the development and integration of the Unit, and significantly shape its development. Samuel received an AHRC Leader Fellowship in 2015 for work on the value of architects, and a KTP with Stantec (£86,000) which is feeding into Farrelly's vision for developing an Urban Room at Reading as a nexus for community, University and industry research. The Newton Interdisciplinary Links project between Reading and the Philippines University of Santo Tomas (Samuel, British Council £120,000) facilitated the development of the RIBA Social Value Toolkit for Architecture. Peters, in collaboration with Trinity College Dublin, is using Irish Research Council funding to investigate co-design and co-creation in community-level sustainability initiatives. Plaza has won a British Council Arts Digital Collaboration Grant (£18,000) investigating the exploration of architectural heritage in Caracas via mobile phone and Vasilikou is undertaking a project in Athens focusing on the generation of local and city-scale public space opportunities for low-cost and high-impact interventions. Wiezcorek (ECR) has exhibited her work on the evaluation of atmosphere at the 2018 Venice Biennale.

The strategy for both Divisions over the next five years is to continue to build from this strong base of funded activity, extend the proportion of staff bidding, by supporting ECRs, and secure funding from even more diverse sources.

Research bid support

An enhanced University Bid Management System was implemented in 2015. It includes more rigorous peer review of bids at Research Division and Research Theme levels. Theme-level review is organised through a Research Theme Grant Development College, supported by central Research and Enterprise Services (RES). The process is designed to improve the quality of bids and success rates, ensure high-quality threshold standards and build proposal development capability. Division-level review is organised by group leads in SBE and by the REP RDLs, supported by their full-time Research Administrator. The new system has led to earlier communication of plans, better one-to-one support of proposal design within resaerch groups and by professional services, and perceived higher-quality bids.

ECRs are supported by Research and Enterprise Services which provides training for grant-writing, particularly to help with their first or major external funding bids as PI or Co-PI. Successful bids from ECRs include Dowsett, securing Network N+ industry funding, Shepherd leading the SLC funded research, and the Plaza and Vasilikou projects described previously.

3.2 Infrastructure and facilities

SBE operates out of a range of high-quality accommodation across two campuses. At Whiteknights campus, Construction Management and Engineering is housed in purpose-built accommodation and energy research operates out of a second building. The School of Architecture is located in the former library of the University's 'red brick' London Road campus. The building was refurbished to accommodate the School and its specific needs. The University plans to accommodate all of SBE in one building within 3 to 5 years. Across SBE, most staff have individual offices and there is dedicated, individual space for each PhD student.

SBE has dedicated Resource Room, Visualisation Lab and BIM lounge space at Whiteknights. Managed by a dedicated part-time Resource Manager, these staff and PGR facilities include high-end computers, immersive visualisation technologies (such as Occulus Rifts) and 3D-printing facilities. Complementing the investment in technology, in addition to the University Library and other resources, SBE subscribes to 43 specialist data analysis, architectural design and publishing software applications (such as Sketch Up, Enscape 3D Sketch Up plug in, Fuzor Matterport, InDesign, Creative Cloud and Stata) and databases (BCIS, HIS Markit and CIS) at an annual cost of £15,000. In 2019, at cost of £12,500, SBE purchased two new drones, the software to support these, and the requisite staff training.

At the London Road campus, staff and PhD students have access to specialist design software, dedicated computer facilities and workshop facilities. The workshops, staffed by two technicians, provide fabrication, 3D-printing and CNC facilities and services. There is ample studio space to support design projects. SBE has recently been gifted the DEGW Archive which documents the DEGW design practice work between 1971 and 1997. This archive comprises around 800 documents (project reports, presentations and drawings, research and business reports) enabling time-series study of design methods.

REP is housed in the purpose-built Henley Business School building. Full-time TR staff are accommodated in 20 individual staff rooms. Part-time and RI staff are housed in an adjacent building with space for visiting scholars. PGR students have individual workstations, many in a purpose-built screened 'deck'.

The HBS building, as well as significant formal and informal meeting space and a dedicated café, has two computer labs and the HBS library, which has a full suite of investment and finance research data resources. The HBS library spends more than £300,000 per year on specialist data/electronic library resources including Business Source Complete, Lexis Nexis, Proquest, Bloomberg, Reuters, Datastream, Thomson One Banker and (through the Wharton Research Data Services portal) CRSP, Compustat and Optionmetrics. A vast array of software packages is available for data analysis through the University's 'Apps Anywhere' initiative, including various econometric software, NVivo, Matlab and Qualtrics.

