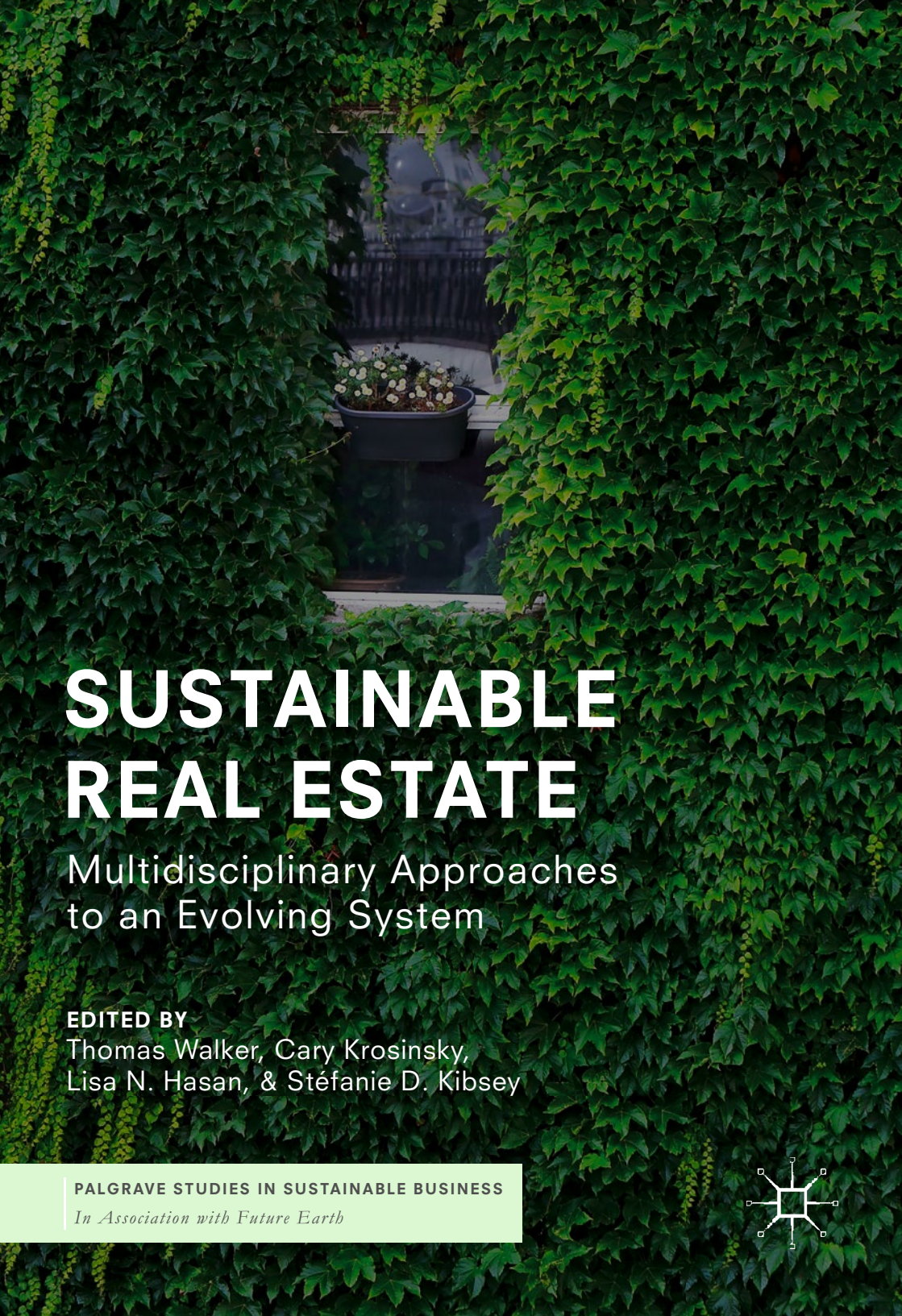

SUSTAINABLE REAL ESTATE

Multidisciplinary Approaches to an Evolving System

EDITED BY
Thomas Walker, Cary Krosinsky,
Lisa N. Hasan, & Stéfanie D. Kibsey

PALGRAVE STUDIES IN SUSTAINABLE BUSINESS
In Association with Future Earth

Palgrave Studies in Sustainable Business
In Association with Future Earth

Series Editors
Paul Shrivastava
Pennsylvania State University
University Park, PA, USA

László Zsolnai
Corvinus University Budapest
Budapest, Hungary

Sustainability in Business is increasingly becoming the forefront issue for researchers, practitioners and companies the world over. Engaging with this immense challenge, Future Earth is a major international research platform from a range of disciplines, with a common goal to support and achieve global sustainability. This series will define a clear space for the work of Future Earth Finance and Economics Knowledge-Action Network. Publishing key research with a holistic and trans-disciplinary approach, it intends to help reinvent business and economic models for the Anthropocene, geared towards engendering sustainability and creating ecologically conscious organizations.

