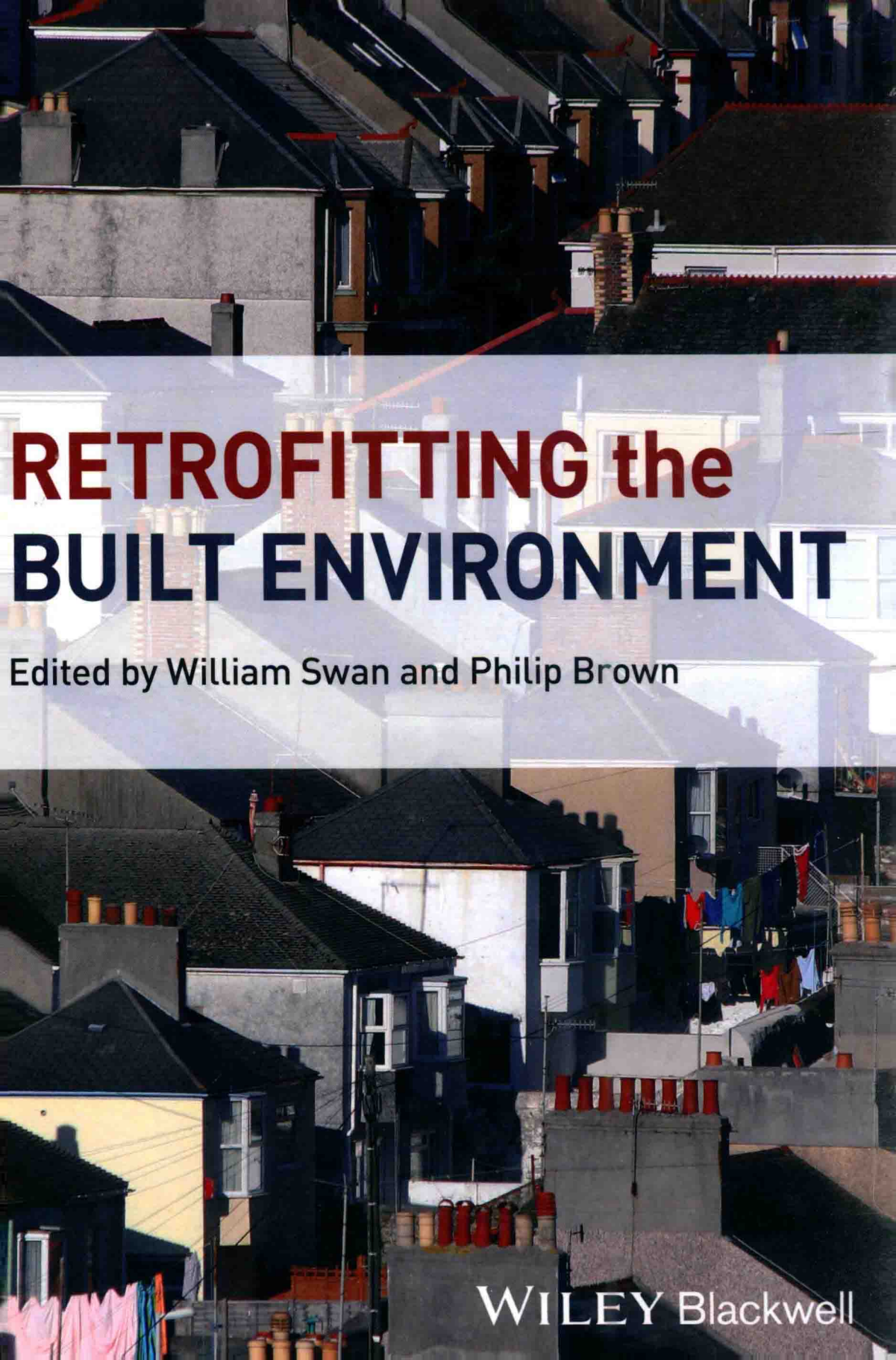

RETROFITTING the BUILT ENVIRONMENT

Edited by William Swan and Philip Brown

WILEY Blackwell

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William Swan & Philip Brown
University of Salford, UK

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Retrofitting the Built Environment

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Philip Brown is Director and Senior Research Fellow at the Salford Housing and Urban Studies Unit (SHUSU) at the University of Salford, UK. He is a Chartered Psychologist with the British Psychological Society with particular interests in public policy and community and environmental psychology. Philip has led and contributed significantly to a wide number of multidisciplinary projects, including current work that looks at energy reduction, behaviour change and retrofitting. Philip has published numerous reports and produced a range of peer-review papers in the field of social policy and the built environment. He is the lead academic on end-use energy demand within the University of Salford's Energy Hub. Philip sits on Greater Manchester's Low Carbon Economic Area Group for Customer Engagement and has been part of the Economic and Social Research Council's (ESRC) Peer Review College since its inception in 2010.

