Built Environment Sustainability and Quality of Life (BESQoL) Assessment Methodology

Paola Sassi

Abstract

The BESQoL (Built Environment Sustainability and Quality of Life) Assessment Methodology is a tool for professionals and students associated with the built environment designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. Developed as a teaching tool for postgraduate students of Oxford Brookes University's masters programme MSc Sustainable Building: Performance and Design, it has been applied to live built environment developments in the Oxfordshire area of the United Kingdom and in 2014 to two projects in Brazil in collaboration with local universities, stakeholders and professionals. The methodology involves a multidisciplinary and transdisciplinary approach involving experts from different disciplines and stakeholders associated with the area of development. The methodology includes examining five categories relevant to the development site: (1) the natural environment and natural capital, (2) the built environment, (3) movement, (4) economics, and (5) human capital and quality of life. By enabling a more holistic and informed approach to built environment developments through the application of the BESQoL assessment method, it is argued that students, professionals and local stakeholders (a) begin a transformative learning experience that addresses professional and personal values and can help refocus their professional contribution; (b) begin to understand the scope that needs to be addressed to create sustainable environments and learn to appreciate the relevance and importance of the various disciplines involved; and (c) are better placed to developed holistic and

P. Sassi (✉)
School of Architecture, Faculty of Technology, Design and Environment,
Oxford Brookes University, Gipsy Lane, Oxford OX3 0BP, UK
e-mail: psassi@brookes.ac.uk

informed strategies that provide sustainable high quality of life solutions for all community members while impacting minimally on the local and global natural environments.

1 Introduction

Creating sustainable futures requires considering multiple issues ranging from reducing carbon emissions to ensuring an economically viable future, protecting the natural environment and supporting human development. Passive low energy and low carbon measures and initiatives applied to the built environment have to be considered within their socio-economic context and in light of sustainability's aim to enable and support the positive growth of individuals, communities and countries. The main stakeholders in creating sustainable futures, the communities themselves, cannot be coerced in adopting sustainable lifestyles; they need to be offered a viable and attractive alternative to their current way of life that is also sustainable. Sustainability cannot be seen as a goal without concurrently considering quality of life.

The built environment has a role to play in creating capabilities for individuals and communities to attain a high quality of life and fulfil their potential for personal growth within the parameters of a sustainable and low carbon lifestyle. The built environment acts as the physical framework for living that can enable, for instance, a car-free existence, living in zero carbon comfortable and healthy buildings, and enjoying walkable neighbourhoods and green spaces. The built environment and the process of development can also encourage the creation or support of existing neighbourhood and support networks, help develop a sense of identity, and provide opportunities for training, education and employment (Sassi 2006). But as in relation to sustainable development in general, where it is increasingly clear that technological advances, legislation and policy frameworks are insufficient to create sustainable communities (UNESCO 2012a), the built environment contribution towards creating sustainable communities should ideally also support changes in mind-sets and values. Such changes could be triggered through educational experiences of developing sustainable communities and living sustainable lifestyles.

Education for sustainable development, whether directed at students, the public or professionals, has to therefore be more than teaching principles and potential solutions. "[In] its broadest sense, [it] is education for social transformation with the goal of creating more sustainable societies" (UNESCO 2012b: 33). The scope of issues to cover is broad-ranging from climate change and environmental issues to poverty reduction, and sustainable consumption (UNESCO 2012c). Furthermore,

within a constantly changing social context, education for sustainable development needs to equip individuals with the skills to develop sustainable solutions appropriate to changing scenarios, without knowing what these scenarios might be (UNESCO 2012b; Mila and Sanmarti 1999). As Tilbury (2011: 2) contends, "sustainability is more a journey than a checklist" and for built environment professionals and to some degree community stakeholders, the journey involves a process of enquiry, analysis and strategising well beyond the building envelop and developing new paradigms rather than accepting existing solutions.

Higher education is well understood as having a significant potential for introducing new paradigms, expanding individuals' world views, and providing students with the skills to address challenges of creating sustainable societies (UNESCO 2012a). However, education in the built environment sector, as in other sectors, often fails to address the existing mindset that limits the ability to address sustainability, by for instance segregating disciplines. It also addresses inadequately the breadth of issues that need to be considered when formulating strategies for sustainable developments (Tilbury 2011; Graham 2014; Warburton 2003) and often fails to address values and attitudes (Shephard 2008). Consequently, not only students but also many professionals often lack the awareness, knowledge and understanding of the fundamental characteristics of the built environment that contribute to sustainable lifestyles and developments. Education for sustainable development in higher education must therefore not only introduce new mindsets, but also reach out beyond the academic limits to the general public and professional to enhance their awareness and knowledge of sustainability.