REP has access to specialist subscription real estate and planning based data such as the Investment Property Databank archive and the current MSCI databases of real estate performance data. Other subscription databases are BCIS (construction costs), Isurv, Egi and Co Star (property specific and deals databases), REVO (shopping centres), Planning Resource, EPRA (public real estate companies), and the UK Property Lending Survey. Research outputs, particularly in real estate finance, investment, development and appraisal, rely heavily on these databases (see Section 4). Additionally, MSCI, JLL, CBRE and other private firm datasets have been purchased separately (£17,500) within grant funding.

Across both Divisions, all offices and workstations are equipped with the latest IT hardware and software and all academic staff have access to databases and electronic academic resources provided by the recently modernised and upgraded University Library (£40m).

The University has invested heavily in professional research support including the introduction of dedicated Research Development Managers and Officers for each Research Theme. The impact strategy set out in Section 1 is supported through the Research Impact team providing dedicated support at Research Theme level. The team works with the Division Impact Leads (Dixon in SBE and Crosby in REP) and supports both the development of REF impact case studies and the generation of impact from other research projects through stakeholder mapping and the procurement of impact evidence. Through communities of practice and training, the University contributes to the development of our impact-focussed research culture. The University's Impact Support Programme (BOISP) provides financial support for impact activity. UOA13 received £53,000 from BOISP to develop 10 projects, including £16,000 for four of the five submitted case studies, and a further £37,000 for six other projects operating within the wider definition of impact. Both Divisions have access to other professional services supporting impact, including Research Communications, Business Development (through the University's Knowledge Transfer Centre) and professional research publications advice in the Library. REP can also access HBS marketing and business support and has a full-time Research Administrator.

As well as its development of the support staff structure, physical infrastructure and financial support for open access publishing, the University provides financial support for research via two funds. In the REF period, the **Research Endowment Trust Fund** has awarded £61,503 to SBE and £29,269 to REP to support 17 individual research projects aiming to 'build research excellence, foster interdisciplinary working, or support the development of large research funding bids'. It includes an annual grant of £1,000 to each Division to support local initiatives. The **Research Travel Grant Fund** assists with the cost of presenting research results and outcomes at seminars, events and conferences and is available to all academic and research staff and to doctoral students. It complements funds made available by Schools. In the period 2014-2020, 25 awards (totalling £10,730) were made to staff in SBE. For REP, HBS covers the cost of all conference attendance from School funds.

Additional University support comes from Reading's UKRI **Global Challenges Research Fund** allocation. SBE have had two awards (Samuel £120,000 in association with British Council/Newton Fund on Eco-Social Surveying mapping social assets, urban greenery and the connections between them, and Luo £32,500 on Air Pollution Inequality in Rural China and Sri Lanka).

RREF provides pump-priming fund of £10,000 for staff per annum as well as the annual PhD studentship. REP received the David Robins donation in 2018, consisting of £50,000 to support planning research at Reading.

4. Collaboration and contribution to the research base, economy and society

We have a multitude of relationships with other academic and research institutions, and with policy bodies, professional organisations and industry groups as research partners and users.

These collaborations inform our strategic aims and objectives, help drive our research agendas and underpin our academic, policy and practice contributions to the discipline.

4.1 Contribution to the academic discipline

Impact strategy is an essential element to achieving our major objective set out in Section 1 - to contribute to the research base of our respective disciplines and develop applied research that addresses policy, practice and societal issues, and provides theoretically sound, evidence-based, and usable solutions. Impact is based on a combination of research output quality and engagement across the research process, from setting agendas to dissemination and aiding adoption by users.

Reading's impact on the research agenda is well illustrated by our involvement with CREDS, TRUUDS and CaCHE.

CREDS is an EPSRC/ESRC-funded research centre comprising 100 academics across 15 universities. Torriti is co-Director and heads the Flexibility stream, orchestrating a research agenda focused on the changing relationship between the timing and extent of **energy demand** on the one hand, and the provision and consumption of **energy services** on the other. Smith and Coker are project leaders within the Flexibility and Transport and Mobility Themes.

