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Reflections on Bridging the Gaps at UCL
Sarah Bell, Principal Investigator

Air pollution, poverty alleviation, renewable energy, water resource management, traffic congestion, over population, public engagement, climate change, accessibility, materials recovery, energy efficiency...

... the list goes on. Problems in urban sustainability abound. Solutions are harder to find and even more difficult to implement. Many of these problems have grown out of the gaps between academic disciplines. Standing in our distinct disciplinary territories researchers have become skilled at breaking down problems to suit our particular tools of analysis, but our capacity to work together to find solutions has been spectacularly inadequate.

The need for interdisciplinary research and practice in urban sustainability has been recognised since the earliest years of the environmental movement. Research councils have made significant efforts to fund interdisciplinary projects and programmes in urban sustainability and other fields. Creating new knowledge that fundamentally addresses the nature of the problem rather than reflecting the names of university departments has proved more difficult than it seemed it should. Interdisciplinary work is much harder than simply bringing together scientists and scholars with complementary expertise. The barriers to interdisciplinary work are philosophical, methodological, managerial and social. The EPSRC Bridging the Gaps programme is an important opportunity for universities to start to address some of these barriers, and at UCL has provided opportunities for 63 researchers to engage in truly novel research partnerships that address the problems of urban sustainability.

The research community at UCL possesses tremendous enthusiasm and commitment for building new ways of working to solve some of the greatest challenges of our time. Sustainable Cities is one of our Grand Challenges and has underpinned our work in Bridging the Gaps: Sustainable Urban Spaces.

The diversity of projects funding by Bridging the Gaps has been astonishing. Personal energy monitoring, disabled children’s access to cities in India, hydrogen fuel cells, statistical modelling of urban air pollution, nanotechnology for water treatment, mapping green spaces in marginalised communities in London, and the use of slime moulds as building monitoring sensors are but a few examples of the work Bridging the Gaps has supported at UCL over the past three years. Our programme has demonstrated the catalytic potential of
providing relatively small amounts of money to highly motivated and capable researchers in a rich and supportive interdisciplinary environment.

Urban sustainability research can at times be a depressing enterprise. So many problems, so few solutions. All of the projects funded under Bridging the Gaps at UCL address an important problem of urban sustainability from a fundamentally interdisciplinary perspective. Managing the programme with James Paskins, Muki Haklay, Ben Croxford and Simon Julier has been a humbling and mind boggling experience. It has also been a lot of fun. The programme has helped many of our colleagues take those first timid steps along the long road to new and productive research territories, towards solutions to some of the greatest challenges of our time. I am hopeful that many of the partnerships started over the last three years will soon be leading research communities with knowledge about both the nature of solutions to urban sustainability and how to go about finding them.
Introduction
Bridging the Gaps: Sustainable Urban Spaces was a three-year EPSRC (Engineering and Physical Sciences Council) funded programme. It had the main aim of encouraging interdisciplinary research collaborations into urban sustainability at UCL.

More details about all of the activities described will be available on the Bridging the Gaps website, www.ucl.ac.uk/btg.

The aims of Bridging the Gaps
The core principles of Bridging the Gaps at UCL were a commitment to supporting new interdisciplinary research collaborations within the university, funding innovative approaches to sustainability research and a focus on involving early career researchers.

The programme ensured that it funded interdisciplinary collaborations by requiring that each proposal identified a lead applicant and a main collaborator who came from different department departments at UCL (except in a few cases, such as the Conference Fund, where applicants did not require a collaborator). A further condition, designed to promote new collaborations, was that the lead applicant and main collaborator could not have been funded together on a previous grant from an external funder. The balance between the contributions of the collaborators was also an important factor in the assessment, with a preference for collaborations that relied on both applicants’ areas of expertise.

Both lead applicant and main collaborator were required to hold permanent academic positions in UCL, this condition was put in place to ensure that they were eligible to apply for future funding from an external body, such as a research council.

The commitment to supporting early career researchers was ensured by including a requirement that Professors could not lead research collaborations. Professors were, however, welcome as collaborators, and this has indeed been the case in some of our collaborations.

Initially Bridging the Gaps was aimed at the three faculties that make up the BEAMS school at UCL: The Bartlett School of the Built Environment; Engineering; and Mathematics and Physical Sciences. As these three faculties contain the departments that most obviously fall within the EPSRC remit. However, there was no bar on applications from other departments, and all the funding opportunities were advertised on a university wide basis.

It can be seen from the figure below, that the funded collaborations brought in departments from other faculties at UCL.

Key facts
• Bridging the gaps has awarded over £245,000 in funding
• Applications were submitted from 26 departments or centres in 6 faculties
• Funding was given to 54 collaborations between departments
• Bridging the Gaps has given 63 academics the chance to test their ideas and new research partnerships

www.ucl.ac.uk/btg
The diagram above shows how different departments at UCL have been linked through Bridging the Gaps funding. Only collaborations that received direct funding through one of our calls are shown above.

The chart above does not show any of the links that were made through the champions network, or between the people who attended events that were funded by our Seminar Funding or Visiting Scholar awards. These events appealed to, and attracted, large audiences from many different departments. The events funded by the Seminar Funding call were designed to encourage interdisciplinary discussion on sustainability topics. For example, the Megalopolis and Sustainability seminar series brought academics from a broad range of disciplines, representing 26 UCL departments or centres, as well as a number of visitors to UCL. The seminar series consisted of 18 hours of presentations and discussion of a range of cross cutting themes.
Gathering feedback for Bridging the Gaps

We were interested in how well Bridging the Gaps had been received and how effective it had been in fostering interdisciplinary collaborations. It was clear that some participants were absolute newcomers to cross-disciplinary collaboration, while others see it as an absolute necessity for their research area.

