Praise for *The Environmental Design Pocketbook 2nd Edition*

“The first edition of Sofie Pelsmakers’ book has been rightly acclaimed as ‘must have’, ‘essential’ and ‘comprehensive’. This new edition brings us up to date on recent changes to regulations, practices and understanding. The information is easily accessible and guides you from the general to the particular, assisted by delightful diagrams and drawings, all backed up with references. Get it!”

Robin Nicholson, Cullinan Studio

“I use this exceptionally comprehensive book as an architect, lecturer and researcher. It is an excellent, essential reference book and is often the starting point for students’ deeper research efforts.”

Huw Heywood, Architect and Principal Lecturer at University of Portsmouth

“We use *The Environmental Design Pocketbook* as a handbook in the office, it’s very useful for quick guidance on lots of issues. The illustrations are lovely and very architect-friendly and it’s the perfect size for a handy textbook.”

Lynne Sullivan, Partner, Sustainable By Design LLP and Chair, RIBA Sustainable Futures 2014-

“A truly informative reference for students and professionals alike. Many will begin to rely on this book; to guide, inform and signpost them towards making environmentally informed decisions at all design stages and scales.”

Dr. Julie Gwillam, Senior Lecturer, Welsh School of Architecture

“This is a brilliant resource that condenses and makes accessible critical aspects of sustainable design, without any dumbing down or greenwashing. It gets the priorities and focus right to allow designers to make a genuine difference in their work and to the environment.”

Elrond Burrell, Associate, Architype Ltd
Chapter 1
CO₂, climate change mitigation and the building industry

The construction and operation of buildings and cities accounts for around 50% of the UK’s CO₂ emissions and is thus a significant contributor to global warming. A reduction in CO₂ is needed to mitigate climate change, and this reduction is the main driver behind many building-specific EU and UK regulations, codes and frameworks.

However, CO₂ emissions are not the building industry’s only environmental impact. Other impacts include loss of biodiversity, resource depletion and negative effects on building users’ health and well-being.

This introductory chapter gives a brief overview of the main causes of global warming. It looks at climate change mitigation policies and frameworks, particularly CO₂ reduction targets. The chapter also discusses the challenges to CO₂ reduction posed by unpredictable ‘human factors’ and how building designers can meet them. Finally, a building maintenance and care checklist is followed by a ‘green’ checklist of the 2013 RIBA Plan of Work.

While this chapter sets out climate change mitigation measures, the succeeding chapter covers climate change impacts and adaptation measures.
Chapter 2
Design strategies and adaptations for a changing climate

Despite even the best mitigation efforts, our climate is experiencing irreversible changes.

Buildings are usually designed with a lifespan of around 60 years. What we build today will still be standing in 2080 and beyond, and we should design for the climate change predicted during that period. We must also carefully consider our reliance on finite resources which move closer to exhaustion by the day. Only in doing so are we able to fulfil our duty towards clients and building users.

Seasons in the UK, in general, are expected to become warmer. We will see drier summers, wetter winters and more extreme winds and rainfall. Although the increases in temperature are incremental, the actual impact on both the natural and the built environment is significant. As an island, the UK is particularly vulnerable to coastal flooding. Inland, extreme rainfall will increase the risk of urban flash floods and swollen rivers. We are also likely to experience more heat waves and droughts which could pose issues of subsidence and affect the way we cool buildings.

This chapter summarises predicted climatic changes and arising design implications and adaptations, both for site planning, building design and during construction.
Chapter 3
Environmental site planning

A building's performance is not only determined by local climate conditions and operational energy efficiency. Site location and urban design approach also have a major impact. Rather than working against the urban grain, we need to work with it by using environmental site planning principles; we can then promote occupant comfort and health as well as minimising operational and transportation energy use.

Instead of endlessly repeating historical patterns, site planning should respond to climate change predictions. This chapter considers the implications of a warmer climate on site planning and Chapter 5 discusses flood risk.

It is crucial to get the environmental basics right on the site. Then whoever ‘plugs into’ the urban grain in the future has a better chance of achieving high environmental building standards.
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**Chapter 4**  
*Urban greenery and biodiversity*

Biodiversity is an important facet of sustainable building, bringing social, economic and environmental benefits to any development. Not only can energy consumption in buildings be reduced by thoughtful planting, but urban greenery can also improve residents’ well-being and provide a crucial habitat for local wildlife.