A new paradigm of the built environment professional is needed. A paradigm that blurs the disciplinary boundaries allowing the professional to consider wider socio-economic and environmental aspects associated with the built environment. To achieve this a transformative education is required. As differentiated by Murray et al. (2014) from transmissive methods of learning, which provide information, the transformative process applied to built environmental professionals would require them to re-examine their professional role in the light of what they can contribute to creating more sustainable environments and communities.

It is therefore proposed that education for sustainable development in relation to the built environment, whether in an academic or professional setting, should aim to:

(a) support the removal of disciplinary barriers and facilitate a better understanding of the wide range of issues to address to achieve sustainable development, constituting the beginning of a transformative process;

(b) help learners to develop research skills and provide a framework for structuring such research, which can support learning within other disciplines as well as one's own;

(c) provide opportunities for multidisciplinary interaction and collective learning and opportunities for critical reflection of such experiences;

(d) provide opportunities for stakeholder interactions involving critically reflective listening, evaluating and responding to stakeholders' needs and aspirations and gaining their feedback on proposals;

(e) support the analysis, evaluation and synthesis of different strands of research and data collected for the purpose of formulating and presenting development strategies that respond to the environmental, economic and social context; and

(f) encourage a review of the role of the professional.

Furthermore, as advocated by the United Nations Decade of Education for Sustainable Development programme (UNESCO 2005), linking the educational initiatives to local communities will help develop public understanding and awareness, as well as providing students with an experience of a real life setting.

The Built Environment Sustainability and Quality of Life (BESQoL) assessment methodology aims to adopt a process-based teaching approach to address the above objectives. The following sections will outline the scope of the BESQoL assessment method, the way it addresses the above outlined educational aims, and evaluate its application in a number of settings.

2 Built Environment Sustainability and Quality of Life (BESQoL) Assessment Methodology—Background and Principles

The BESQoL assessment methodology is a tool for professionals and students associated with the built environment designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. The methodology was developed by the author as a research tool for postgraduate students of Oxford Brookes University's masters programme M.Sc. Sustainable Building: Performance and Design, and is applied in the research-led module, Sustainable Built Environments.

The tool was derived from a traditional site analysis and developed to include research into quality of life and economics and future visioning. Using the BESQoL assessment methodology, student participants in groups of five undertake comprehensive environmental and socio-economic research of the context of a site for development, which will also constitute the site for the students' individual design projects. The sites selected are 'live' in the sense that they are typically under consideration for development by the local authority, local residents' groups and or developers.

The aim of the assessment is to identify the needs of a community that relate to the built environment, as well as the strengths that exist and can be built on. The potential contribution of the built environment to creating or supporting sustainable communities is considered in its widest sense. This means that well-documented aspects of sustainable development, such as energy-, water- and material-efficient building and urban designs are researched, but also investigated are opportunities for addressing individual and community identity, encouraging social interaction, providing safe and secure environments, and supporting community and social networks. Relevant community stakeholders are invited to contribute to the research process. The assessment identifies and evaluates the status quo, envisages future developments and

changes, and after a detailed analysis proposes strategic development briefs that include development targets for sustainability. The BESQoL assessment results and proposed development briefs and strategies are presented to the community stakeholders and can inform the 'live' development. The briefs and strategies also form the basis for the students' individual architectural design proposals.

3 BESQoL Scope and Process of Assessment

The BESQoL multidisciplinary methodology examines five categories (Table 1) relevant to the development site: (1) the natural environment and natural capital, (2) the built environment, (3) movement, (4) economics, and (5) human capital and quality of life. The aim of the assessment is to identify (a) current status, (b) current needs and priorities, and (c) formulate strategies for the development. The categories were determined drawing from a number of sustainable design and development assessment systems and other relevant references including: Maslow's hierarchy of needs (1954), the OECD Framework to Measure the Progress of Societies (Hall et al. 2010), the BRE sustainability checklist for developments (Brownhill and Rao 2002), the SPeAR framework (Arup 2012), Building for life 12 (Collins and Quinn 2012), igloo footprint (Rossi 2012) and previous research undertaken by the author into over one hundred sustainable developments (Sassi 2006). The categories only include topics that either have an impact on the built environment or can be affected by the built environment, and participants can expand and amend the topics as required in response to the individual context.

