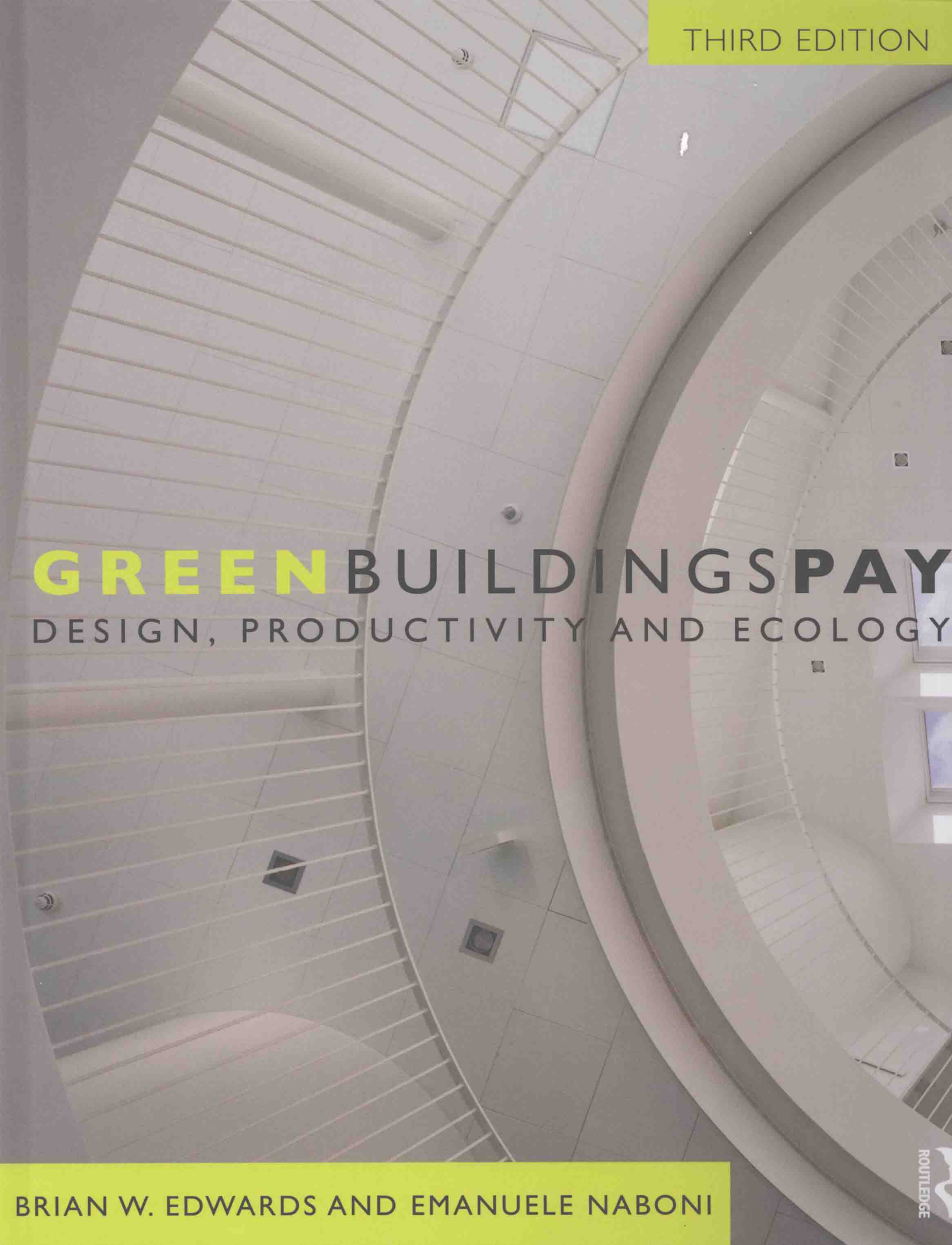

THIRD EDITION

GREEN BUILDINGS PAY

DESIGN, PRODUCTIVITY AND ECOLOGY

BRIAN W. EDWARDS AND EMANUELE NABONI

ROUTLEDGE

Green Buildings Pay

Design, productivity and ecology

Third Edition

Brian W. Edwards
and
Emanuele Naboni

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

Green Buildings Pay

This third edition of *Green Buildings Pay* presents new evidence and new arguments concerning the institutional and business case that can be made for green design. The green argument has moved a long way forward since the previous edition, and this fully updated book addresses the key issues faced by architect, engineer and client today.