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Patricia Gee is President and owner of GreenRoots Strategies (GRS), a consulting practice specializing in stakeholder engagement and participatory programme

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Victoria Haines is a Senior Lecturer and heads the User Centred Design Research Group at Loughborough Design School, Loughborough University. She is a Fellow of the Institute of Ergonomics and Human Factors and a Registered European Ergonomist. Her research focuses on consumer behaviour and user-centred design, exploring how people interact with their environment and the products and services they use, particularly in the area of energy efficiency and domestic buildings. She has worked extensively on multidisciplinary projects with commercial and industrial partners, acting as Co-Investigator on RCUK/E.ON funded projects CALEBRE (developing consumer appealing technologies for building retrofit) and CCC (Carbon, Control and Comfort in social housing), as well as the EPSRC DEFACTO project, focusing on domestic energy saving following refurbishment.

Marianne Heaslip is an architect at URBED (Urbanism Environment Design) Ltd in Manchester, UK. In recent years she has developed an expertise in low-energy building retrofit, through direct involvement in retrofit projects, strategic research and mapping of programme models, and evaluation of completed projects. She was a designer on 10 whole house retrofits as part of the TSB 'Retrofit for the Future' project, working on specification, supply chains and resident liaison in very low-energy retrofit. She is currently working with the Carbon Co-op in Manchester and community-led regeneration projects in Liverpool. She was a researcher and co-author of The Community Green Deal for SHAP (Sustainable Housing Action Partnership), which mapped out how low-energy refurbishment might be rolled out at a neighbourhood and regional scale. She also contributed to the Greater Manchester Domestic Retrofit Strategy.

Mike Hodson is Associate Director and Senior Research Fellow at the Centre for Sustainable Urban and Regional Futures (SURF), University of Salford, Manchester, UK. His research interests focus on urban and regional transitions to low-carbon economies and the lessons to be learned from such processes. Mike has published and presented widely on this agenda. He has done so for academic, practitioner and policy audiences, in the UK and internationally. Most recently Mike has written *Low Carbon*

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Becky Mallaband is a Research Associate and a member of the User Centred Design Research Group at Loughborough Design School, Loughborough University. Her research focuses on User Centred Design (UCD), particularly within the domestic energy domain. She is particularly interested in how a UCD approach can be used within interdisciplinary research and how it can add value to the engineering design process of energy saving technologies. She has worked on multidisciplinary projects with other academic institutes, commercial and industrial partners, including the RCUK/E.ON funded project CALEBRE (Consumer Appealing Low Energy Building Retrofitting) and the EPSRC DEFACTO project (Digital Energy Feedback and Control Technology Optimisation).

Simon Marvin is currently the Carillion Chair of Low Carbon Cities and Deputy Director of Durham Energy Institute in the Department of Geography at the University of Durham. Simon is an expert on the changing relations between cities, regions and infrastructure networks in a period of resource constraint, institutional restructuring and climate change. Simon's research has been funded by the ESRC, EPSRC, international research foundations, the European Commission, commercial funders and many public agencies. He is currently working with the UNEP as a lead author on a major new report on decoupling cities and resource use. His research is currently focused on two large programmes – the first looking at comparative urban responses to climate change and resource constraint by cities in Africa, China, Sweden and the UK, and the second funded by the EPSRC looking at whether and how UK cities develop the knowledge and capability to systemically re-engineer their built environment and urban infrastructure.