TRUUD is a £10m project over five years involving five universities based at Bristol. Pain leads the **Real Estate** sub-package, researching **health inequalities within urban planning and development systems** within two major city/city regions.

CaCHE is the ESRC/AHRC/Joseph Rowntree Foundation research centre bringing together 14 organisations including 11 universities based at Glasgow. It aims to provide evidence-based research into a wide range of housing issues. Reading (Clapham, Meen (Economics), Foye) were heavily involved in its inception and Samuel leads the **Place Theme**, developing research into place-making and design value and its importance for health sustainability, social cohesion and the economy.

Academic staff have held visiting positions within major universities all over the world including UCL, Xi'an and Chongqing (China), Hong Kong Polytechnic University, Copenhagen Business School, Chalmers University of Technology (Gothenburg), Sharjah UAE, Amsterdam and Delft (The Netherlands), NTNU (Norway), Tokyo and Tsukuba (Japan), Deakin and Melbourne (Australia).

Examples of high-level peer review activity include:

- Research Council peer review colleges: Chettiparambil, Cook, Connaughton, Dixon, Flanagan, Lu, Luo, Pain, Sexton, Shao, Schweber, Torriti, Yao and Green.
- International research assessment or research grant review: European Commission and NWO WOTRO Science for Global Development and Smart Urban Regions of the Future (Pain); Hong Kong (Green, McAllister, Samuel, Li Shao); Canada, Singapore (Mohareb); Netherlands (Shao, Yao); China, Turkey, Portugal, South Africa (Yao)
- Other peer review activity: Leverhulme (Shao), British Academy (Yao, Samuel), Royal Society (Yao, Smith), Royal Academy of Engineering (Farrelly).
- REF 2021 UOA13 sub-panel membership and Queen's Anniversary Awards for HE (Crosby).

Examples of leadership roles in **academic agenda-setting groups** include Globalization and World Cities Research Network, GaWC (Pain Associate Director and Global City Planning Lead); Association of European Planning Schools, AESOP (Chettiparambil Secretary-General); American Real Estate and Urban Economics Association, AREUEA (Marcato International Board); Association of Researchers in Construction Management, ARCOM (Hughes, Lu, Schweber) and the International and European Real Estate Societies, IRES/ERES (D'Arcy).

Early career staff contribute fully and are building reputations: for example, Street is past secretary of the Royal Geographical Society, Planning and Environment Research Group; Vasilikou is a member of the AHRC Sensory Cities Network; Lu is UK management committee member of the COST inter-governmental framework responsible for the allocation of significant EU-based research funding.

Five major journals are or have been edited or co-edited by Reading staff in the REF period, including *Planning Theory* (Chettiparambil Rajan), *Construction Management and Economics* (Hughes), *Journal of Real Estate Literature* (Mori), *Arena Journal of Architecture* (Samuel), and the *Journal of Building Engineering* (Yao). Vahdati is subject editor of *Renewable Energy*. Associate editor, editorial board and advisory board appointments across the two Divisions cover over 30 journals by more than 20 current and former staff.

There are numerous examples of recognition such as academic conference keynotes and awards for research excellence and impact. Both projects and people have been recognised by government and professional/industry institutions. Examples include:

- Yao – First Prize for Excellent Research by the Ministry of Science and Technology, PR China in 2017; First Prize for Advancing Science and Technology Award, Chongqing Government in 2015; and Second Prize in the 2019 National Education Awards, PR China
- Street et al. were awarded the 2017 RTPI Academic Research Excellence Award for *CycleBoom*
- Crosby and Sayce were commended runners-up in the same RTPI award for *Viability in the Planning System*
- Pain was commended runner-up in the 2014 RTPI award for the REP contribution to the *European Spatial Observation Network TIGER project*
- Crosby received the European Real Estate Society Annual Achievement award in 2014 and was awarded Life Fellowship of the Society of Property Researchers and Life Membership of the Investment Property Forum
- Both Parker and Crosby were elected Fellows of the Academy of Social Sciences.
- Parker, Wargent and Salter were awarded the 2019 RTPI Sir Peter Hall Award for Public Engagement for 'Neighbourhood planning in practice'
- School of Architecture, The Urban Room project - longlisted for the RIBA MacEwan award for projects that 'make the world better'
- Samuel's 2014 AHRC Home Improvements project - shortlisted for RIBA President's Medal for Research
- Samuel's (2020) RIBA President's Awards for Research in the Cities and Community category.