Provisions for biodiversity need to be carefully thought through, if the benefits are to be maximised. The positioning of vegetation in relation to buildings and green corridors needs to be closely considered, as does the type of vegetation and future maintenance requirements. Native plants are essential for supporting indigenous wildlife habitats, while on the other hand some native plant species will not survive or thrive in a changing climate.

Urban vegetation also contributes to CO₂ sequestration. In addition, the principle of ‘food miles’ illustrates the carbon reductions that can be achieved by growing food locally.
Environmental design must work with water rather than against it. This is a primary consideration which will become even more important in a changing climate:

- Increased flooding due to extreme rainfall events is anticipated.
- At the same time, increased periods of drought and water shortages are expected.

Careful consideration is no longer a luxury; where to build, which building typology, how much land to set aside for water storage and which surface finishes are more resilient are now vital decisions for design. Allowing water runoff to soak-away on site instead of connection to sewers is nearly always the preferred option.

Water efficiency inside buildings is also starting to be regulated. Water-efficient appliances, rainwater harvesting systems and grey water recycling will eventually become embedded in building design. However, not all such systems are sustainable: it is energy intensive to treat and pump water around, and the embodied energy of the system can be significant.

Hence, careful building-specific design specification is required to avoid increasing carbon emissions in the quest to save precious water. Usually, connection to mains water supply and sewers is the most suitable option.
Chapter 6
The internal environment: space, warmth, light and air

Two key drivers are making consideration of a building’s internal environment ever more vital: the changing climate and the increased thermal performance of the fabric from which the building is built.

The fact that we are operating in a changing climate can no longer be ignored. If buildings are not designed to cope, temperature-related health issues will become a significant problem and it is therefore critical that issues such as thermal comfort, purge ventilation, daylighting, winter solar gain and summer solar shading are considered early on by the designer.

Equally, increased airtightness standards, controlled background ventilation and even the impact of building fabric on space standards all mean that a careful approach is required to avoid compromising the quality of the internal environment.
Chapter 7
The building fabric

Taking steps to reduce a building’s operational carbon footprint usually requires an increase in its embodied carbon footprint, owing to the increased amount of insulation and other material required. This ‘investment’ in a higher carbon footprint will soon pay off if the building is carefully designed and constructed for long life, ease of maintenance, deconstruction and reuse.

Materials and construction methods may be chosen according to:
• aesthetics
• costs
• availability
• robustness
• material performance, e.g. acoustics and structural strength.

When specifying the fabric of a sustainable building, the designer should also prioritise:
• life-cycle assessment and embodied carbon of materials, including designing for deconstruction and reuse
• thermal performance
• air, vapour and water permeability
• impact on internal air quality.

This chapter explores the latter points in more detail. The focus is on mainstream UK building techniques and materials.

Symbol indicates relevance to the Code for Sustainable Homes, EcoHomes, BREEAM and LEED.
Chapter 8
Retrofit of existing housing stock

There are around 26 million dwellings in the UK,¹ 80% of which will still exist in 2050.² At present, these dwellings represent around 27% of the UK’s CO₂ emissions.³

Around 7.6 million dwellings are solid walled properties.⁴ One entirely uninsulated solid walled property needs about the same amount of space heating as four to eight dwellings of the same size built to current Building Regulations. This illustrates both the necessity and the potential impact of retrofitting the existing housing stock.

Yet, so far, less than 1%⁵ of solid walled dwellings have been insulated, and no UK regulations deal with the refurbishment of existing housing stock. However, the 2008 Climate Change Act aims to make the entire UK housing stock zero or low carbon by 2050.⁶

By simply refurbishing to much higher insulation and airtightness standards, carbon reductions of at least 40% can be achieved. This would reduce the operational energy required just to heat our buildings by at least 80%.

Symbol indicates relevance to the Code for Sustainable Homes, EcoHomes, BREEAM and LEED.
Chapter 9

Key details

This chapter contains key details to illustrate good practice concerning insulation placement, airtightness zones and minimising thermal bridging. The details for new build are based on cavity wall brick/block construction with concrete super-structure and include green walls. Typical retrofit junctions are based on solid brick walls. The airtightness recommendations and principles in Section 7.4 need to be applied to all of the details at both design and construction stage. For the environmental impact of different construction materials and for details of timber-framed construction, SIP, hempcrete and structural engineered timber pre-fab panels, see Section 7.2.

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Chapter 10

Energy supply and demand

Energy supply is often wrongly considered to be the most important issue in delivering low carbon buildings.

In fact, the priority is to reduce energy demand.