The assessment methodology is introduced at the start of the process through a set of lectures and presentations from experts in the fields of building and urban design, urban food production, ecology, transport, economy and psychology. A conference format is used to encourage discussion and interaction between participants. Only once the fundamental principles are explained does the group visit the development site and on this occasion local groups with interests in the development site are invited to discuss their views with the participants.

The data collection is undertaken in groups of five to manage the quantity of data available and provide peer support during this learning stage. For each topic area the status quo is recorded, as well as historic developments that shed light on the current status and planned or expected future developments that would impact on the development in the future. Considering that built environment developments have decades and even centuries of potential life, it is essential for the planning of sustainable and long life developments to understand what the future is likely to bring, be it future climate change, population growth, demographic changes or technical innovation.

The data is collected by means of library and internet-based literature reviews of academic, grey and government literature; on-site measurements and observations; and surveys and questionnaires. Surveys and questionnaires are used to mimic a community consultation process and are particularly useful in identifying issues

Table 1 Assessment categories and topics. Italics denote categories and topics typically reviewed in a traditional project feasibility study and site analysis, which take place at the start of architectural developments

The natural environment and natural capital	The built environment	Movement	Economics	Human capital and quality of life
• *Site topography/land and soil quality* • Local geology/potential for use of local materials • Integrated agriculture and landscape • *Local macro/microclimate* • *Solar/wind/hydro/ground source heating and cooling and other potential sources of low carbon and renewable energy* • *Access to water and rainwater/site drainage/wastewater treatment & disposal* • *Conserving and improving local biodiversity/protected species and habitats/habitat connectivity* • *Waste disposal and composting*	• *Brownfield sites* • *Building uses existing and required* • *Urban density and grain* • *Quality of public, private and communal spaces/ legibility/townscape and visual character* • *Building stock characteristics (materials, character, height, scale and massing)* • Building stock performance (energy, water, material impacts, adaptability and maintenance) • *Secure and accessible environments* • Healthy environments (light, noise, pollution)	• Public transport infrastructure, connectivity, usability and quality of facilities • *Pedestrian facilities, networks, walkways design and usability* • *Cycle facilities and networks, walkways design and usability* • *Street design for inclusiveness* • *Waterways as transport connections* • Support for alternative transport e.g. electrical vehicle points • Car clubs, car sharing • Cycles rental schemes • *Parking for cars and cycles*	• Demographics existing and projected • Training and education • Existing skill-base, employment and businesses/contribution to local economy and sustainability • Employment and unemployment levels • Employment opportunities and creation, including during development process • Political framework to support economy • Social mobility • Access to finance • Access to and definition of affordable housing within the local economic context	• Access to housing, schools, retail, healthcare, employment and food growing opportunities • *Safe, secure and healthy environments* • Child-friendly environments • Physical and mental health • *Access to green spaces, culture and leisure facilities for all age groups* • Respecting socio-cultural-religious identities and opportunities for expressing group and personal identities • Community/social cohesion, engagement and interaction • Institutions and social networks

particular to the site and local community, investigating specific questions and collecting personal views from the local community and are typically found to be very helpful to the community stakeholders involved in the 'real' development.

In addition to collecting data about the development site, examples of good practice that relate to the areas are researched. Good practice examples from international settings may not always apply to the local context but can generate ideas and represent ideals that can inspire and help change fixed mindsets.

The data is presented in written, graphic and video form. For instance, the use of an existing carpark designated from future development might be recorded with video; surveyed in terms of use and then graphically represented with plans showing the number of cars every hour over a 24 h period; spatial quality might be illustrated with photographs; and user surveys may be represented in graphs with pertinent quotes to support the quantitative results. The data is then analysed in terms of (1) current status, (2) what should be done, (3) what can be done considering future political, economic or social plans and trends. The overall aim is to identify what the proposed development should include, remove or change to develop sustainable high quality of life solutions for all community members while impacting minimally on the local and global natural environments.