More information about this series at
http://www.palgrave.com/gp/series/15667

Thomas Walker • Cary Krosinsky
Lisa N. Hasan • Stéfanie D. Kibsey
Editors

Sustainable Real Estate

Multidisciplinary Approaches to an Evolving System

palgrave
macmillan

Editors
Thomas Walker
David O'Brien Centre for Sustainable Enterprise
John Molson School of Business
Concordia University
Montreal, QC, Canada

Lisa N. Hasan
David O'Brien Centre for Sustainable Enterprise
John Molson School of Business
Concordia University
Montreal, QC, Canada

Cary Krosinsky
Yale University
New Haven, CT, USA

Brown University
Providence, RI, USA

Stéfanie D. Kibsey
John Molson School of Business
Concordia University
Montreal, QC, Canada

Palgrave Studies in Sustainable Business In Association with Future Earth
ISBN 978-3-319-94564-4 ISBN 978-3-319-94565-1 (eBook)
https://doi.org/10.1007/978-3-319-94565-1

Library of Congress Control Number: 2018953323

Cover image © Denys Kuvaiev / Alamy Stock Photo
Cover design by Tom Howey

This Palgrave Macmillan imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Acknowledgments

We acknowledge the financial support provided through the Sam and Diane Scalia Sustainable Real Estate Program, the David O'Brien Centre for Sustainable Enterprise, and the John Molson School of Business at Concordia University. In addition, we greatly appreciate the networking support provided by Future Earth as well as the research and administrative assistance provided by Amr Addas, Katrina-Frances Gattuso, and Tyler Schwartz at Concordia University. Finally, we are grateful for the excellent copy-editing and editorial assistance we received from Naomi and Stephen Miller.

Contents

Notes on Contributors

Muhammad Umar Bello is a lecturer in the department of Estate Management and Valuation of Abubakar Tafawa Balewa University, Bauchi, Nigeria. He obtained his doctor of philosophy in Real Estate and Facilities Management from the Faculty of Technology Management and Business of Universiti Tun Hussein Onn Malaysia (UTHM) in March 2018. He obtained a master's degree in 2015 in Gender, Environment and Development from Usumanu Danfodiyo University, Sokoto, Nigeria. He attended Abubakar Tafawa Balewa University, Bauchi, for his first degree where he graduated from the Department of Estate Management and Valuation in 2009.

Margarita Caycedo is an economist with a Master's degree in Industrial Economics and a Graduate Diploma in Finance and in Business Administration. She has performed research and project evaluation roles and community involvement work in social economy organizations in Montreal related to sustainable finance, sustainable trade, women's entrepreneurship, and human rights education. Caycedo is studying for the Sustainable Investment Professional Certification at John Molson Executive Centre at Concordia University, Canada.

Pernille H. Christensen is the Course Director for the Bachelor of Property Economics program at the University of Technology Sydney and a member of multiple industry sustainable development advisory committees. Using a multi-disciplinary approach, her research focuses on decision-making related to sustainability in property and planning, specifically

enhancing community resilience to flooding, heat island effect and terrorism, operational building management, and developing alternative solutions to affordable housing challenges.

Isa Olalekan Elegbede is a PhD candidate in the chair of Environmental Planning at Brandenburg University of Technology, Cottbus-Senftenberg, Germany. He had previously obtained an MSc in Environmental and Resource Management from the same university. His research area is in Voluntary Sustainability Standards (VSS). He is a member of various organizations of high repute.

Jeremy Gabe is Lecturer in Property at the University of Auckland, New Zealand; an award-winning researcher; and an advisor to various Green Building Council technical committees. His multi-disciplinary research explores green building certification markets, operational building management, urban policy, environmental economics, and affordable housing solutions.