“It is essential to work with other departments as most of the research topics involve multi-disciplinary collaboration…” (LC)

In general the programme participants found the process of cross-disciplinary to be positive.

“Collaboration across disciplines and departments is most of the time very fruitful as it provides you with an opportunity to complement skills and knowledge.” (PH)

Most participants felt that this style of working was already necessary, or soon would be.

“It is inevitable that more cross disciplinary interaction is going to have to take place.” (RB)

In almost all cases the participants had not made a previous attempt to get funding for their research idea. In many cases this is because the idea had not existed in that form before a Bridging the Gaps call.

In some cases Bridging the Gaps funding, or an activity run by Bridging the Gaps was essential to starting the collaboration. For instance, JT thought that his collaboration involving nanostructured catalysts “would have been very difficult without [the Bridging the Gaps sandpit]”. More simply NK told us that “The entire project would not have been possible without Bridging the Gaps funding”.

Blocks to interdisciplinary working

Many participants noted factors that blocked effective cross-disciplinary working. Time and money were both mentioned. The time required for cross disciplinary working was usually in addition to the participant’s day to day duties.

“cross-disciplinary working can be very time consuming” (NK)

“Researchers may spend time transferring knowledge to cross-disciplinary colleagues… with no immediate benefit.” (KJ)

It was also felt by many that it would be difficult to secure significant external funding for their cross-disciplinary research ideas, as grant applications put the applicant in double-jeopardy situation, having to convince two or more research communities of the importance of the work.

“despite [pushing] for more of it … the research council peer review system hasn’t entirely caught up with the reality of cross-disciplinary research.” (RC)
However, participants saw that for the right problem the benefits brought by working across disciplines outweigh the complexities.

**The value of Crossing Disciplines**

Most respondents described the importance of taking a cross-disciplinary approach to their research. For instance, one research project required theoretical understanding of both chemical engineering and nano-scale processes related to energy conversion.

The reasons for seeking cross-disciplinary collaboration include a lack of equipment or expertise one department:

- “Energy efficiency is a function of many factors not studied in computer science departments” (KJ)
- “it allowed us to bring in ... staff from other departments [with] skills that we would have been unable to provide ourselves” (PH)
- “Positive value ... access to laboratory facilities to use specialist equipment” (LC)

As well as bringing in expertise, the collaboration was also seen as an opportunity for the participants to learn about different academic areas and pick up new skills.

**In the future**

In general respondents reported that as a result of Bridging the Gaps funding they were more likely to apply for external grant funding for cross-disciplinary work, or that they had previously been active or interested in applying for cross-disciplinary research funding.

An example of the latter response comes from PH, “[cross-disciplinary working] was already part of my working practice”, however, involvement in the programme has made her “think a bit more about cross-disciplinary research with other people at UCL”.

Cross-disciplinary working also introduces participants to different ways of working, “I liked the straightforward way physical scientists approach things” (NK).

In some cases Bridging the Gaps involvement is leading directly to an application for a larger fund. LC, for instance, has found that Bridging the Gaps “is helping us to get some preliminary results that can support [an application to] a larger fund such as FP-7 or EPSRC.”

As well as creating new ideas for research grant applications, cross-disciplinary research was also seen as an opportunity to expand the audience and the impact of their research.

It has become clear during the course of the programme that cross-disciplinary working is seen as the future, or indeed the present, for many of the participants.
It is also clear that cross-disciplinary working presents challenges beyond the usual responsibilities of an academic staff member.

At its best, the Bridging the Gaps programme, has allowed researchers to take a more problem-focused approach to the urban sustainability issues. It has done this by overcoming the barriers associated with crossing disciplines, and allowing intelligent people, with different skills, to focus on the same problem.
The Open Programme

The Open Programme provided small grants to initiate novel research collaborations. The first round of awards were up to £1,000, after a review of the programme at the end of the first year, the limit for awards was increased to £2,000.

In order to receive funding the planned research had to take a novel, cross-disciplinary, approach to an urban sustainability problem. Preference was given to entirely new collaborations between applicants, in addition to the requirement that applicants should not have been funded together on a previous research grant.

Awards were made to support activities as diverse as running a conference session on environmental crime, visiting

The Open programme was the first step on a funding escalator for a number of participants in the Bridging the Gaps programme.