Tim May is Professor and Director of the Centre for Sustainable Urban and Regional Futures (SURF), University of Salford, Manchester, UK. His interests centre upon the relationship between knowledge, action, organizational strategy and working context, which he has developed in a variety of fields including: local government, probation

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Beth Perry is Associate Director and Senior Research Fellow at the Centre for Sustainable Urban and Regional Futures (SURF), University of Salford, Manchester, UK. Her main conceptual interests are in governance, cities and urban change and communities, as well as the changing dimensions and tensions of the research–practice relationship. Beth has published widely on these themes and seeks in practice to explore the strengths and limitations of engagement with different partners through innovative methods in co-producing relevant and excellent knowledge for sustainable urban futures. She is currently also Director of the Greater Manchester Local Interaction Platform for Sustainable Urban Development, Mistra Urban Futures and is Salford-lead on an Arts and Humanities Research Council project on connecting communities in the cultural urban economy. Through these programmes of work, her current research focuses on governance and the socio-cultural dimensions of sustainability in cities.

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Sergio Sabbadini is an architect specialised in alternative and ecological technologies in the building sector. He has been working at the Centre Ecologique Européen Terre Vivante (France) and is member of the Terre Vivante association. He is co-founder of the DISSTUDIO building design company and carries out sustainable architecture projects. His research activities are focused on constructive techniques that utilise earth as a building material. His activities include new constructions, building refurbishment, cultural heritage conservation and some archaeological experiences. He collaborates with several different companies to develop new products based on natural insulation materials and new plasters based on earth. He is also responsible for a building design course at the Politecnico di Milano. He is member of the board of ANAB (Italian National Bioecologic Architecture Association), where he is responsible for the activities related with the use of earth as a building material, including international projects such as the Leonardo da Vinci project Inater.

Luke Smith is an Architectural Technologist whose career to date has been dedicated to low carbon sustainable development and refurbishment of buildings. His experience includes working with the Energy Efficiency Partnership for Buildings, a not-for-profit membership organisation that facilitates closer working between industry, government and community organisations. He has also worked with the National Energy Foundation, the University of Salford and with Housing Associations and Local Authorities to advise on the conception and delivery of numerous domestic and non-domestic sustainable retrofit projects. Most recently he has contributed to a Built Environment Sustainable Energy Action Plan for the Liverpool City Region and led the development of a bespoke toolkit capable of systematically evaluating the opportunities and feasibility of reducing the demand for energy and water across a portfolio of existing assets. Luke is a BREEAM Accredited Professional, holds APMP status and is a qualified Domestic Energy Assessor. Prior to his work on retrofit Luke worked with the Vietnamese Green Building Council on the development and application of sustainable building metrics and benchmarks, Preston City Council and contributed to a number of international sustainable design competitions.

Will Swan is a Senior Lecturer in Buildings Retrofit based in the School of Built Environment in the University of Salford. He leads a number of projects in the field of sustainable retrofit looking at issues of the delivery of sustainable retrofit. He is particularly interested in issues of adoption, assessment of delivery of sustainable retrofit with regards to supply chains and process. Will chairs the Greater Manchester Retrofit Product and Process Innovation Group, sits on the National Refurbishment Centre and the Greater Manchester Buildings Group, dealing with buildings and energy use generally for buildings stock. Previously, he worked for the Centre of Construction Innovation where he advised on regional policy for sustainable buildings.

Stephen Todd, Senior Lecturer in Construction and Maintenance Technology, Building Pathology and Defects at the University of Salford, UK. Stephen has a background in practice before entering academia. He has worked on innovative European Commission funded low-energy housing research. He has also undertaken Stock Condition Surveys for Local Authorities and is a registered Energy Trainer, Code for Sustainable Homes Assessor and BRE Associate. He was also part of the team that developed the Warrington Energy House, which was a collaborative project between the University of Salford, Warrington Housing Association and Warrington Borough Council. For the past 28 years he has undertaken consultancy work in the building defects and energy conservation areas and has appeared as an expert witness where the quality of building work is under dispute. He also had a major input to the DETR Rebuilding Grant Project and was a member of the Welsh Pilot Scheme for Home Information Packs and Energy Performance Certification. He sits on Greater Manchester's Low Carbon Economic Area Group for Product and Process Innovation and previously on the Retrofit Standards Group. He also sits on an advisory panel for DCLG in respect of changes to the Building Regulations.