Sarah Gomez is a senior at Yale University, double majoring in History and History of Art and studying through the Energy Studies program. On campus, she is involved in Dwight Hall Socially Responsible Investing, the Sustainability Service Corps, and the Yale Student Environmental Coalition.

Sherif Goubran is a Ph.D. student in the Individualized Program (INDI) at Concordia University, Canada. He conducts interdisciplinary research on sustainability assessments in buildings and the built environment. Goubran holds an M.A.Sc. in Building Engineering and a B.S. in Architecture. His research has been published in engineering, design, and architecture journals, and he has been awarded several honors and grants for his academic excellence and research.

Lisa N. Hasan is a practicing architect, who holds a Master's degree in Architecture from McGill and an MBA from Concordia University, Canada. Her work has focused on green buildings and the development and implementation of sustainable practices for both public and private real estate owners, managers, and investors. Her involvement with the National Research Council of Canada, Canada Green Building Council, urbanism committees, and not-for-profit organizations is testament to her long-term commitment to sustainable real estate.

Russell Heller is an Environmental Studies Major at Yale University, USA, concentrating in Sustainable Business, and is also a part of the Energy Studies Certificate Program. He spent two years as the Board Co-Chair of

the Dwight Hall Socially Responsible Investment (SRI) Fund, the nation's first undergraduate-managed Socially Responsible Investment Fund, and the first to file a shareholder resolution with a public company.

Ramzi Kawar has over 30 years of international exposure and multi-disciplinary experience in strategic consulting in architecture, affordable housing, physical planning, community planning, land use planning, sustainable development, risk management, community engagement, contract management, team building, strategic corporate leadership, and innovative business development. He is an engaged leader and advocate for innovative sustainable building practices and is the Manager, Building Design at Housing Nova Scotia.

Willem G. Keeris is Professor Emeritus in Real Estate Management, Development included. His first posting was at Eindhoven University of Technology, Faculty of Architecture, Building, and Planning—Department Real Estate Management & Development, Netherlands. He subsequently became Academic Director of the Executive Master of Real Estate course of Tilburg University, TIAS Business School, and served until 2017 as a visiting professor at Delft University of Technology, Faculty of Architecture—Department Management in the Built Environment. Keeris is also Managing Director of Keeris Vastgoed-Consultancy and was a member of the Supervisory Board of Kadans Science Partner Fund N.V. until the end of March 2017.

Stéfanie D. Kibsey coordinates the Sustainable Investment Professional Certification program at the John Molson School of Business, Canada. She has previously worked at the David O'Brien Center for Sustainable Enterprise and La Caisse de dépôt et placement du Québec. She received a Master's degree in Environmental Studies from the University of Waterloo. Kibsey specializes in connecting sustainability principles with policy and business practices.

Cary Krosinsky writes, advises, and teaches at Yale, Brown, and elsewhere. At Brown, his teaching helps support the Brown University Sustainable Investment Fund within the Endowment. His most recent book is *Sustainable Investing: Revolutions in Theory and Practice* and papers include a "Framework for Asset Owner Strategy on Climate Change for Principles for Responsible Investing (PRI)". He is an ongoing advisor to BlueSky Investment Management and the Carbon Tracker Initiative.

Ruben A. R. Langbroek is the Head of Strategic Development of Global Real Estate Sustainability Benchmark (GRESB) in Asia Pacific. GRESB is an investor-led initiative that aims to enhance and protect shareholder value by evaluating and empowering sustainability practices in the real asset sector, including real estate and infrastructure. Langbroek holds Master of Science degrees in Building Engineering and in Real Estate Investments. He is also a professional Member of the Royal Institute of Chartered Surveyors (MRICS) and is accredited as a Leadership in Energy and Environmental Design (LEED) Green Associate.

Bruno Lee is Assistant Professor of Building Engineering at Concordia University, Canada. He specializes in building energy performance simulation and focuses on the employment of different simulation techniques to study the performance of the built environment in an integrated manner. His research areas cover resilient high-performance smart building, integrated building design through co-simulation, stochastic optimization of energy and durability performance, and BIM (Building Information Modeling)-based automated energy performance simulation.

Behzad Malekpourasl is Assistant Professor of Urban and Regional Planning in the Department of Urban Planning and Design, Shahid Beheshti University (SBU), Tehran, Iran. Malekpourasl's main research lies in the area of urban and regional planning theory with special highlight on developing countries, sustainable development, methods and techniques in planning, the role of planning in energy efficiency, and social issues in planning. His current research is about reassertion of space in critical social planning theory.