Liora Malki-Epshtein (Civil and Environmental Engineering) and Serge Guillias (Statistical Science), who became one of our most successful researcher pairings, began their work together with a £1,000 award to begin work on “Novel approaches to street-scale pollution dispersion modelling through the integration of advanced statistical methods with environmental fluid modelling”, work which was continued with a Staff Exchange award and two Escalator Fund awards.
Another successful collaboration, between Julien Harou (Department of Civil and Environmental Engineering) and Lazaros Papageorgiou (Chemical Engineering) began their work on resource modelling using open source tools with the Open Programme award “Building a system schematic and simulation model of the London water supply and its dependence on the Thames Basin” to use Hydroplatform develop a Simulation Model for the London water supply.
Table 1 shows all the successful applications to the Open Programme. Research in the open programme covered topics as diverse as slime mould in architecture and disability in Indian slums.
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Applicant(s)</th>
<th>Supervisor(s)</th>
<th>Amount (£)</th>
</tr>
</thead>
</table>
| 1   | Novel approaches to street-scale pollution dispersion modelling through the integration of advanced statistical methods with environmental fluid modelling. | Liora Malki-Epstein  
Civil Environmental and Geomatic Engineering | Serge Guillias  
Statistical Science | £996.80 |
| 2   | Children, disabilities and well-being: a preliminary research in India | Alexandre Apsan  
Development Planning Unit | Jean Francoise Trani  
Leonard Cheshire Disability and Inclusive Development Centre | £1,000 |
| 3   | National Environmental Crime Conference | Hervé Borrion  
Centre for Security and Crime Science | Michael Emes  
Centre for Systems Engineering | £500 |
| 4   | Natural ventilation for greener and healthier buildings | Dejan Mumovic  
Bartlett School of Graduate Studies | Kaman Lai  
Civil Environmental and Geomatic Engineering | £1,000 |
| 5   | Investigating the potential of the slime mould organism [Physarium polycephalum] as an architectural-biological sensor and indicator of environmental change | Rachel Armstrong  
Bartlett School of Architecture | Sylvia Nagl  
The Cancer Institute | £1,000 |
| 6   | Building a system schematic and simulation model of the London water supply and its dependence on the Thames Basin | Julien Harou  
Civil Environmental and Geomatic Engineering | Lazaros Papageorgiou  
Chemical Engineering | £2,000 |
| 7   | Questioning the sustainability of post-industrial urban landscapes | Quentin Stevens  
Bartlett School of Planning | Matthew Gandy  
Geography | £1,861 |
| 8   | UCL DRR Conference | Camillo Boano  
Development Planning Unit | Catherine Lowe  
Geography | £2,000 |
| 9   | Community Mapping in Hackney: Community use and appropriation of Hackney Marsh, London | Pascale Hofmann  
Development Planning Unit | Muki Haklay  
Civil, Environmental and Geomatic Engineering | £1897 |
| 10  | Geographical Perspectives on Planning the Sustainable City | Andrew Harris  
Geography | Susan Moore  
Bartlett School of Planning | £1765 |
| 11  | SafeSoil - Preliminary Investigations | Julia Stegemann  
Civil, Environmental and Geomatic Engineering | Nikos Karadimitriou  
Bartlett School of Planning | £1897 |
| 12  | The UCL Electrochemical Innovation Lab and Network | Dan Brett  
Chemical Engineering | Xiao Guo  
Chemistry | £2000 |

**£ 17,916.80**
Staff Exchange

As a result of the previous funding for the Open Programme “Novel approaches to street-scale pollution dispersion modelling through the integration of advanced statistical methods with environmental fluid modelling”, a scientific collaboration was started between Serge Guillas and Liora Malki-Epshtein. The funding enabled a series of water tunnel experiments for which Serge Guillas was involved at the stage of the design of lab experiments and in the analysis of the measurement uncertainties.

Table 2: The successful application to the Staff Exchange Programme

<table>
<thead>
<tr>
<th>Calibration of environmental fluid modelling for Street-scale pollution dispersion</th>
<th>Serge Guillas</th>
<th>Liora Malki-Epshtein</th>
<th>£3,000</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistical Science</td>
<td>Civil Environmental and Geomatic Engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

£3,000

A student was co-mentored by Serge Guillas and Liora Malki-Epshtein in the summer of 2008. This produced reliable measurements of speed flow in an idealized street canyon containing a car. Good estimates were obtained of the speed flow and their corresponding uncertainties at any location using a spatial statistical prediction method (Kriging).

The Staff Exchange programme has allowed the collaborators to build on their previous work. The funding was used to buy out some of Serge Guillas’s teaching time, allowing him to work with Liora Malki-Epshtein.
Sandpits

Bridging the Gaps held two sandpits that encouraged researchers to consider sustainability challenges and propose how they could be tackled with novel applications of leading edge technologies. In 2009 the chosen area was nanoscience and nanotechnology, in 2010 networked sensors were chosen as the technology.

Each sandpit event was held over two days, including an overnight stay, at a hotel in Greenwich. The venue was chosen to be close enough to be convenient for participants, but far enough away so that they were removed from their usual UCL routine and could give full attention to the sandpit.

The aim of the sandpits were to produce research partnerships that were both interdisciplinary and collaborative, bringing academics with a knowledge of the sustainability challenges together with academics who had a knowledge of the potential solutions.

The sandpits were interactive workshops that allowed those with a knowledge of the sustainability challenges and those with a knowledge of the technologies...
and processes made possible by nanotechnology, to share ideas, identify pressing challenges and start thinking about applying the appropriate technologies.

The sandpits were designed and run with the assistance of Andrew Clark and Katie Finch, Research Facilitators for the BEAMS School (the BEAMS School is comprised of the Bartlett, Engineering, and Mathematics and Physical Sciences faculties). The sandpits were based on an EPSRC sandpit, but modified to fit into the two days available.

All recipients of Sandpit funding have agreed to produce reports covering the results of the research. All feedback reports will be made available on the programme’s website at www.ucl.ac.uk/btg.

Sandpit 2009
Little Green Things: Nanotechnology for Sustainability Challenges

The first sandpit took place in February 2009 and had the theme of sustainability and nanotechnology.

The aim was to produce research partnerships that were interdisciplinary and collaborative, bringing academics with a knowledge of the sustainability challenges together with academics who had a knowledge of the potential nanotechnology solutions. The sandpit was originally advertised with a fund of £20,000 to support research collaborations, but this was increased to £30,000 (utilising money that had not been spent under other programmes during the first year).

The sandpit topic was chosen ahead of the EPSRC launching its third grand challenge in nanotechnology. At the time it had been announced that the EPSRC would be seeking proposals that focused on nanotechnology and the environment, and it was felt that an added benefit of the sandpit would be to place the participants in a better position for this EPSRC funding.