Alexandra Willey is a Special Projects Manager within the Property Investment team at Affinity Sutton, a national affordable housing provider to over 57 000 homes in the UK. After completing a Masters in town planning, she joined the organisation on the Graduate Management scheme in 2009, completing placements with Community Investment, Strategic Projects and Asset Management before being appointed as the FutureFit Project Manager in June 2010. FutureFit was Affinity Sutton's response to the challenge of Greening its homes and involved delivering various packages of retrofit and energy efficiency lifestyle advice to 150 homes nationwide. The award winning project looked at the practical implications of wide-scale retrofit and has provided a body of evidence to help prepare the industry for the Government's Green Deal. As Special Projects Manager, a post she has held since 2011, Alex is responsible for Affinity Sutton's approach to the retrofit agenda, including feeding into a number of industry groups and engaging with staff and residents around the forthcoming Green Deal.

Foreword

Kevin Anderson

Setting the scene for 2012

With early evidence that large-scale impacts of climate change are becoming discernable from the background of natural variability, there is increasing concern over the international community's abject failure to control emissions. The International Energy Agency's (IEA) chief executive (Maria van der Hoeven 2012) captures this pivotal moment in history when noting that 'The current state of affairs is unacceptable .... Energy-related CO_2 emissions are at historic highs, and under current policies, we estimate that energy use and CO_2 emissions [will] increase by a third by 2020, and almost double by 2050.' The IEA's chief economist (Fatih Birol; see Rose 2012) goes on to state that '[This] trend is perfectly in line with a temperature increase of 6 degrees Celsius, which would have devastating consequences for the planet.'

Reality or rhetoric: Revealing the challenge of climate change

It is almost two decades since the international community committed to the 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UN 1992). However, it was not until 2009 that the threshold between dangerous and acceptable levels of climate change was finally enshrined in an international agreement. The Copenhagen Accord (UN 2009), later reiterated in the Cancun Agreements, established a clear target against which to measure progress. The Accord, to which most nations are now signatories, requires that the global community 'hold the increase in global temperature below 2 degrees Celsius, and take action to meet this objective consistent with science and on the basis of equity'.

Against this backdrop of well-meaning but ultimately rhetorical commitments, emissions of carbon dioxide have continued to rise (IEA 2012), this despite several years of economic contraction in many industrialised nations. In 2009–2010, global carbon dioxide emissions rose markedly, up by almost 6%; in 2010–2011 they rose by a further 3%, with a similar rate of growth anticipated for this year.

Coinciding with this escalation in emissions, there is increasing recognition that climate change has little correlation with long-term end-point reduction targets, for example the UK's statutory requirement for an 80% reduction in emissions by 2050. By contrast, the rise in temperature is closely related to the continual build-up of long-lived greenhouse gases, particularly carbon dioxide, in the atmosphere. This characterisation of climate change as an issue of cumulative emissions and *carbon budgets*, has fundamental implications for the framing, chronology and urgency of

policies for reducing emissions. Whilst 2050 targets lend themselves to gradual reductions dominated by the roll-out of low-carbon energy supply technologies, the science makes clear that in the absence of radical and immediate mitigation, such technologies will fail to deliver on the UK's international climate change commitments (Anderson *et al.* 2008).

The scale of the challenge, framed by scientifically informed carbon budgets as opposed to scientifically illiterate 2050 targets, has fundamental implications for mitigation policies, or, if neglected, the level of climate-related impacts and accompanying adaptation. This already testing transition from fiction to fact around climate change is made yet more difficult for the UK (and all Annex 1 nations) once the 'equity' dimension of the Copenhagen Accord is acknowledged (Anderson and Bows 2011).

The UK government, with guidance from the Committee on Climate Change (CCC), have established an overarching regime for UK mitigation policy premised on non-Annex 1 emissions peaking by around 2018. Whilst this may be a little later than is assumed for Annex 1 nations, it is nevertheless far removed from the spirit, if not the words, of the Copenhagen Accord, which explicitly recognises 'that the time frame for peaking will be longer in developing countries and ... that social and economic development and poverty eradication are the first and overriding priorities'. If the UK were to take seriously the international commitments to which it is a signatory, the peak in emissions from non-Annex 1 nations would be post-2025, with the consequent rate of mitigation for the UK substantially increased.

Similarly, and again despite its explicit commitments, the UK frames national obligations in terms of a global carbon budget that, according to the CCC's own analysis, has a high probability (63%) of exceeding 2 °C. This not only contravenes the probabilities accompanying the Copenhagen Accord, but also those associated with the UK's own Low Carbon Transition Plan as well as various EU commitments.