Using tools such as SWOT analysis and through group discussions, the analysis identifies a long-list of recommendations to prioritise. Prioritising strategies requires discussing values within the group and also considering the limits of impact and contribution the built environment can make. While the built environment can support a more sustainable lifestyle, it becomes clear to participants that the built environment is only one of a number of elements and mechanisms that can help to develop sustainable societies.

The research and analysis is summarised in a report, which includes supporting data and recommendations. The reports are made available to all stakeholders.

4 BESQoL Applications

The BESQoL assessment methodology has been applied to several live developments in the Oxford shire area. The most recent assessment was for the redevelopment of a redundant university building and adjacent car park in the Summertown area of Oxford. This redevelopment was under discussion by the local community, Oxford University and Oxford council. A local community group was formulating a Neighbourhood Plan, which constitutes a community-led framework for development, regeneration and conservation of an area. Representatives of the local group introduced the students to the site history, current use and future uses under discussion. They expressed their opinions about what should be included in the redevelopment and these views were noted and discussed. The students continued the exchange of views with the group and approached other members of the local community, such as retailers, staff from the local library and other community venues, as well as members of the public of all ages. The resulting assessment

reports were presented to the local group and a public exhibition was held of the assessment results as well as urban design and building proposals for the site. The local group used the research data to inform the Neighbourhood Plan and the public exhibition served to raise awareness public awareness of comprehensive sustainable solutions in general and for the site.

The previous year, the methodology was applied to a village north of Oxford looking for ideas on how to become more sustainable. On this occasion the design of a new sustainable community building was adopted by the community. The methodology is currently being applied to the North Gate development in north Oxford, which has attracted much local attention due to its extensive scope including commercial facilities and 500 new homes.

When applied by students at Oxford Brookes University the assessment was initially undertaken in a time period equivalent to ten days over a period of twelve weeks. In the last two years this period was reduced to four weeks. In 2014 the delivery period of the assessment methodology was further reduced when the Oxford Brookes University team was invited to run the BESQoL assessment methodology as an intensive workshop over 9 days at two universities in Brazil.

The first intensive workshop was run in Recife, where the city had appointed a consulting team associated with the Federal University of Pernambuco to develop a masterplan for a 30 km stretch of the Capibaribe River in Recife. The BESQoL workshop was supported by local ecologists, architects and urbanists, and was attended by local city council staff from the urban design and building departments. The requirement was to address the needs of local disadvantaged communities living along the river and the flora and fauna inhabiting the river side, while integrating a new transport link parallel to the river. Proposals were developed for smaller scale connectivity improvements, housing solutions and means to enhance the local identity and community cohesion. A second workshop was run in Porto Alegre and a third is planned also in Porto Alegre for the end of 2015.

The application of the BESQoL assessment by practitioners would involve broadening the scope of a traditional site analysis to include the BESQoL categories applicable to the development project under consideration. Not all categories may be relevant to all developments, and elements of the BESQoL assessment can also be cost-effectively included in community and stakeholder consultations, which are increasingly being commissioned by clients and councils in the UK. A competent professional may therefore require between two and seven additional work days to incorporate the additional BESQoL assessment elements into their standard scope of work.

5 Review of Teaching Methods and Learning Outcomes

The BESQoL methodology encompasses educational principles that are fundamentally important to sustainability education. It sets a framework for deep learning as defined by Warburton (2003: 45) who argues that "deep learning is particularly

crucial in the case of sustainability education, where holistic insight and an ability to organise and structure disparate types of information into a coherent whole is central to the whole exercise. Deep learning involves paying attention to the underlying meaning. It is associated with the use of analytic skills, cross referencing, imaginative reconstruction and independent thinking".

Deep learning is affected by prior knowledge and experience (Warburton 2003) and the first set of lectures delivered at the start of the assessment process, which adopt a traditional transmissive and disciplinary learning approach, are an attempt at levelling the knowledge starting point of all participants. The subsequent stages of the teaching and learning process aim to provide a transformative learning experience.