The sandpit was an interactive workshop that allowed those with a knowledge of the sustainability challenges and those with a knowledge of the technologies and processes made possible by nanotechnology, to share ideas, identify pressing challenges and start thinking about applying the appropriate technologies.

We had a good response from academics across UCL, including members of the LCN (London Centre for Nanotechnology).

Prior to the main event we ran a pre-sandpit briefing session, the briefing consisted of presentations that covered the basics in sustainability and nanotechnology from two leaders in those fields, Sarah Bell (Senior Lecturer in Civil, Environmental and Geomatic Engineering and Co-Director of the Environment Institute) and Gabriel Aeppli (Quain Professor of Physics and the Director of the London Centre for Nanotechnology). Videos of the pre-sandpit briefing session are available on the Bridging the Gaps website.
The titles and team members for the successful research projects are given in the table on the following page. The name of the lead on each project is given on the left, with co-investigators being listed on the left.

**Table 3: Successful projects and groups from the sustainability and nanotechnology sandpit**

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Team Members</th>
<th>Lead Institution</th>
<th>Co-investigators</th>
<th>Year</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Modelling how nano-scale processes relate to macroscale function</td>
<td>Alexandra Olaya-Castro, Luca Mazzei, Alexandra Porter</td>
<td>Luca Mazzei, London Centre for Nanotechnology</td>
<td></td>
<td>2009</td>
<td>£15,000</td>
</tr>
<tr>
<td>2. Duracoat: Using nanoscience to protect wood</td>
<td>Nikos Karadimitriou, Mihaly Foldvari, Alexandra Olaya-Castro, Matija Strlic</td>
<td>Mihaly Foldvari, Genetics, Evolution and Environment</td>
<td></td>
<td>2009</td>
<td>£5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>£30,000</strong></td>
</tr>
</tbody>
</table>

*For funding purposes Arokia Nathan has been identified as Principal investigator for this project by Research Finance.

The nanotechnology sandpit produced a very successful research collaboration between Luiza Campos (Civil and Environmental Engineering) and Arokia Nathan (London Centre for Nanotechnology). The initial research idea was to develop novel nano metal-oxide structures to purify water, by removing compounds that are not removed by conventional treatment processes, including natural organic matter (NOM) and synthetic organic micro-contaminants such as hydrocarbons, PCB's, and pesticides. The matching of a sustainability challenge, ensuring clean, drinkable water, and a technology, filtration using novel material combined with photocatalysis, was developed during the sandpit. The research idea was developed with the help of funding from two escalator awards.
Figure 7: Progression through the "escalator" of the Nanostructures for Water Treatment project
Sandpit 2010
Sense and Sustainability: Networked Sensors for the Urban Environment

The second sandpit took place in May 2010 and took the theme of networked sensors for sustainability.

As with the first sandpit, the aim was to produce interdisciplinary and collaborative research collaborations. Matching academics with a knowledge of the sustainability challenges and academics with a knowledge of the networked sensors and data handling. The sandpit was advertised with a fund of £30,000, matching the first sandpit.

The second sandpit session included a feedback session for participants. Some improvements were suggested: it was felt the sandpit should have had wider publicity, and that more time should have been dedicated to the open space element, the part of the sandpit where participants were free to share ideas and suggest areas for research. The feedback session also revealed that overall the event, especially the chance to meet and share ideas with other researchers, was highly valued by the participants. Overall, the participants reported that the sandpit was a useful and enjoyable experience.

The titles of and team members for the successful research projects are given in the table on the following page. The name of the lead on each project is given on the left, with co-investigators being listed on the left.
Table 4: Successful projects and groups from the sustainability and nanotechnology sandpit

<table>
<thead>
<tr>
<th>#</th>
<th>Project Title</th>
<th>Researchers</th>
<th>Funding</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What's my energy footprint?</td>
<td>John Mitchell (Electronic and Electrical Engineering)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kyle Jamieson (Computer Science)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Renzo De Nardi (Computer Science)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dietmar Backes (Civil, Environmental and Geomatic Engineering)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paul Greening (Civil, Environmental and Geomatic Engineering)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muki Haklay (Civil, Environmental and Geomatic Engineering)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Spatio-temporal description of air quality with mobile and static arrays of</td>
<td>Serge Guillias (Statistical Science)</td>
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<tr>
<td></td>
<td>MOS sensors</td>
<td>Russell Binions (Chemistry)</td>
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<td></td>
<td></td>
<td>Venus Shum (Computer Science)</td>
<td>£8,000</td>
<td>2010</td>
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<tr>
<td></td>
<td></td>
<td>Daren Caruana (Chemistry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Energy Efficiency for the Computer Cloud</td>
<td>Kyle Jamieson (Computer Science)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muki Haklay (Civil, Environmental and Geomatic Engineering)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>John Mitchell (Electronic and Electrical Engineering)</td>
<td>£8,000</td>
<td>2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Venus Shum (Computer Science)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Wireless Sensor Networks for Energy Efficiency in Historic Properties</td>
<td>Irina Spulber (Bartlett School of Graduate Studies)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Kyle Jamieson (Computer Science)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muki Haklay (Civil, Environmental and Geomatic Engineering)</td>
<td>£4,000</td>
<td>2010</td>
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<tr>
<td></td>
<td></td>
<td>Venus Shum (Computer Science)</td>
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<td></td>
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<td></td>
<td>£30,000</td>
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</table>
MSc Competition

The MSc competition offers funding for a pair of academics to co-supervise an MSc student. It was suggested that the awards (£6,000 for each pair of supervisors) were used to pay a student’s course fees, with any excess being paid as a stipend, however, it was left to the supervisor’s discretion how the money was spent. The competition aims to build interdisciplinary links between supervisors, and introduce MSc students to interdisciplinary research.