Finally, the CCC and UK government's chosen carbon budget takes no account of global deforestation, presuming instead that any such emissions are solely the responsibility of nations where deforestation occurs. Given that the UK and most Annex 1 nations have already reaped the short-term rewards of their own national deforestation, this presumption is incompatible with the Accord's equity concerns (Anderson and Bows 2011).

Bringing together the science with a direct reading of the UK's international commitments transforms the climate challenge agenda from one of gradual mitigation and adaptation to 2 °C to one of urgent and deep reductions in emissions alongside adaptation to 4 °C (and higher) futures. As it stands the UK's current position, though politically palatable, is evidently and significantly in breach of international commitments as well as its own domestic obligations.

Consequently, whilst the UK asserts:

- its intention to make a fair contribution to avoiding dangerous anthropogenic interference with the climate system;
- that a 2 °C rise in global mean surface temperature is the appropriate delineation between acceptable and dangerous levels of climate change;

- that the chance of exceeding the 2 °C threshold should be kept to *exceptionally unlikely* to *very unlikely* (1% to 10%) (Intergovernmental Panel on Climate Change 2010);
- that national mitigation efforts should be derived on the *basis of equity*, by which non-Annex 1 nations are given considerable emissions space to further develop;

... the reality is that the UK position is premised on:

- a ~63% chance of exceeding 2 °C (contrasts with the below 10% chance to which it has committed);
- an almost complete disregard for issues of equity, with poorer nations:
  - expected to bear all of the responsibility for deforestation,
  - required to peak their emissions just a few years after nations such as the UK,
  - and be responsible for all emissions from manufactured goods consumed within the UK, but manufactured in poorer nations (i.e. maintain a 'producer'-based inventory of emissions).

Retrofitting the future: Making the most of what we have

The scale of the mitigation challenge faced by the international community, even for an outside probability of staying below 2 °C, is unprecedented. However, for the wealthier parts of the world, not only are the necessary rates of mitigation beyond anything previously countenanced, they need to begin immediately if any emission space is to remain for poorer nations to develop. As a guide to the challenge, Annex 1 nations need to achieve an absolute reduction in emissions of around 40% by 2015, 70% by 2020 and over 90% by 2030 – and still emissions from non-Annex 1 nations would be required to peak by around 2025.

However, the challenge, particularly for the built environment and wider infrastructure, is more demanding still. Coincident with such deep mitigation is the need to ensure that communities are resilient to large and unpredictable changes in their local climate. The prospects of holding to a 2 °C future are slim; a 4 °C rise in the second half of the twenty-first century must be seriously considered (New *et al.* 2011). It is here that the built environment must endeavour to find the appropriate compromise. Houses must be designed not only to be low- or zero-carbon, but also to provide shelter in climatic futures likely to be very different from those currently experienced.

The UK is probably in a more fortunate position than many nations. Not only is it geographically insulated from some of the more extreme temperature impacts, the UK is a wealthy nation with a good science base that is beginning to provide some understanding of regional impacts. However, whilst the mitigation agenda is quantitatively clear, impacts and adaptation will never be subject to such certainty. Consequently, despite the benefits that accrue to the UK, the country's uncertain

climatic prospects frame the future of the built environment as one of compromise and learning-by-doing rather than of optimisation.

With around 30% of the UK's carbon emissions arising from its 26 million domestic residences (EST undated) the built environment is a pivotal sector in terms of mitigation and adaptation. As in all sectors, to date the focus of attention has been typically on new technologies and new equipment as a path to a low-carbon and resilient future. However, such a vision is simply incompatible with the chronology of change necessary to deliver a 2°C or even 3°C future. Virtually all the properties in which we will be living in 2015 and 2020 exist today, as do many of those for 2030 and even 2050. Consequently, although attention is focused typically on new-build, the real substance of the challenge is in retrofitting. Transforming the existing housing stock into the low-carbon and climate-resilient bedrock of communities is itself a difficult task. However, for the UK not to renege on its 2 °C commitments, this transition must begin now and be achieved within the coming decade. Perhaps the sector's greatest challenge is that this can only succeed if genuine partnership is developed between civil engineers, architects, planners, house-builders and, of course, householders. Ultimately, this is as much a political and social as it is a technical challenge, and one that needs to be tackled immediately if futile rhetoric on mitigation is to be replaced with meaningful leadership on climate change.

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