Tristan Masson is a Bachelors of Art candidate (2019 expected) in Political Science (Honours) and Sustainability Studies at Concordia University, Montreal, Canada. His research fields are International Relations and Public Policy where he studies the national, regional and global dimensions to policy problems relating to media, technology, climate change and sustainability. He worked as a researcher for the David O'Brien Centre for Sustainable Enterprise (DOCSE) in the summer of 2017. His most recent publications include a chapter with Guy Lachapelle, entitled "Political Coalitions in Canada", in Adrian Albala and Josep Maria Reniu's (eds) *Coalition Politics and Federalism* (Springer, 2018), an article with Guy Lachapelle entitled "Adjusting the Sails: Québec-U.S. Commerce Under the Trump Administration" in *Québec Studies* (December 2017), and a

chapter, "Political Advertising in Canada", in Christina Holtz-Bacha et Marion R. Just's (eds) *Routledge Handbook of Political Advertising* (2017).

In addition to his academic work, Masson serves in a number of roles for non-profits such as Sustainable Concordia, Concordia's Sustainability Action Fund and Future Earth. He co-hosts a monthly podcast show on cutting-edge research, projects and people working for sustainable development called The Worlds We Want, in partnership with Future Earth and CJLO 1690AM.

Saheed Matemilola is a Ph.D. candidate at the Department of Public Law, Law of Environment and Planning, Brandenburg University of Technology, Cottbus-Senftenberg, Germany. He holds an M.Sc. in Environmental and Resource Management from the same institution. He studied Estate Management at Abubakar Tafawa Balewa University, Bauchi, Nigeria. He is a member of International Association for Impact Assessment (IAIA), Association for Environmental Impact Assessment of Nigeria (AEIAN), the Environmental Impact Assessment Association Germany (UVP), Nigerian Institute of Safety Professionals (NISP), and Nigerian Institute of Management (NIM).

Molly J. McCabe is founder and President of HaydenTanner, a strategic real estate investment advisory firm focused on accelerating impact and sustainability in the built environment. He is the Chair of the Urban Land Institute's (ULI) Responsible Property Investment Council, Center for Sustainability Advisory Board, and Faculty for the Daniel Rose Fellowship Land Use Program. He is the author of *Practical Greening: The Bottom Line on Sustainable Property Development, Investment and Financing*.

Asma Mehan is a visiting Ph.D. student at École polytechnique fédérale de Lausanne (EPFL) in Lausanne, Switzerland; former research fellow at the Alfred Deakin Institute (ADI) in Deakin University, Melbourne, Australia; and Ph.D. candidate in "Architecture- History- Project" Doctoral Program in the Department of Architecture and Design (DAD), Politecnico di Torino, Torino, Italy. Mehan's main research lies in the area of politics of architecture, Middle Eastern studies, and social sustainability. Her current research on Tehran goes beyond the symbolic capacities of architecture and focuses on the politics of space production.

Gordon Noble has a vast experience in the Australian financial sector, having worked in a variety of positions including as a political adviser, trade union official for a major superannuation fund, and for the pension

industry's peak body—the Association of Superannuation Funds of Australia. He is the Principal Adviser for the Better Infrastructure Initiative at the John Grill Centre for Project Leadership and the President of the Network of Sustainable Financial Markets.

Amir Rahdari is the founder of Global Sustainability Research Network, Director of Sustainability Research Group at Universal Scientific Education and Research Network (USERN), associate editor of *International Journal of Sustainable Entrepreneurship and Corporate Social Responsibility* (IJSECSR), and a Sustainability and Social Responsibility Certified Associate in the UK. He was selected as one of the TOP25UNDER25 leaders in sustainable business (2 degrees, UK), a Science Sentinel (publons), and he is a member of Green Building Initiative (GBI) (USA), International Society for Development and Sustainability (ISDS) (Japan), and two dozen sustainability organizations. His research concerns the sustainability-business intersection with a major focus on sustainable business, corporate sustainability, rating systems, transparency, sustainability indicators, and performance evaluation systems.

Sara Levana Schoen is a corporate sustainability advocate with a passion for integrating long-termism into business processes to advance organizational and societal prosperity. She has led sustainability for Clarion Partners and First Potomac Realty Trust and managed private-sector partnerships for the US Green Building Council and the US Department of Energy.