The applicants were asked to identify an area of urban sustainability research that crosses disciplines, has the potential to produce new findings, and can be investigated in a project suitable for an MSc student. The award was intended to allow the academics to begin working together on a new research area with research assistance provided by their MSc student, who it was envisaged would do half a day's work a week on the research during the taught part of the course. The student has a number of advantages from the scheme, course fees and a stipend, and the opportunity to gain research experience and material for their dissertation. All recipients of MSc funding have agreed to produce reports covering the results of the research.

MSc Competition 2008

10 applications were received for the programme in 2008. The three top rated projects were given £6,000 of funding each.

The project title and details for the two supervisors for the winning entries to the 2008 competition are given in the table below.

Table 5: MSc competition winners from the 2008 competition

<table>
<thead>
<tr>
<th></th>
<th>Contribution of rooftop rainwater harvesting to the water supply-demand balance in London - a case study.</th>
<th>£6,000</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Luiza Cintra Campos, Civil Environmental and Geomatic Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Michael Batty, Centre for Advanced Spatial Analysis (CASA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A New Hydride Fuel Cell Hybrid for Zero Emissions Vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dan Brett, Chemical Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Xiao Guo, Chemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Uncertainty in building performance simulations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Richard Chandler, Statistical Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mike Davies, Bartlett School of Graduate Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£18,000</td>
<td></td>
</tr>
</tbody>
</table>

£18,000
**MSc Competition 2009**

5 applications were made to the programme in 2009. The three highest rated projects were each given an award of £6,000. The table below gives the project title and details for the two supervisors for the winning entries to the 2009 competition.

**Table 6: MSc competition winners from the 2009 competition**

<table>
<thead>
<tr>
<th>No.</th>
<th>Project Description</th>
<th>Supervisor 1</th>
<th>Supervisor 2</th>
<th>Award</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negotiating local adaptive capacity - learning from the dynamics of urban institutional and grassroots built-in resilience in Dhaka, Bangladesh</td>
<td>Adriana Allen Development Planning Unit</td>
<td>John Twigg Aon Benfield UCL Hazard Research Centre</td>
<td>£6,000</td>
<td>2009</td>
</tr>
<tr>
<td>2</td>
<td>Automated estimation of cloud cover from thermal imagery</td>
<td>Lewis Griffin Computer Science</td>
<td>Jan-Peter Muller Space and Climate Physics</td>
<td>£6,000</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>CO2 capture and conversion to a renewable fuel by means of photocatalysis on a nanostructured catalyst</td>
<td>Junwang Tang Chemical Engineering</td>
<td>Zhengxiao Guo Chemistry</td>
<td>£6,000</td>
<td>2009</td>
</tr>
</tbody>
</table>

£18,000
Escalator Fund

Two calls for escalator funding awards were made during the course of Bridging the Gaps, the first in July 2009, the second in August 2010. Unlike the open programme or sandpits, which were designed to initiate new collaborations and novel research ideas, the escalator fund was designed to allow members of successful collaborations to take their work further, building on the best collaborations.

The escalator fund was only open to researchers who had been successful in previous Bridging the Gaps funding opportunities. Preference was be given to applications that clearly showed how Bridging the Gaps had led to the formation of the team making the application, and applications that built on an activity that has already received Bridging the Gaps funding.

The tables below (Table 8 & 9) show details for the successful applicants to the Escalator fund.
## Table 7: Research funded under the first Escalator fund

<table>
<thead>
<tr>
<th>#</th>
<th>Title</th>
<th>Investigator 1</th>
<th>Investigator 2</th>
<th>Amount</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Novel Nanostructures for Water Purification &amp; Treatment</td>
<td>Luiza Campos</td>
<td>Arokia Nathan</td>
<td>£8,000</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td>London Centre for Nanotechnology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Enhanced laboratory experiments and field study for street-scale pollution dispersion modelling</td>
<td>Serge Guillas</td>
<td>Liora Malki-Epshtein</td>
<td>£6,000</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Statistical Science</td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Adapting UK water resource systems to changing conditions - Building a foundation for UCL-Environment Agency Collaboration</td>
<td>Julien Harou</td>
<td>Lazaros Papageorgiou</td>
<td>£3,000</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td>Chemical Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Children, Well-being and Disability: Re-visiting India</td>
<td>Alexandre Apsan Frediani</td>
<td>Jean Francois Trani</td>
<td>£3,000</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development Planning Unit</td>
<td>Leonard Cheshire Disability and Inclusive Development Centre</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**£20,000**
## Second Escalator Fund