Best paper/book awards/citations

- Journal of Sustainable Real Estate Best Paper Award 2020 – Dixon for 'Measuring the Social Sustainability of New Housing Development: A Critical Review of Assessment Methods'
- Nick Tyrrell Research Prize 2018 – Ametefe, Devaney and Stevenson for 'Optimal Composition of Hybrid/Blended Real Estate Portfolios'
- Nick Tyrrell Research Prize 2016 – McAllister and Nanda for 'The Impact of International Investment on Real Estate Cap Rates' Aareal Awards of Excellence in Real Estate Research 2014 – Mori, best paper award
- Political Geography Research Group Royal Geographic Society Book Award 2020 – Plaza shortlisted for monograph *Culture as Renewable Oil: How territory, bureaucratic power and culture coalesce in the Venezuelan petrostate*
- Art and Christianity Enquiry/Mercer Book Award 2014 – Samuel's co-authored book *Sacred Concrete: The Churches of Le Corbusier* shortlisted
- BRE Trust/UBM Ecobuild Wellbeing in the Built Environment awards 2014 – Dixon won best domestic paper for 'Creating Strong Communities: Measuring social sustainability in new housing developments'

- ARCOM best paper awards – including Tutt (2018), Larsen and Green (2017), Larsen (2014), Boyd (2014)
- ERES best paper awards include K.Farrelly (PhD, 2014), Heinig (PhD, 2015).

4.2 Collaboration with international, national, local government bodies and agencies
A major element of our research and impact strategy is engagement with **international, regional, national and local Government agencies and policy setting bodies.**

International examples range from multiple contributions to research in China, to the International Energy Agency (Torriti, Yao) and the United Nations (Wyatt).

- In China, Essah is a Visiting Associate Professor of the National Centre for International Research of Low-Carbon and Green Buildings in the Ministry of Science & Technology and at the Joint International Research Laboratory of Green Buildings and Built Environments, Ministry of Education.
- Yao is Committee member of the China Green Building Council in Chongqing and International Expert Advisor in Urbanisation and City Development (appointed by the Ministry of Science and Technology).
- Between 2016 and 2020, Green was Honorary International Co-Director, Joint International Research Laboratory of Green Buildings and Built Environment, Chongqing University (funded by PR China Ministry of Education).
- Pain is expert advisor to the Chengdu Municipal Government and the Guangzhou Urban Research Strategy Unit and has developed a major research programme into global business connectivity facilitated by real estate financial services and related sustainable urban and regional development policy.

In the UK, staff have or have had formal research links with BEIS (Samuel), DEFRA, Ofgem and British Standards Institute (Torriti), Bank of England (Crosby), West of England and Greater Manchester Combined Authorities (Pain), and the Greater London Authority (GLA) (Samuel, Crosby).

Advice to Government or other related institutions is evidenced within impact case studies around the subjects of property appraisal, neighbourhood planning and energy management. Ad-hoc advice also includes Hughes to MHCLG on procurement issues in the aftermath of the Grenfell Tower fire, Wargent's evidence to the Commission on the Future of Localism, Ball's evidence to a UK Government Select Committee and to MHCLG ministers on the impact of aging on housing, Crosby's advice to the International Monetary Fund on Financial Stability and Marcato's advice to both the BOE and the Financial Conduct Authority on Mortgages. Samuel gave advice to the UK Chief Scientific Officer within BEIS on research and development and to MHCLG on Design for Better Places. Pain has been consulted by the BEIS Industrial Strategy Council Places Project. Nunes was an expert member of the working group on Building Lower Carbon Economies for the Government Office for Science's Rebuilding a Resilient Britain project, and chaired sub-group 4 – economic development.

Local Government engagement includes Bray, who is a Design Review Group panel member, Southampton City Council and Pain's role on the Thames Valley Berkshire Local Enterprise Partnership Local Industrial Strategy Commission. Kane is a member of the London Borough of Southwark Design Review Panel since 2007. Doak was a member of the Reading Borough Council Green City Forum until 2016. Samuel is a CABE Built Environment Expert.

Marcato chaired the 2019 conference 'Climate Change: The Science, The Economics, The Law' as part of the Mayor of London's Climate Action Week and moderated a conference at the Argentinian Embassy in London on renewable energy opportunities in Argentina.