Philippe St-Jean is a LEED BD+C accredited professional and a certified Passivhaus consultant and course instructor. With over 15 years in the construction industry, St-Jean has experience both onsite, as a foreman, and offsite, as a project manager, estimator, construction director, course instructor, and sustainable construction consultant.

Diane Strauss is research director of the Yale Initiative for Sustainable Finance at Yale University, USA. Prior to this, she worked as a policy analyst in the think-thank 2 Investing Initiative in Paris and as a research assistant in World Wide Fund (WWF), Brussels, doing research and advocacy to shift financial flows toward climate-friendly investments.

Thomas Walker has written numerous articles and books in the area of risk management, shareholder litigation, and sustainable finance. He previously directed the David O'Brien Centre for Sustainable Enterprise and has served as the chair of the Finance Department and as Associate Dean, Research, at Concordia University, Canada. He frequently consults in the area of sustainable management and shareholder litigation.

List of Figures

List of Pictures

List of Tables

CHAPTER 1

Introduction

Lisa N. Hasan

This phase of rapid product introduction to an increasingly receptive market has provided the real estate sector with a wide range of solutions. In contrast to the industrial and transportation sectors, the majority of the technologies required to meet resource conservation targets set for the real estate sector are already commercially available and cost effective (IEA, 2013, p. 9). However, this flurry of activity has also created a culture of experimentation, where there is little consensus as to basic definitions and best practices, and capacity building often lags behind innovation implementation. The segmented and conflicting nature of current policies, practices and incentives currently impedes the widespread adoption of the technological and procedural innovations required to meet these ambitious goals (IEA, 2013; UNEP, 2016).

Fortunately, the market is showing signs of maturing. The motivation for engaging in sustainable initiatives is shifting from an idealistic desire to "do the right thing" to a recognition of the business opportunities associated with sustainable practices (McGraw-Hill Construction, 2013). As an increasingly wide spectrum of stakeholders become involved in sustainability around the globe, there is a growing recognition of the need for a

L. N. Hasan (✉)
David O'Brien Centre for Sustainable Enterprise,
John Molson School of Business, Concordia University, Montreal, QC, Canada

T. Walker et al. (eds.), *Sustainable Real Estate*, Palgrave Studies in Sustainable Business In Association with Future Earth,
https://doi.org/10.1007/978-3-319-94565-1_1

shared understanding, common benchmarks and a more holistic approach to sustainability in the real estate sector.

Despite this high-level consensus, achieving a truly sustainable global real estate sector is no small task. Staying abreast of all the changes and their implications is a challenge made all the more daunting by the fact that they have occurred in parallel with the evolution of the definition of sustainability itself. Early reports on sustainable development expressed the need to strike a balance between economic growth and resource conservation (United Nations Conference on the Human Environment, 1972; World Commission on Environment and Development, 1987; United Nations, 1987). These general recommendations evolved into the comprehensive 17 global sustainable development goals and associated targets described in the United Nation's 2030 Agenda for Sustainable Development (UN General Assembly, 2015). This latest framework for understanding sustainable development has profound implications for the real estate industry. It pushes the boundaries of sustainability further beyond the building's walls to include responsible resource production and consumption as well as a range of social issues associated with housing and energy affordability, health and well-being, global urbanization and even climate change.

Achieving the sustainable development targets set out by the UN and refined by local governments will require a concerted effort on the part of all stakeholders working together across traditional disciplinary, geographic and political boundaries. The traditional project lifecycle will also need to be redefined in order to involve more stakeholders in preplanning, post-occupancy and even demolition and redevelopment phases. Implementing piecemeal solutions will not be sufficient to reach the targets set by the Paris Agreement[1], nor to overcome many of the obstacles to the global adoption and implementation of sustainability measures. Integrated solutions, greater information transparency and the continued development of globally adopted but locally adapted, standards, benchmarks and best practices will shape the future of sustainable real estate practice.

By collecting the latest insights in a single volume, this book aims to provide readers from all disciplines with a better appreciation of sustainable real estate as a grand system and shed some light on its past, present and future evolutions. We begin by examining the role that real estate can

[1] http://unfccc.int/paris_agreement/items/9485.php.

play in addressing climate change (Chap. 2). Next, we explore real estate's new role in building and supporting sustainable and resilient communities (Chap. 3). This broad, forward-looking context provides a backdrop to the subsequent chapters that discuss current public-sector regulatory trends (Chap. 4) and the European Union's policy framework in particular (Chap. 5).