Green Buildings Pay examines, through a range of detailed case studies, how different approaches to green design can produce more sustainable patterns of development. These cases are examined from three main perspectives: that of the architect, the client and the user. Completely revised with all new chapters, cases, sections and introductory material the third edition presents:

- over 20 new researched case studies drawn from the UK, Europe and the USA, written in collaboration with the architects, engineers, clients and user groups;
- examples of office and educational buildings of high sustainable and high architectural quality;
- an exploration of the architectural innovations that have been driven by environmental thinking, such as the new approaches to the design of building façades, roofs and atria;
- cases that demonstrate current practice in the area of energy/eco-retrofits of existing buildings;
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- beautiful full colour illustrations throughout.

In the fast evolving arena of green building, the book shows how architects are reshaping their practices to deal with ever more demanding energy standards and better informed users and corporate clients.

Brian Edwards is Emeritus Professor of Architecture at ECA, part of Edinburgh University, and was Associate Professor of Sustainable Architecture at the Royal Danish Academy of Architecture, Design and Conservation from 2008–11. He has practised as an architect in London, Vancouver, Edinburgh and Glasgow. Professor Edwards has written numerous books on architecture and many journal articles.

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EHDD: 9.2.2, 9.2.3
EN: 4.5.4, 9.4.1, 9.4.2, 9.4.3, 9.4.4, 9.4.7
Feilden Clegg Bradley Studios: 6.1.2
Floto + Warner: 5.6.3
Foster + Partners: 3.1.2, 3.1.3, 3.1.4, 3.2.6, 3.2.8, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 10.2.1, 10.2.2, 11.0.6, 11.0.7, 11.0.8
Gensler: 10.1.2, 10.1.3
HOK: 2.2.1, 10.2.3
Hopkins Architects: 9.1.2, 9.1.3, 9.1.4, 9.1.5, 9.1.6
Eduard Hueber-Archphoto: 5.6.1, 5.6.2, 5.6.7
KieranTimberlake: 9.6.1, 9.6.3, 9.6.4
KPMB Architects: 5.8.1, 5.8.2, 5.8.3
Eleanor Lee: 3.2.3
Loisos + Ubbelohde: 3.2.4, 3.2.5, 5.3.2, 5.3.4
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Foreword

Brian Carter

A current lack of consensus about the existence and particularities of climate change is in sharp contrast to the resounding agreement that the global economic crisis is real. In this context, the development of buildings that actually save money by conserving resources through thoughtful design is attracting increasing interest. And, while the architect is fundamental to the advancement of ideas related to the design of truly sustainable buildings, the clients who commission those architects, albeit often prompted by an economic imperative, are vital.

During the last few years clients across the world, operating in both the private and public sectors, have made significant commitments to sustainable design. In North America, one of the most notable clients is the General Services Administration. This federal agency in the United States, which is responsible for the design, maintenance and operation of all government buildings, initiated a Design Excellence program at the prompting of former US Senator Daniel Moynihan. Moynihan, an architectural enthusiast and an advocate for design, wrote the 'Guiding Principles for Federal Architecture' in the sixties. It was a document that was to provide the basis for a new approach to the design of government buildings and public space. Subsequently, the GSA's Design Excellence programme was enthusiastically advanced and, after notable architects had been sought out to design a series of new courthouses across the country, the programme has been expanded to include the renovation of existing buildings, the planning of government offices such as in San Francisco (see p. 128), research facilities and the creation of new ports of entry along both the northern and southern borders of the United States.

Universities and other educational institutions have also proved to be inspired patrons of modern architecture and sustainable design. In North America many campuses are large, often free-standing and planned to serve a diverse population. Like small cities, they include a mix of different building types with teaching and research facilities, community buildings and residential accommodation. In addition, they often include extensive natural landscapes and require infrastructural systems to provide energy, drainage, refuse disposal, transportation and more. Operated by a specialised staff under the direction of a University President, they are also environments that are not only required to operate efficiently but also provide settings that will attract and retain high-quality faculty, administrators and students. As a consequence, many successfully designed buildings and sustainable environments can currently be found on university campuses in settings from Yale, Princeton, Stanford and Buffalo to Toronto, Montreal and Vancouver. The same is true in Europe with examples such as the Green Lighthouse at University of Copenhagen and in the Gulf with King Abdullah University