Table 8: Research funded under the second Escalator fund

<table>
<thead>
<tr>
<th></th>
<th>Project Title</th>
<th>Principal Investigator(s)</th>
<th>Co-investigator(s)</th>
<th>Amount</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Novel Nanostructures for Water Purification &amp; Treatment (part two)</td>
<td>Luiza Campos (Civil, Environmental and Geomatic Engineering)</td>
<td>Aroki Nathan (London Centre for Nanotechnology)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td>2</td>
<td>A Feasibility Study of Integrating CO2 Capture and Light-Driven CO2 Conversion to a Fuel</td>
<td>Junwang Tang (Chemical Engineering)</td>
<td>Xiao Guo (Chemistry)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td>3</td>
<td>Development and Application of UCL’s open-source platform for modelling urban resource networks</td>
<td>Julien Harou (Civil, Environmental and Geomatic Engineering)</td>
<td>Lazaros Papageorgiou (Chemical Engineering)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td>4</td>
<td>Justice in the Green</td>
<td>Pascale Hofmann (Development Planning Unit)</td>
<td>Muki Haklay (Civil, Environmental and Geomatic Engineering)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td>5</td>
<td>Modelling Porous Materials as Chemical Reactors</td>
<td>Luca Mazzei (Chemical Engineering)</td>
<td>Matija Strlic (Bartlett School of Graduate Studies)</td>
<td>£10,000</td>
<td>2010</td>
</tr>
<tr>
<td>6</td>
<td>Optimising the design, performance and use of electric, fuel cell and hybrid vehicles (A new low carbon vehicle collaborative network for UCL)</td>
<td>Dan Brett (Chemical Engineering)</td>
<td>Xiao Guo (Chemistry)</td>
<td>£5,000</td>
<td>2010</td>
</tr>
<tr>
<td>7</td>
<td>Calibration of CFD simulation of an urban street canyon using experimental PIV observations</td>
<td>Liora Malki-Epshtein (Civil, Environmental and Geomatic Engineering)</td>
<td>Serge Guillas (Statistical Science)</td>
<td>£5,000</td>
<td>2010</td>
</tr>
</tbody>
</table>

**£50,000**
Grant Writing Support

This fund provided a fund to help a pair of academics write a cross-disciplinary grant application. The funding was used to pay for an assistant to work on the grant application with the researchers.

The table below gives details for all the successful grant writing support applications.

Table 9: Grant application titles supported by the Grant Writing Scheme

<table>
<thead>
<tr>
<th></th>
<th>Socio-technical Change for Sustainable Urban Water Use</th>
<th>Robert Lowe</th>
<th>UCL Energy Institute</th>
<th>£3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sarah Bell</td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Richard Taylor</td>
<td>Geography</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>David McCoy</td>
<td>Institute of Child Health</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Quentin Stevens</td>
<td>Bartlett School of Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Matthew Gandy</td>
<td>Geography</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serge Guillas</td>
<td>William J. McGuire</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>European Network on Near-shore Tsunamis</td>
<td>Statistical Science</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**£12,000**
Conference Fund
Previous recipients of Bridging the Gaps funding were invited to apply for up to £2,000 for to attend a conference that relates to cross-disciplinary work in sustainable urban spaces. Applicants were not required to make a presentation, although most did, but the conference had to be related to their cross-disciplinary work.

The table below shows all the successful applicants for funding under the Bridging the Gaps Conference Fund.

Table 10: Applications to disseminate Bridging the Gaps funded work

<table>
<thead>
<tr>
<th>#</th>
<th>Event</th>
<th>Applicant Name</th>
<th>Department</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>219th Electrochemical Society Meeting</td>
<td>Russell Binions</td>
<td>Chemistry</td>
<td>£1,350</td>
</tr>
<tr>
<td>2</td>
<td>Workshop on Urine Diverting Toilets</td>
<td>Sarah Bell</td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td>£230.43</td>
</tr>
<tr>
<td>3</td>
<td>15th International Congress of Photosynthesis</td>
<td>Alexandra Olaya-Castro</td>
<td>Physics and Astronomy</td>
<td>£2,000</td>
</tr>
<tr>
<td>5</td>
<td>International Congress on Environmental Modelling and Software</td>
<td>Julien Harou</td>
<td>Civil, Environmental and Geomatic Engineering</td>
<td>£1,157.99</td>
</tr>
<tr>
<td>6</td>
<td>12th International Building Performance Simulation Conference</td>
<td>Serge Guillas</td>
<td>Statistical Science</td>
<td>£2,000</td>
</tr>
<tr>
<td>7</td>
<td>Human Rights and Human Development</td>
<td>Alexandre Apsan Frediani</td>
<td>Development Planning Unit</td>
<td>£2,000</td>
</tr>
</tbody>
</table>

£ 8,738.42
Seminar Funding
This call provided funding to cover the costs of arranging interdisciplinary seminar. Funding was split between funding for a series of interdisciplinary seminars by the Environment Institute and an open call for seminar funding.

Megalopolis series
The Environment Institute at UCL hosted a series of seminars that covered the sustainability challenges faced by the emergence of extremely large urban areas across the world. These regions are so large, and have such a complex relationship the surrounding urban region that the term city no longer seems sufficient. Megalopolis is one term that is used to reflect this qualitative difference. 'Sustainability and the Megalopolis: Facing the Urban Realities of the 21st century' consisted of a series of 6 themed seminars, each seminar began with informal lunchtime discussion, followed by presentations given by invited speakers, and then a more detailed discussion session focusing on the content of the presentations.

The seminars have addressed a number of pressing questions: Can a megalopolis ever be sustainable? How can they be made more sustainable? Are megalopolises particularly vulnerable to climate change and other 21st century hazards? How can they be made more resilient? Do they have a particular role to play in accentuating or mitigating climate change? How big do they get before they become unsustainable? What breaks down as size increases?