Following the introductory disciplinary lectures, the research stage adopts a number of the forms of transformative learning identified in the 2012 Report on the UN Decade of Education for Sustainable Development (UNESCO 2012a, b, c) as being associated with Education for Sustainable Development. The research process constitutes 'discovery learning' where participants are primarily self-motivated and become experts in their area of investigation. The participants bring their particular expertise to their working group and experience 'collaborative learning', whereby participants not only learn but also teach their peers. The diverse areas of investigation create an interdisciplinary learning experience and the interaction with community stakeholder brings an invaluable insight in non-professional views of built environment developments and sustainability. Finally the analysis of the different areas of investigation requires participants to adopt a critical thinking approach to views, values, data and proposals that the group develops and discusses. The development of proposals for the brief is effectively a problem-based learning process that requires applying systems thinking in the process of synthesising all the analysed data.

Participants in Oxford, Porto Alegre and Recife reported that they found the BESQoL workshops instructive and that they would use the assessment methodology in their future architectural work. In particular, they reported that the BESQoL methodology raised their awareness of the wider scope of issues affecting sustainability, a learning experience typically absent from disciplinary learning (Tilbury 2011; Graham 2014; Warburton 2003). They also reported that it gave them a better understanding of the role that the built environment has to play in creating sustainable environments that also offer a potential for a high quality of life. This new knowledge triggered some of the participants to reassess their role as built environment professionals. For instance, architecture graduates from Oxford Brookes University have progressed to professional posts and research degrees associated with sustainability in the built environment rather than design. Feedback from community stakeholder also suggests their participation and the research reports and exhibited designs raise awareness and open minds. While the assessment process is only one of many triggers for change, for both participants and recipients of the assessment reports, it supports a change of attitude by providing a structured framework for considering issues that are new to many.

Whether the change in attitudes translates into a long-term change in behaviour depends also on other factors including: personal values, opportunities and personal competences. According to Wals (2014: 12) generic sustainability competences include:

- Competence to think in a forward-looking manner, to deal with uncertainty, and with predictions, expectations and plans for the future.
- Competence to work in an interdisciplinary manner.
- Competence to see interconnections, interdependencies and relationships.
- Competence to achieve open-minded perception, trans-cultural understanding and cooperation.
- Participatory competence.
- Planning and implementation competence.
- Ability to feel empathy, sympathy and solidarity.
- Competence to motivate oneself and others.
- Competence to reflect in a distanced manner on individual and cultural concepts.

The workshop provides opportunities to develop some of the above competences, such as interdisciplinary working, but it cannot necessarily help participants develop the ability to feel empathy, sympathy or solidarity or motivate oneself and others. Some Oxford Brookes University students who participated in the workshop in their penultimate year of architectural education and fully embraced the approach, when faced with a lack of support for addressing sustainability in their final year, they abandoned the BESQoL methodology and reverted to a narrow discipline limited approach to their work. This also applied to some professionals employed in practices that did not have an active sustainability agenda.

It is human nature to conform to the norms of the community one inhabits. Perhaps one of the learning outcomes that could be added to the BESQoL workshop as well as Wals' (2014) list of sustainability competences is the ability to work within 'hostile' environments (environments that ignore or actively discourage addressing sustainably) and retain ones conviction despite lack of support. Education, discussions and debates can help formulate a clear personal position, but it is a value judgement that will dictate whether living consistent with a clear personal position is worth forfeiting other benefits.

6 Conclusion

The BESQoL assessment methodology is a tool designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. It provides a framework for considering, researching and addressing a wide range of issues that can be affected by or affect the built environment in terms of quality of life and sustainability.

Participants' learning outcomes suggest the methodology effectively raises awareness and knowledge of the wider sustainability and quality of life issues, and provides research, analytical, collaborative and problem-solving skills. The local stakeholders, including professionals and the community, benefit from the interaction with new and different approaches and ideas, as well as informative data and inspiring visual representations of sustainable developments and lifestyles.

The benefits of such educational initiatives on the sustainability of the built environment take a long time to come to fruition. The assessment methodology is a tool and it is the individual's choice whether to apply it. To make comprehensive quality of life and sustainability considerations mainstream either a critical mass of informed and dedicated individuals is required to make such approaches the norm (Ball 2005) or financial and legal instruments have to be employed. Financial and legal instruments are most expedient, but even though educational changes manifest themselves more slowly, they are long-lasting and also form the basis for successfully implementing any legal instrument.