Clients whose business is related to construction, energy supply and the environment can be particularly discerning with regard to the advancement of ideas related to sustainable design. In the United Kingdom the Central Electricity Generating Board led the way with the design of its new headquarters for the south west region that was completed in 1978 and, more recently, the headquarters for the Manitoba Hydro Company in Canada, which was designed by KPMB, has significantly advanced concepts for sustainable workspaces while also serving as a prototype for interested clients to test out new ideas. And, while many of these ideas relate specifically to the use of energy, they are also frequently related to the creation of workplaces that enhance the health, well-being and productivity of staff.

The corporate headquarters – a building type that, like the university campus, houses a complex set of uses – has proved to be a good testing ground for sustainable design over the last thirty years. Developed on large open sites as well as within cities across the world, they provide compelling models that are designed by multidisciplinary teams. Those teams, often based in notable practices including SOM, Arup Associates and Foster + Partners, frequently work with multinational corporations – clients who, like IBM, frequently bring together multidisciplinary groups of specialists to present the client's specific needs and work with designers to develop ideas. More recently, corporate headquarters have increasingly been replaced by spaces within buildings created by speculative developers. Perhaps as a

consequence of the more demanding requirements of tenants those developers, often maligned for their lack of concern for the environment, are increasingly committed to the design of sustainable buildings. Projects designed for Stanhope Properties, and more recently commercial buildings commissioned in London by British Land, clearly underline this commitment.

The clients who are commissioning new buildings for the future are also radically reshaping architectural practice. With particular interests that focus on achieving economy through sustainable design, those clients are demanding design proposals that are comprehensive and supported by advice that is interdisciplinary. This is transforming the discipline of architecture from an activity that was solely the realm of the single professional practitioner into one where the architect is increasingly working alongside structural and environmental engineers, cost estimators, materials scientists, fabricators, contractors and construction specialists so as to develop ideas from the initial concept through to the completion of the building and the operation of the facility once it is completed and in use. This integrative approach to architecture is not new. Early in the twentieth century the architect Albert Kahn was encouraged to create such a practice in Detroit to service the needs of rapidly growing industries. More recently, Arup enthusiastically advocated the benefits of this way of working and inspired the design and construction of significant buildings throughout the world. Increasingly, the interests of both clients and architects to conserve resources and reap the economic benefits of sustainable design have significantly advanced the organisation of professional services, improved the quality of professional service and configured new forms of practice. This is evident both in the US with, for example, SOM and in Europe with Foster + Partners.

At the same time, new digital systems have also been developed to encourage integrative design and construction documentation with the adoption of such systems as BIM increasingly demanded by clients. At the same time, other programs have been developed to predict the performance of different design options for buildings. And once those buildings are in use, sophisticated building management systems are increasingly being installed to assist operators, users and building managers to operate facilities effectively. It is also noticeable that these monitoring systems are not only being located in service spaces, but placed in the prominent public spaces of new buildings so as to make the operational needs and performance of buildings more obvious to occupants.

In order to respond to the complex requirements of these clients and the buildings that they commission, an increasing number of architectural practices are actively engaged in research. This response, which not only informs architectural practice but broadens the scope of design, has been led by new research groups that have been created both within offices as well as through collaborations between professional practices, clients and academic institutions.

In considering the value of the sustainable design of buildings, attention is increasingly being focused on the use of land and the importance of the site. In addition to working closely with landscape architects in the consideration of the design of natural landscapes and the impact that they can have on adjacent buildings, the reclamation of land, together with the repair and reuse of formerly derelict sites, are being increasingly viewed as fundamental aspects of a sustainable building design proposal. In this context, the reuse of derelict urban land to create a site for the Olympic Sculpture Park in Seattle or the ambitious programme of land reclamation prompted by the 2012 Olympic Games in London are notable examples. Similarly, the reuse and reconstruction of urban infrastructure has thoughtfully brought together city planning and architecture to create notable sustainable civic projects like the High-Line in New York City, the 'Big Dig' in Boston and Millennium Park in Chicago.