The topics covered by the six seminars are given below:

Climate change and the megalopolis
Prof. Sir Alan Wilson (Centre for Advanced Spatial Analysis)
Prof. Mark Maslin (Geography)
Prof. Michael Davies (Bartlett School of Graduate Studies)
Prof. Michael Batty (Centre for Advanced Spatial Analysis)

Transport, energy and water infrastructure, sustainability and the megalopolises
Dr Sarah Bell (Civil, Environmental and Geomatic Engineering)
Prof. Tadj Oreszczyn (Bartlett School of Graduate Studies)
Prof. Roger Mackett (Civil, Environmental and Geomatic Engineering)
Dr Adrianna Allen and Dr. Julio Davila Silva (Development Planning Unit)

Health, climate change and the megalopolis
Dr David Satterthwaite (Development Planning Unit)
Dr Ka-Man Lai (Civil, Environmental and Geomatic Engineering)
Dr Ben Croxford (Bartlett School of Graduate Studies)

Security, resilience and the megalopolis
Prof. Gloria Laycock (Jill Dando Institute of Crime Science)
Prof. David Crichton (Benfield UCL Hazard Research Centre)
Dr Mark Pelling (Kings College London Department of Geography)
Sustainability, society and culture in the megalopolis

Prof. Matthew Gandy (Geography)
Dr Paolo Favero (Anthropology)
Dr Claire Thomson (Scandinavian Studies)

Policy frameworks for megalopolises: economics, planning and governance

Prof. Alan Penn (Bartlett School of Graduate Studies)
Prof. Stephen Smith (Economics)
Prof. Mark Tewdwr-Jones (Bartlett School of Graduate Studies)
Dr Colin Provost (School of Public Policy)

The seminars brought together experts from across UCL to address the problem of sustainability and the megalopolis, and the results of the discussions have been brought together in a report which can be found on the UCL Environment website at http://www.ucl.ac.uk/environmentinstitute/research/megalopolis.

Open call for seminars

The Climate and Uncertainty Symposium

The open call for seminars funded one event: The Climate and Uncertainty Symposium on the 16th of February 2009. A wide spectrum of UCL researchers discussed the issues raised by uncertainty in climate predictions.

Richard Chandler (Statistical Science)
Mike Davey (Mathematics)
Mark Maslin (Environment Institute)
Tadj Oreszczyn (Bartlett School)
Joanne Scott (Laws)
Martin Todd (Geography)

The event included the opportunity to discuss the issues of uncertainty at all levels and the impact of those uncertainties on our ability to accurately forecast the effects of climate change on urban and natural systems, human health and public policy.

The presentations included hydrology and aquatic systems, climate change and the built environment, health impacts of climate change, developments in climate models, and statistical methods and downscaling. The presentations were followed by discussion and a poster session.

Table 11: Successful applications to the Seminar Funding Programme

<table>
<thead>
<tr>
<th>#</th>
<th>Event Title</th>
<th>Applicant Institution/Name</th>
<th>Amount</th>
<th>Year</th>
</tr>
</thead>
</table>
| 1  | Sustainability and the Megalopolis: Facing the Urban Realities of the 21st century | Marianne Knight
UCL Environment Institute | £6,000 | 2008 |
| 2  | Climate and Uncertainty Symposium                    | Julien Harou
Civil Environmental and Geomatic Engineering | £922   | 2009 |
|    |                                                      | Yvonne Rydin
Bartlett                                             |        |      |
|    |                                                      | Richard Chandler
Statistical Science                              | £6,922 |      |
Visiting Scholar
The Visiting Scholar fund was made available so that academics at UCL could suggest an eminent person from outside the university who could contribute to the research community and stimulate cross-disciplinary discussion and research activity.

Table 12: The successful application to the Staff Exchange Programme

<table>
<thead>
<tr>
<th>Encounters with Development Planning</th>
<th>The Inaugural Professor Sir Peter Hall Lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caren Levy</td>
<td>Matthew Carmona</td>
</tr>
<tr>
<td>Development Planning Unit</td>
<td>Bartlett School of Planning</td>
</tr>
<tr>
<td>£3,000</td>
<td>2009</td>
</tr>
</tbody>
</table>

The Visiting Scholar award was used to contribute £3,000 towards the cost of a visit by Professor John Friedmann. The request for funding was originally submitted as an application under the Seminar Funding stream of Bridging the Gaps, from Caren Levy (Development Planning Unit) and Matthew Carmona (Bartlett School of Planning).

Professor Friedmann was invited to give the inaugural Professor Sir Peter Hall Annual Lecture, ‘Encounters with Development Planning’. During his stay Professor Friedmann also gave a research seminar entitled ‘Varieties of Planning Experience: Towards A Globalised Planning Culture?’. Both events provided a valuable opportunity for the UCL community to explore Professor Friedman’s contribution to the contemporary debates on sustainability.

Apart from providing two high quality events relating to sustainable urban spaces for the UCL community, the applicants felt that this “major externally-facing event” would lead to further collaborations between the two departments.

The Bridging the Gaps team was convinced of the value of a visit by Professor Friedmann, one of the world’s pre-eminent planning theorists, and suggested that the Bridging the Gaps Visiting Scholar fund should be used to part fund his visit, the award covered just over half of the £5,827 needed to bring Professor Friedmann to the UK and to arrange the lecture and research seminar.
Website

During the course of the programme the Bridging the Gaps website www.ucl.ac.uk/btg provided a central location for information and resources for the programme team members, our departmental champions and anyone who was interested in making an application for funding.

All the information and application forms for our funding calls were placed on the website, as well as details of our eligibility criteria and contact details for the project team.

![Figure 9: Front page of the Bridging the Gaps website](image)

During the course of the programme the website was visited over 7,100 times with over 24,000 page views. The website shows a strong growth in both new and returning visitors, and overall the site was viewed by over 1,600 absolutely unique visitors.

The website has been redeveloped as a legacy site, featuring details of the funded work.
Events

Launch event
The Bridging the Gaps Programme was officially launched on the 25th of June 2008. Over 80 people registered interest in the event, and we had a good turnout from those who registered. The launch featured talks from Sarah Bell (Principal Investigator for the programme), David Price (Vice Provost for Research) and Jonathon Porritt co-founder of Forum for the Future. UCL’s Provost, Malcolm Grant, opened the event, and was on hand to chair the discussion after the presentations.