Market-driven approaches are then discussed, including critical reviews of green building labeling systems (Chap. 6) and global real estate sustainability benchmarking (Chap. 7). These methods for assessing and comparing sustainability levels are followed by more focused discussions on the business case for green buildings for owner-operators (Chap. 8) and the value of sustainability as an organizational effectiveness tool for real estate management companies (Chap. 9).

Chapters 10–12 discuss methods for delivering affordable, reliable and sustainable energy to real estate projects. This topic is approached from both a design standpoint, through a discussion of building energy simulation for sustainable and resilient buildings (Chap. 10), and a finance perspective, exploring the challenges and solutions driving investment in high-performance buildings (Chap. 11). Chapter 12 covers the specific case of financing rooftop solar for single-family rental properties.

The final portion of the book brings us back to the topic of real estate's role in building and supporting sustainable cities and communities. This section provides case studies from around the globe and shows how multiple stakeholders, under various regulatory and market conditions, have come together to address a number of sustainable real estate issues. A case for sustainable affordable housing in the US (Chap. 13) and an overview of affordable Passive House projects in Nova Scotia (Chap. 14) provide insights into the North American housing market. Investing in Community Sporting Facilities (Chap. 15) outlines a new financing model that is being implemented in Australia to fund social communal infrastructures. Chapter 16 discusses the specificities of sustainable real estate in the Middle East and Chap. 17 provides an overview of sustainable community development in Nigeria.

In sum, the continued success of the sustainable real estate industry hinges on, not only continued technological innovation but also greater integration and awareness of agreed upon best practices. This can only be achieved if a broader spectrum of stakeholders is able to work across traditional disciplinary boundaries at all phases of the real estate development's lifecycle. The next wave of innovation in sustainable development will

assuredly be less technology driven and more focused on creating structures conducive to the development, implementation and monitoring of sustainable solutions in real estate. We hope that this book will provide a strong base for future research and thought leadership in sustainable real estate, arguably the only type of real estate that will stand the test of time.

References

Devine, A., & Kok, N. (2015). Green Certification and Building Performance: Implications of Tangibles and Intangibles. The Journal of Portfolio Management (Special Real Estate Issue 7th Edition), 1–14. Retrieved July 30, 2017, from http://www.bentallkennedy.com/news-2015-10-06.php

Dodge Data & Analytics. (2016). World Green Building Trends 2016: Developing Markets Accelerate Global Green Growth. (H. M. Bernstein, M. A. Russo, E. Fitch, & D. Laquidara-Carr, Eds.) Bedford, MA, USA. Retrieved July 27, 2017, from http://www.worldgbc.org/sites/default/files/World%20Green%20Building%20Trends%202016%20SmartMarket%20Report%20FINAL-2.pdf

Eichholtz, P., Kok, N., & Quigley, J. (2013). The Economics of Green Building. *Review of Economics and Statistics, 95*(1), 50–63.

Eichholtz, P., Kok, N., & Quigley, J. M. (2010). Doing Well by Doing Good? Green Office Buildings. *American Economic Review, 100*(December 2010), 2494–2511.

Eichholtz, P., Kok, N., & Yonder, E. (2012). Portfolio greenness and the financial performance of REITs. *Journal of International Money and Finance, 31*(7), 1911–1929.

Fuerst, F., & McAllister, P. (2009). An Investigation of the Effect of Eco=Labelling on Office Occupancy Rates. *Journal of Sustainable Real Estate, 1*(1), 49–64.

Gabe, J. (2016). Successful Greenhouse Gas Mitigation in existing Australian Office Buildings. *Building Research & Innovation, 44*(2), 160–174.