Education relating to values is as important as any disciplinary and personal knowledge and skills in terms of providing individuals with the strength of conviction to act in contrast with the current norm, which while changing, will persist for some time to come. Gaining knowledge and understanding in relation to the underpinning of values is the first step towards changes in values and ultimately behaviour (Schwartz 1977). Strong values are difficult to sway and any educational programme needs to provide opportunities for individuals to gain new insight, such as that provided by the BESQoL assessment methodology, and form a strong foundation for their new values.

References

Arup (2012) SPeAR Handbook 2012, External Version, Arup: Version 1.1| May 2012

Ball P (2005) Critical mass, how one things can lead to another. Arrow Books, London

Brownhill D, Rao S (2002) A sustainability checklist for developments, a common framework for developers and local authorities. BRE Centre for Sustainable Construction, Watford

Collins P, Quinn B (eds.) (2012) Building for life 12, building for life partnership

Graham P (2014) Sustainability and the Struggle for Hegemony in Australian Architectural Education, In: Leal Filho W (ed) World trends in education for sustainable development. Peter Lang GmbH, Internationaler Verlag der Wissenschaften, Frankfurt

Hall J et al (2010) A framework to measure the progress of Societies, OECD Statistics Working Papers, 2010/05. OECD Publishing. http://dx.doi.org/10.1787/5km4k7mnrkzw-en

Maslow A (1954) Motivation and personality. Harper, New York

Murray P, Goodhewb J, Murray S (2014) The heart of ESD: personally engaging learners with sustainability. Environ Educ Res 20(5):718–734

Mila C, Sanmarti, N (1999) A model for fostering the transfer of learning in environmental education, Environ Educ Res 5(3). 13504622

Rossi A (2012) Igloo, the world's first responsible real estate fund. Igloo, Manchester

Sassi P (2006) Strategies for sustainable architecture. Taylor and Francis, Abingdon

Schwartz SH (1977) Normative influences on altruism. In: Berkowitz L (ed) Advances in experimental social psychology, vol 10. Academic Press, London, pp 221–279

Shephard K (2008) Higher education for sustainability: seeking affective learning outcomes, Int J Sustain High Educ 9(1):87–98

Tilbury D (2011) Assessing ESD experiences during the DESD: an expert review on processes and learning for ESD. UNESCO, Paris. Available http://insight.glos.ac.uk/sustainability/Education/Documents/GUNI%20HE%20in%20the%20World%204%20HE%27s%20Committment%20to%20Sus.pdf. Accessed 09 Apr 2015

UNESCO (2005) Contributing to a more sustainable future: quality education, life skills and education for sustainable development. http://unesdoc.unesco.org/images/0014/001410/1410-19e.pdf. Accessed 09 Apr 2015

UNESCO (2012a) Shaping the education of tomorrow. 2012 report on the UN decade of education for sustainable development. http://unesdoc.unesco.org/images/0021/002166/216606e.pdf. Accessed 09 Apr 2015

UNESCO (2012b) Education for sustainable development sourcebook, education for sustainable development in action UNESCO education sector, learning & training tools N°4. http://unesdoc.unesco.org/images/0021/002163/216383e.pdf. Accessed 09 Apr 2015

UNESCO (2012c) ESD, Building a better fairer world for the 21st century, http://unesdoc.unesco.org/images/0021/002166/216673E.pdf. Accessed 09 Apr 2015

Wals AEJ (2014) Sustainability in higher education in the context of the UN DESD: a review of learning and institutionalization processes. J Clean Prod 62(2014):8–15

Warburton K (2003) Deep learning and education for sustainability. Int J Sustain High Educ 4 (1):44–56

Author Biography

Dr. Paola Sassi is an architect who teaches and undertakes research at Oxford Brookes University and the Oxford Institute of Sustainable Development. She taught sustainable architecture at Nottingham University and Cardiff University and currently runs the M.Sc. Sustainable Building: Performance and Design at Oxford Brookes University. She has 30 years of architectural practice experience mainly in Germany and the UK. As partner of Sassi Chamberlain Architects she was responsible for two shortlisted sustainable design competition entries and the design and construction of experimental buildings, including two ultra-low energy closed loop material cycle flats in Cardiff and a Victorian terrace refurbishment achieving 80 % reduction in heating requirements. She researches and has published in the field of design for deconstruction and closed loop material cycles, ventilation in ultra-low energy homes, motivations for adopting sustainable lifestyles and is the author of 'Strategies for Sustainable Architecture', runner up in the RIBA International Book Award 2007.