The inauguration of BREEAM and LEED in Europe and North America are administrative initiatives that have also had profound effects on the design of buildings and their sites. In North America the formulaic make-up of criteria that qualify buildings for LEED status continues to conspicuously direct the work of clients and designers. However, like a recipe that lists ingredients but gives little guidance about the mixing of those ingredients it is a system that is easily abused in the race to secure LEED rating. In addition, the confirmation of LEED certification can be expensive and, while commercial benefits may accrue, this tends to discourage some clients. However, the status attached to a BREEAM or LEED certified building continues to encourage many clients to request that their designers focus on sustainable design and both have made significant impacts on the perceptions of sustainability in architecture.

In a setting where buildings account for the use of nearly half of the world's energy, it is encouraging to see an increasing interest and commitment to sustainable design in modern architecture by both architects and their clients. It is also an interest that is informing the design process and prompting new forms of practice. And although this interest and commitment is frequently prompted by an economic imperative, it is clearly becoming a pervasive area of concern that is increasingly influential, as is evidenced by the continuing interest in this particular book.

Brian Carter, a registered architect in the United Kingdom, is Professor of Architecture at the School of Architecture and Planning at the University at Buffalo, The State University of New York where he served as Dean from 2003 to 2011. The designer of several award-winning buildings he is author of numerous books and articles on design, construction and practice. His work has been widely published in Europe and North America.

Preface

Brian Edwards

Since the last edition of this book, the forces that shape the design of buildings from ecological perspectives have come into clearer focus. The first is the impact of environmental certification schemes such as BREEAM and LEED on client expectation and hence on development briefs. Related to this is the growing recognition of the impact of climate change on future lifestyles, economic patterns and building sustainability. Clients have policies that address global warming, which architect and engineers have to address in order to win approval from development boards. In parallel, the building regulations and town-planning laws put far greater emphasis on resource conservation (mainly energy and water use) than in the past. Architects now work within a stricter legislative and awareness environment than when the second edition of this book was written a decade ago.

However, there have been other significant changes. More emphasis is placed on user needs and occupier preferences than in the past. People who spend their working lives inside buildings now demand better standards – thermal, acoustic and in terms of control of their own workspace. There is now greater appreciation that the performance or productivity of occupiers of office spaces is influenced by design variables, including the degree of access to daylight, natural ventilation, natural materials and views of nature. Small improvements in worker productivity through good quality design can pay for all the energy costs of a building. Likewise, poor design and poorly understood environmental controls can add greatly to human resource costs and lead to companies not reaching their energy targets. So one big change over previous office design models is the search for more natural and satisfying interior environments; this, evidence suggests, brings both productivity and energy benefits.

Another shift in emphasis is the perception of added value attached to green buildings. This derives from the resource efficiencies present, the enhanced comfort and perception of quality experienced by users, and the long-term robustness of sustainable architecture in an age of rising energy prices and expanding environmental laws. In this sense, a building branded with a BREEAM or LEED logo has marketplace cache and hence can attract a better quality tenant, allowing the developer to demand higher rents. Added value and green have become linked even in the hard-headed world of property development.

Technology has also moved forward a long way over the past ten years. The façade in particular has been the focus of interest with double and triple skins, more intelligent solar control systems, natural and cross-ventilation through stack-effect systems, and more user friendly window and blind controls. Roofs too have played their part in generating more sustainable solutions using renewable energy, harvesting rainwater and creating biodiversity more widely than in the past. Internally, new technologies have found their way in the wider use of daylight sensors and more sophisticated metering of spaces. The interior climate has benefited from integrated lighting and ventilation systems with display screens now used to show energy use (and carbon emissions) thereby motivating users to be responsible workers. What were R&D innovations in earlier editions of the book have become mainstream practice.

The book highlights the emergence of three typologies for the office building with their parallels in educational and research facilities. In city centres there are highly serviced, often deep plan, offices that use atria, heat recovery and natural cooling to achieve environmental targets. These buildings often have intelligent façade systems and intelligent roofs. The second, common in more suburban locations, is the narrow office with cross-ventilation and plenty of natural light, sometimes solar-assisted ventilation or geothermal energy. This group is more passive than active in the use of environmental technologies. The third group are hybrid buildings, often bespoke for corporate clients creating office space for their own use. These buildings employ a combination of passive and active systems, leading to buildings whose environmental technologies are externally visible and internally well integrated.