The talks were followed by a reception giving all the attendees an opportunity to discuss research ideas and to start building interdisciplinary links. The event was well received and generated a great deal of discussion during the reception about the possibilities for interdisciplinary research at UCL.

Pictures from the event are available on the Bridging the Gaps website at http://www.ucl.ac.uk/btg/events_launch_pictures.html

A video from the event is available on iTunesU:
http://itunes.apple.com/itunes-u/launching-bridging-gaps-at/id390417177#ls=1

First Year Review
A review was held after the first year featuring presentations and posters from researchers funded by Bridging the Gaps, which are available on the Bridging the Gaps website at http://www.ucl.ac.uk/btg/firstyearreview.html

Figure 10: Examples of posters from the first year review
Final Event

A final event was held in the February before the programme finished. As well as presentations and poster from Bridging the Gaps participants, the final event featured talks from Muki Haklay (Co-Investigator on the project), James Paskins (Programme Manager), David Price (Vice Provost for Research) and Paul Finch, Chair of CABE (the Commission for the Built Environment).

Details of the event together with posters and presentations from the event can be found at [http://www.ucl.ac.uk/btg/FinalEvent.html](http://www.ucl.ac.uk/btg/FinalEvent.html).

Figure 11: Julien Harou's presentation at the final event

Figure 12: Liora Malki-Epshtein's Presentation at the Final Event
Champions network

One of the ways that the programme encouraged interdisciplinary collaboration was through a network of departmental champions. The champions acted as a first point of call within a department for anyone interested in research collaborations and funding opportunities from Bridging the Gaps. We asked for people who were well known within their departments and who had an interest in urban sustainability and interdisciplinary collaboration. One of the roles that the champions fulfilled was keeping the staff in their departments up to date with the funding opportunities available from the Bridging the Gaps programme.

Figure 13: A list of champions was available to anyone with a UCL username and password

All champions were listed on our website, in a dedicated section accessible to anyone with a UCL username and password. Champions were paid £500 for each full year they acted as champions, provided that they promoted Bridging the Gaps and attended the majority of Champion’s Events, described below.
Champions’ Events

Champions were also expected to attend the majority of champions’ events. Most of these visits have consisted of a tour of a UCL facility, and a description of the research carried out there, which often includes an overview of the specialist equipment used by the research groups.

The visits have been enjoyable and interesting experiences for everyone involved, and proved to be an effective way to inform the champions about the equipment and the research groups available across UCL.

As well as advertising the research and facilities available in different UCL departments, the champions’ events kept a group of early career researchers from different departments in contact over the course of the programme.

Figure 14: One of the champions experiencing an immersive 3D environment in the Computer Science CAVE

Figure 15: Demonstration of a model to study ballast tank flushing in the Pat Kemp Fluids Laboratory

Figure 16: Testing a catalyst in the Centre for CO₂ Technology, Chemical Engineering
The following champions’ events were held over the course of the programme:

**Bartlett Graduate Studies** 25 July 2008
3D colour printing, lighting simulator for architectural models and large environmental chambers that control humidity and temperature.

**Computer Science** 30 October 2008
Pollution monitoring and visualisation. CAVE demonstration: a 3D virtual environment, featuring a tour of the South Bank and a 3D scan of a statue.

**Chorley Institute** (including the Christmas Party) 4 December 2008
3D colour scanner used for digital archiving and digital repatriation of museum objects, extensive GIS capabilities and geographical datasets.

**CEGE Fluids Lab** 16 January 2009
Pat Kemp Fluids Laboratory: Water tanks, flumes, and scale and full-size models, used to research erosion, tsunamis and ship ballast flushing.

**CEGE PAMELA** 13 February 2009
Adjustable pavement, with sophisticated lighting and sound systems, used to research transport, accessibility and the built environment.

**Ear Institute** 20 March 2009
Tour of the facilities including laser Doppler vibrometry, magneto encephalograph and an anechoic chamber.

**Physics** 29 May 2009
Research Computing, a very powerful computer cluster, and the Optical Science Lab which produces large optical components to a high tolerance.

**Mullard Space Science Laboratory** 15 July 2009
Presentation about how MSSL produces satellites, satellite components and impactors with a very low chance of failure.

**Development and Planning Unit** 25th October 2009
Presentations about the DPU’s research into development policy and planning in Africa, Asia, the Middle East and Latin America.

**Champions Christmas Party** 9th December 2009
Drinks and networking for champions and their guests.

**London Centre for Nanotechnology** 4 May 2010
Tour of the vibration free facility housing equipment that can probe and build nanoscale structures.

**Biochemical Engineering** 25 May 2010
Tour of the advanced facilities for research into the manufacturing processes for biochemical products, including medical drugs.

**Healthy Infrastructure Research Centre** 5 November 2010
Facility to test the effects of various aerosols in different environmental conditions, and to test air for a wide variety of pathogens.
The Bridging the Gaps Team

**Principal Investigator**
Dr Sarah Bell  
Civil, Environmental and Geomatic Engineering

**Co-Investigators**
Dr Ben Croxford  
The Bartlett School of Graduate Studies

Dr Muki Haklay  
Civil, Environmental and Geomatic Engineering

Dr Simon Julier  
Computer Science

**Programme Manager**
James Paskins  
Civil, Environmental and Geomatic Engineering

Contacting Bridging the Gaps
James Paskins  
Bridging the Gaps Programme Manager

**Postal Address:**
Chadwick Building  
University College London  
Gower Street  
London  
WC1E 6BT

**email:**  
j.paskins@ucl.ac.uk

**Telephone:**  
020 7679 0661

**Website**  
www.ucl.ac.uk/btg/