IEA. (2013). Transition to Sustainable Buildings: Strategies and Opportunities to 2050. Paris: International Energy Agency (IEA). Retrieved July 24, 2017, from https://www.iea.org/publications/freepublications/publication/Building2013_free.pdf

McGraw-Hill Construction. (2008). Commercial & Institutional Green Building SmartMarket Report. (M. A. Russo, C. O'Shaughnessy, & S. Lewis, Eds.) Bedford, MA, USA. Retrieved July 30, 2017, from http://mts.sustainableproducts.com/Capital_Markets_Partnership/BusinessCase/MHC%20Commercial%20&%20Institutional%20Green%20Building%20SMR%20(2008).pdf

McGraw-Hill Construction. (2009). Green Retrofit & Renovation SmartMarket Report. (M. A. Russo, D. Laquidara-Carr, & J. Miltner, Eds.) Bedford, MA, USA. Retrieved July 30, 2017, from http://mts.sustainableproducts.com/Capital_Markets_Partnership/BusinessCase/MHC%20Green%20Building%20Retrofit%20%26%20Renovation%20SMR%20%282009%29.pdf

McGraw-Hill Construction. (2013). World Green Building Trends—Business Benefits Driving New and Retrofit Market Opportunities in Over 60 Countries. (H. M. Bernstein, M. A. Russo, E. Fitch, & D. Laquidara-Carr, Eds.) Bedford, MA, United States: McGraw-Hill Construction. Retrieved June 20, 2017, from http://www.worldgbc.org/files/8613/6295/6420/World_Green_Building_Trends_SmartMarket_Report_2013.pdf

UN General Assembly. (2015). Transforming our World: The 2030 Agenda for Sustainable Development. Retrieved July 29, 2017, from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

UNEP. (2016). The Emissions Gap Report 2016. Nairobi: United Nations Environmental Programme. Retrieved June 21, 2017, from wedocs.unep.org/bitstream/handle/20.500.11822/…/emission_gap_report_2016.pdf

United Nations. (1987). Our Common Future—Brundtland Report. Oxford: Oxford University Press. Retrieved July 20, 2017, from https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

United Nations Conference on the Human Environment. (1972). Declaration of the United Nations Conference on the Human Environment. Stockholm, Sweden. Retrieved July 20, 2017, from http://www.un-documents.net/unchedec.htm

World Commission on Environment and Development. (1987). *Our Common Future*. Oxford: Oxford University Press.

CHAPTER 2

The Relevance of Real Estate in Solving Climate Change

Cary Krosinsky

Buildings can seem boring to many. But within the world's current and future building stock could well lay the most important area of work ahead for ensuring better environmental and social future outcomes.

Sustainable real estate is in fact a critical baseline for establishing better financial outcomes, as not fixing for the track we are headed down regarding climate change would likely be economically disastrous, perhaps in the many tens of trillions of dollars.[1]

If we are to solve for climate change, however, efficiency emerges as the most important area of carbon reduction potential to be achieved. The International Energy Agency argued in its World Energy Outlook in 2014[2] that for a 2-degree world, over US $1 trillion in annual investment

[1] https://www.privatebank.citibank.com/home/fresh-insight/gps-energy-darwinism.html.

[2] https://www.iea.org/publications/freepublications/publication/WEO2014.pdf.

C. Krosinsky (✉)
Yale University, New Haven, CT, USA

Brown University, Providence, RI, USA
e-mail: cary.krosinsky@yale.edu

T. Walker et al. (eds.), *Sustainable Real Estate*, Palgrave Studies in Sustainable Business In Association with Future Earth,
https://doi.org/10.1007/978-3-319-94565-1_2

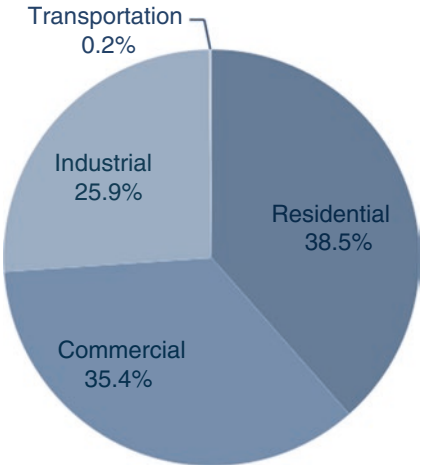

Fig. 2.1 Retail sales of electricity, end use by percent of ultimate customer (https://www.c2es.org/energy/use/residential-commercial)

will be needed on average by 2040, with a majority of this amount falling into the efficiency category.

While efficiency can be a broad term touching all sectors, real estate is a large percentage of the existing global carbon footprint and therefore a large percentage of carbon reduction potential as well. For example, in the US (Fig. 2.1), the largest components of electricity use are residential (38.5%) and commercial (35.4%), and electricity use is the largest component of energy consumption, making building efficiency a very large percentage of what is possible and necessary.