When considering energy supply and demand, a clear hierarchy exists:

1. Fabric energy efficiency is always the first ‘renewable’ to consider as opposed to trying to meet a building’s large energy demand.
2. Once reduced, it is easier to meet any remaining energy demand, which should be met using efficient methods. This avoids wasting energy in transmission, even if it is energy from ‘low carbon’ sources.
3. Low carbon energy supply should only be considered once the above strategies have been maximised.

The preceding chapters have focused on the first point and set out strategies to reduce energy demand in buildings.

This chapter relates to operational energy and operational carbon from buildings. It summarises the energy demands of different building typologies. It investigates efficient methods of delivering energy, such as underfloor heating, use of A-rated appliances and local energy generation from district heating schemes.

Symbol indicates relevance to the Code for Sustainable Homes, EcoHomes, BREEAM and LEED.
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### Chapter 11

**Zero Carbon Buildings**

Despite zero carbon buildings becoming a reality in just a few years, development of the zero carbon framework is still being developed at the time of writing. England has made the most progress with its zero carbon definition for housing and so it is this standard which is used in this chapter.

By 2020, all new UK buildings must meet the zero carbon standard. At present this means that 100% of a building’s regulated carbon emissions are to be reduced to ‘zero’ over a 30-year life span. This is achieved through:

1. Increased fabric energy efficiency standards (FEES)  
   - Jump to Section 7.5.2
2. On-site energy supply (low and zero carbon technologies)  
   - Jump to Chapter 12
3. ‘Allowable solutions’, which could be a combination of the above, or other off-site measures, and this may include payment per tonne of remaining CO₂ emissions (see Section 11.1.3).

Steps 1 and 2 are called ‘carbon compliance’. A simple zero carbon calculator is provided so that the reader may roughly estimate a development’s zero carbon feasibility.

The zero carbon standard is continuously evolving, so the reader should always check for the latest updates:

- Scotland: www.scotland.gov.uk/Topics/Built-Environment/
- England: www.zerocarbonhub.org
- Wales: www.sustainablebuildingportal.co.uk
- Northern Ireland: www.theccc.org.uk/topics/uk-and-regions/northern-ireland

Symbol indicates relevance to the Code for Sustainable Homes, EcoHomes, BREEAM and LEED.
Chapter 12
Low and zero carbon technologies and renewables

Renewable energy is energy that comes from inexhaustible sources. It usually originates directly or indirectly from the sun’s radiation.

Not all technologies which offer significant environmental benefits over the use of conventional fossil fuels fall into this category. This is why the term ‘low and zero carbon technologies’ (LZC) is often used instead of ‘renewable energy technologies’.

Low and zero carbon technologies are often incorrectly seen as fundamental to ‘green buildings’. In fact, reducing energy demand is the priority when delivering low energy buildings.

Suitable ‘clean’ energy sources should be discussed early on as part of a holistic strategy, but only utilised after maximising energy savings from passive measures and fabric efficiencies.
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“A simply brilliant book. A must have for anyone interested in the why, what and how to design and deliver sustainable buildings. Accessible, educational, practical, common-sense and evidence-based, a book that you’ll refer to again and again. If everyone involved in the policy and practice around green building read and used this as a matter of course, we’d be a whole lot closer to making sustainable development happen for real.”

Paul King, CEO, UK-GBC; Vice Chair, World-GBC; Chairman, Zero Carbon Hub

“This is the most comprehensive and authoritative single reference work in the field of sustainable design. The new edition consolidates its reputation.”

Dean Hawkes, University of Cambridge

“The Environmental Design Pocketbook is an outstanding source of information and techniques. It should be part of every architect or aspiring architect’s library.”

Matt Bridgestock, John Gilbert Architects, SEDA

This 2nd Edition is now fully up to date with the latest UK Building Regulations, legislation and guidance, the RIBA Plan of Work 2013 and BREEAM credits.

New material includes care and maintenance of buildings and LEED credits, with information on the performance gap, Zero Carbon, and the Green Deal. It contains updated references, web links and further reading sections throughout, while the retrofit chapter and the ventilation, airtightness and heat-loss sections have been expanded. The new edition also continues to provide:

- guidance on all core sustainability topics
- handy tools, allowing quick design estimates
- design guidance, technology, building science and best practice

Whether used in the classroom, office or on-site, the book guides the designer through the entire process; from the fundamentals to the building details. From future-proofing for a changing climate to rainwater harvesting, retrofit, and zero-carbon technologies – the Pocketbook has got it covered.