4.3 Engagement with national and international industry-based agenda setting bodies
Our impact strategy expects engagement with industry, both nationally and internationally, in order to contribute to their research and practice agendas. This enables us to both identify and drive those agendas and undertake applied research with significant impact in these areas. Our impact case studies showcase three very distinctive and major research agendas which span our research capacity and have considerable impact on industry practice. These include energy demand (people and planet), property valuation (place and prosperity), and neighbourhood planning (people and place). They range across a variety of sustainability and resilience issues (sustainable real estate finance, planning and development and energy management), and illustrate the importance of this engagement.

Engagement leadership role highlights include contributions to **CIB** (International Council for Research and Innovation in Building and Construction), a worldwide network of over 5000 experts and 500 member organisations active in BE research. Larsen was chair of Working Group 65 (Organisation and Management), the oldest and largest of its international working groups shaping research agendas. Eight other staff across both Divisions are CIB members.

Connaughton is a past chair of **CIRIA**, Harty is vice chair **BSRIA**, Samuel is Vice President (Research) of **RIBA**, Green and Hughes have chaired panels for **CIOB** and **BSI.** TI staff D'Arcy and Sayce have chaired/chair the **European Public Real Estate Association Research Committee/RICS Research Trust**.

There is also significant engagement with the leading national and international professional institutions including board, committee and panel memberships contributing to research agendas. Examples include **Architect's Council for Europe** (Farrelly); **RICS, IVSC, TEGOVA**, (Crosby, Wyatt, Sayce); **RTPI** (Parker).

Local and regional engagement includes the Reading 2050 project (Dixon) described earlier; Bracknell town centre regeneration (Street, Nicholls), and the Thames Valley Local Economic Partnership (Pain).

4.4 Conclusion
Our major aim as set out in Section 1 is to support and enhance the development and management of sustainable built environments within an environmental, socio-economic and policy context. The objectives are to reduce the pace of climate change and provide built environment solutions for the *planet*, enhance the design, management and use of property and *places,* and improve the quality of life and economic *prosperity* of *people*. We believe that we have provided evidence within outputs, impact case studies and this statement that we have achieved our objectives across a wide range of sub-disciplines within the remit of UOA13.

There are a number of areas where we feel we have made a significant contribution to enhancing sustainable environments and we will continue to develop these and new areas in the next REF period. For example, we have contributed to the sustainability in planning agenda with our collaborative work into the boom in cycling (Street) and Dixon's work on technical standards in green infrastructure evaluation and master planning. Other work includes research into the social value/social sustainability of places and housing (Samuel, Dixon), regeneration of town centres (Street), connectivity and sustainability of global city regions (Pain) and the work evidenced in the impact case studies on neighbourhood planning and affordable housing provision.

Our work on energy forms part of the strong, University research priority on climate change and we have given substantial evidence in this statement of our interdisciplinary work across the University with Meteorology and the Walker institute and the external collaborations within CREDS.

Collaborative SBE-REP work for the BRE Trust on 'Recognising mutual benefits of sustainable homes to all stakeholders' (Sexton, Dixon, Wyatt) is part of an agenda that looks at the design of

sustainable and resilient places and buildings. Yao's impact case study on design standards in China and other work such as the impact on rents and values of energy efficient buildings (McAllister, Wyatt, Van de Wetering), the promotion of sustainable practices in the construction industry (Schweber), and research into 'Smart Cities and Big Data in the Built Environment' (Dixon), all contribute to improving the development and management of sustainable practices within the built environment and to changing behaviours.

Our contribution goes wider than sustainable built environments. A significant example with global reach is our contribution to the development of the commercial real estate research base and its influence on the industry. The quality of the contribution is represented by the significant number of research outputs submitted by REFI and REVLMP contributing staff, including leavers, with some major collaborations across the two research groups on depreciation, liquidity, and performance measurement. The impact of Reading on the development of the industry research base is considerable. The Investment Property Forum in 2020 identified nine Key Contributions for impact on industry practice from the 76 projects it had funded over the last 20 years. Four were either led or had significant contributions from Reading academics, including the work underpinning our commercial real estate and financial stability impact case study. The commercial real estate research programme has made a significant contribution to global development within the discipline, as have many other areas of our work across UOA13.