Hence, if necessary reductions in the carbon footprint are expected and necessary from efficiency and finance, and buildings make up the majority of the carbon footprint of consumption, then efficiency in existing buildings stock, both current and new, becomes one of the biggest investment opportunities and this could create a useful paradigm of sorts with increasing and specific focus.

Consider as well the effects of automation, technological innovation, and globalization.[3]

These trends are likely unstoppable and create unrest in previously developed countries where jobs for those less skilled are suddenly disappearing. Add to this what we call the effect of "the entrenched nature of the status quo," largely in the form of people driving existing cars longer

[3] http://www.thejei.com/wp-content/uploads/2015/01/209-713-1-PB.pdf.

and operating existing buildings and power plants past the original length of time expected, and this creates an unsustainable path for ongoing carbon emissions versus reductions required.

In economies which are otherwise economically vibrant, retrofitting at scale and sustainable real estate more generally therefore becomes a means of establishing adequate jobs and necessary efficiency including through creative financing mechanisms so that governments do not take on the entire financial burden.

Many studies show rents are higher and residents happier in more efficient buildings that take into account the environment or otherwise create healthier and happier spaces for both living and working conditions. While often thought of as coming best from new building stock, this could come from revised existing stock as well. The area of retrofit finance is largely untapped but could form a "new deal" of sorts and is arguably essential given this entrenched nature of the status quo previously mentioned. This "new deal" could be politically palatable as well to a disgruntled voting public in countries such as the US and UK where 2016 elections went in unexpected directions. So we see improving existing building stock as a critical and often overlooked component of what might be necessary and possible.

On the new building front, for all the good work occurring on new building standards, there is also growing concern about measurement and net impact, specifically whether standards such as Leadership in Energy and Environmental Design (LEED) and BREEAM (Building Research Establishment Environmental Assessment Method) bring about actual environmental impact reductions, and if so whether they are sufficient. In addition, new building development can often lag behind what might be necessary to create overall levels of necessary building efficiency, given the long time it takes to replace building stock more generally.

At minimum, better standards, methods of analysis, and reporting are needed to ensure that when sustainable real estate projects are chosen through upfront design, there is a specific understanding of what improvement in net impacts are likely and possible, perhaps even from a scenarios perspective, including the better financial outcomes which result from better design choices.

The Rocky Mountain Institute (RMI) has seen all this as well, and is an example of an organization working diligently and thoughtfully to increase efficiency solutions being deployed, including through more efficient cooling and building functionality. RMI, which has long worked in China

and increasingly as well in India where climate solutions are being implemented rapidly, sees that 35% of global energy is consumed by buildings, and 60% of consumed energy occurs in buildings, so the potential is clear. They aim to reduce energy consumption in buildings by 390 trillion BTUs (British thermal units) in the US alone, the equivalent of decommissioning 17 coal power plants.[4]

Better standards are also needed on the financing side of building efficiency, with some early examples of energy efficiency financing being achieved by the green banks and infrastructure banks in states such as Connecticut, Rhode Island and New York, and in Europe surrounding groups such as Energy Efficiency Financial Institutions Group (EEFIG) and their new underwriting toolkit,[5] but as per Chap. 5, much more work is needed in Europe on this basis.

Region by region, more and better work is happening, such as Siemens rebuilding Cairo,[6] cities banding together to fight climate change,[7] cities creating benchmarking ordinances[8] and otherwise creating positive environments for new building design and related technological improvement.

Yet we lack a true and robust picture of what is necessary of buildings on a global basis. What would be really helpful is a roadmap of what we need to do and should do in each category of building by region (and by category of owner as well given the significant percentage of family owned building empires doing arguably not enough on this subject in cities such as New York).

We hope that this text starts to provide a roadmap of the many strategies that need to run in parallel to achieve the sustainable real estate sector we now know we can achieve. It can only be achieved through will, intent, design, and successful implementation. We hope to have at least started on this path with this effort.

[4] https://www.rmi.org/our-work/buildings/.

[5] http://www.unepfi.org/wordpress/wp-content/uploads/2017/06/EEFIG_Underwriting_Toolkit_June_2017.pdf.

[6] https://www.siemens.com/eg/en/home/company/topic-areas/egypt-megaproject.html.

[7] http://www.c40.org/.

[8] http://www.phillymag.com/property/2017/07/11/philly-just-misses-the-top-10-for-green-building/.