One significant change over earlier editions is the emphasis placed on examples from the US. Here, market deregulation and a slack national landscape in terms of energy

laws has led to the emergence of green buildings where clients demand environmental standards well above that in local legislation. Hence, in America the green movement is propelled more by corporate self-interest. The clients that demand LEED platinum for their buildings are investing in future robustness for their estate and, to a degree, in more immediate self-promotion. The ethical position in the US is subtly different from that in Europe where high taxes, strict planning laws and high energy standards force more uniformity. The free market approach in the US has provided some valuable lessons in sustainable construction for the rest of the world.

One aim of this book has been to describe and evaluate the new generation of office and university buildings emerging in the post Kyoto Protocol years. One pattern that has appeared is the worrying gap in energy figures between design expectation and the reality of use. Sometimes the design standards have been exceeded by a factor or 30 per cent or more. Buildings in use do not behave as their designers and engineers believe they will. Post-occupancy evaluation (POE) has revealed a distressing dichotomy between theory and reality. Many BREEAM and LEED top-scoring buildings have a lifelong certification that may not reflect the true picture. The book explores some of the reasons for this and makes a number of suggestions.

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Thanks also go to the editors of *Architecture Today* who allowed articles by Brian Edwards to be used here in abridged or developed form. In similar vein, thanks go to RIBA Publishing for permission to adapt sections from the third edition of *Rough Guide to Sustainability* written by Brian Edwards.

Routledge provided professional and courteous support at all times. The relationship between authors and commissioning editor is an interactive one. On this occasion, matters ran smoothly not least because of the enthusiasm and charm of Fran Ford.

Introduction to the third edition

Brian Edwards

The third edition of *Green Buildings Pay*, with the new subtitle 'design, productivity and ecology', explores the business and ecological benefits that derive from an approach to architectural design driven by sustainability. The addition to the title signals the focus of the book and its relevance to those who not only design and engineer buildings but those who commission architecture and those who occupy the products of this process. Hence, the user is a key and often neglected consideration.

The book examines via a number of cases the buildings that flow from corporate social and corporate environmental responsibility. It asks a number of questions:

- How does social and environmental care find expression in corporate architecture?
- What are the measurable and unmeasurable benefits for clients and users?
- How are new energy technologies finding expression in the design of the workplace and in the practice of architecture?
- What are the internal and external drivers behind green architecture?

There are three main perspectives: the client, the architect and the user. The general argument and the cases seek to present these three angles into a coherent whole. The choice of the cases examined has been made on the basis of three main criteria:

- Architectural quality as evidenced by design awards or publication in reputable professional journals.
- High BREEAM or LEED accreditation (or similar independent certification).
- The availability of Post Occupancy Evaluation (POE) from both a user and technical angle.

These parameters have been the basis for most of the buildings selected and also for the framework for wider discussion contained in Parts One and Two. However, some flexibility has been employed in order to present to the reader green buildings that the authors think warrant investigation. The main area where data is not always available in quality or scale is in POE. This is either because the building is too new to have been evaluated or because the data held is confidential. Frequently, there are statistics on the performance of the building but not user reaction or feedback. Technical monitoring tends to take priority over social or user-operational considerations. One key finding of the book is that periodic monitoring via an independent POE should be a condition of continuing BREEAM or LEED certification.

Some cases are presented because of their overwhelming architectural interest, others because of the innovative ecological or environmental approach, or because of the level of technical invention. However, the key criterion is that the buildings examined have something important to say in terms of architecture, sustainability and company ambition. Hence, the territory explored is where architectural values, green ethics and social sustainability come together.

The focus of the book, as in earlier editions, is on office buildings. These are often company headquarters and hence places where the corporate client has a big interest in providing conditions that enhance worker productivity. Such buildings also normally embrace company values such as transparency and innovation. Image too is important: projecting a green image through sustainable architecture impresses partners, planning authorities, customers and potential employees. The book also explores the impact that certification schemes such as LEED and BREEAM have had on the approach to design and the construction of a business case in favour of the extra costs of sustainability.

Companies have a big interest in ensuring that their buildings lead to a committed and productive workforce. Hence, a key theme of the book is the way the architecture of the workplace aids concentration, imagination and good team working. The kind of knowledge and research-based industries which many of the buildings examined support require staff to be entrepreneurial, innovative and creative. This goes for the pharmaceutical headquarters of Genzyme in Boston as well as the animator company Aardman in Bristol. Different kinds of spaces and different kinds of environmental settings support different kinds of workplace production. So the book discusses the architecture of productivity and speculates on the subtle relation between space, environment and creative working.

If the book investigates the arena of commercial architecture, it does not do so exclusively. An important secondary interest concerns university clients and the buildings produced on campus for students. Like corporate patrons, universities are also interested in low-energy design and associated benefits for student learning, image and in testing innovative clean technologies. Hence, green university or college buildings are examined using similar methodology as for commercial architecture. The chapter on schools is much reduced (it is well documented elsewhere) but again, the emphasis is on the ability of school buildings to improve education via attention to ecological design.

As a third edition, much old material has been removed. The aim is to present an overview of the chronology of green commercial architecture with an emphasis upon the future. Hence, some cases are designs of buildings still unbuilt, others are very recent creations, others still more mature. This is true of offices as well as the minor theme of educational buildings. Unbuilt projects form a bigger component than in earlier editions because they often contain the latest thinking on ecological design.

However, a significant change in direction concerns not the recent history of green architecture but its regional or national characteristics. Far more emphasis in the new edition is given to the office architecture of the US and (to a lesser degree) Canada. In these countries clients have been the main driver towards green architecture supported often by enlightened state authorities. Lax Federal taxes and laws have not led to the abandonment of sustainability. On the contrary, the private sector has stepped in believing that green buildings are good for business, good for employees and good for external relationships with customers and the wider public. Ironically, undemanding environmental law has fostered not hindered the search for cleaner technologies and healthier workplaces. The same may be true of China.

So one feature of the new edition is the wider geographical spread. This reflects the authors' interest in the geoclimatic and geopolitics of sustainability. There is a marked difference between Europe and the US, and also between Europe and Asia. All three regions are embraced – the latter mainly as cases of projects under construction. There are also differences in approach between different countries in Europe. Hence, the UK and Denmark are used to highlight the consequences of different planning, building and political systems even within a unified Europe.

Sustainability is not free of the cultural forces that shape most things. My choice of collaborating authors includes authorities drawn from different green traditions. From the US, I am fortunate in being able to draw on the expertise of Brian Carter, Professor of Architecture at the University of Buffalo and before that at Michigan University. He previously worked in London for Arup Associates and brings many years of interest in green architecture to bear. He has written the Foreword for this edition. From a different tradition, the book is the result of collaboration with Dr Emanuele Naboni who is an architect by training from Milan Polytechnic where he obtained his Ph.D. in sustainable design. He was a researcher at the Lawrence Berkeley National Laboratory (UC Berkeley) and is a LEED Accredited Professional. Dr Naboni has worked in the US on green projects for Skidmore Owings and Merrill (SOM) and currently is an Associate Professor of Architecture at the Royal Danish Academy of Architecture, Design and Conservation in Copenhagen.

The book is structured in six parts. Part One examines the business and institutional case for green buildings. Here, there are a number of chapters exploring the changing corporate and economic case for green buildings over the past two decades. These have influenced design approaches and led to the recognition that health and productivity are key consequences of sustainable design.

Part Two explores the design consequences of the growing business recognition that sustainable architecture is good for company balance sheets. Here, the emphasis is on the interface between architectural practice and business ambition. Key design approaches are explored as well as the tools used by architects to help develop green solutions and the new technologies that are emerging. A key theme is that of the power of consumers to shape the working environment. This part also examines research, innovation and development in the area of sustainable commercial design.

Part Three presents a number of case studies of green offices, some new and others drawn from earlier editions of *Green Buildings Pay*. The examples from the US, Canada and Europe are selected to present a chronology of changing design strategies and to highlight differences in architectural approach between continents.

Part Four examines green educational buildings with an emphasis on facilities for teaching, learning and research.

Universities, along with offices, are leading players in the search for sustainable solutions. This part of the book represents a minor theme but many of the same corporate and user pressures exist across many building types.

Part Five looks to the future. Here, there is an examination of emerging projects in emerging economies. The focus is on China and the Gulf Region, with both designed and recently constructed examples considered. The aim is to explore how green design is evolving and to set down some key findings of interest for those working in rapidly expanding regions.

Part Six draws a number of conclusions and presents guidance for those who commission, certify, design and construct sustainable architecture. Here, six themes are identified as key drivers or issues requiring attention for the future.

Contents

PART ONE

The greening of the property industry