

Innovation For Sustainable Electricity Systems

The future of modern societies depends on their ability to deal with the challenge of climate change in the coming decades. One essential component is a better understanding of innovation processes in the energy sector. This book focuses on sustainability innovations in renewable energies, combined heat and power, and energy service contracting, and analyses the institutions, actors and functions within the innovation system. Of particular interest is the question of whether the joint effect of EU-driven market liberalization and climate policies will succeed in establishing market forces that will drive actors towards more climate-friendly energy production. A special focus is on the role of local utilities in the electricity sector as opposed to large transmission net operators or regional net operators. The countries covered in the contributions include Germany, Denmark, the UK, Switzerland, and the Netherlands.

The United States and China are the world's top two energy consumers and, as of 2010, the two largest economies. Consequently, they have a decisive role to play in the world's clean energy future. Both countries are also motivated by related goals, namely diversified energy portfolios, job creation, energy security, and pollution reduction, making renewable energy development an important strategy with wide-ranging

implications. Given the size of their energy markets, any substantial progress the two countries make in advancing use of renewable energy will provide global benefits, in terms of enhanced technological understanding, reduced costs through expanded deployment, and reduced greenhouse gas (GHG) emissions relative to conventional generation from fossil fuels. Within this context, the U.S. National Academies, in collaboration with the Chinese Academy of Sciences (CAS) and Chinese Academy of Engineering (CAE), reviewed renewable energy development and deployment in the two countries, to highlight prospects for collaboration across the research to deployment chain and to suggest strategies which would promote more rapid and economical attainment of renewable energy goals. Main findings and concerning renewable resource assessments, technology development, environmental impacts, market infrastructure, among others, are presented. Specific recommendations have been limited to those judged to be most likely to accelerate the pace of deployment, increase cost-competitiveness, or shape the future market for renewable energy. The recommendations presented here are also pragmatic and achievable.

This volume features research and case studies across a variety of industries to showcase technological innovations and policy initiatives designed to promote renewable energy and sustainable economic development. The first section focuses on policies for the adoption of

renewable energy technologies, the second section covers the evaluation of energy efficiency programs and the final section provides evaluations of energy technology innovations. Environmental concerns, energy availability and political pressure have prompted governments to look for alternative energy resources that can minimize the undesirable effects for current energy systems. For example, shifting away from the conventional fuel resources and increasing the percentage of electricity generated from renewable resources, such as solar and wind power, is an opportunity to guarantee lower CO2 emissions and to create better economic opportunities for citizens in the long run. Including discussions of such of timely topics and issues as global warming, bio-fuels and nuclear energy, the editors and contributors to this book provide a wealth of insights and recommendations for sustainable energy innovations.

This volume contains the proceedings of the 11th KES International Conference on Sustainability and Energy in Buildings 2019 (SEB19) held in Budapest, 4th -5th July 2019 organised by KES International in partnership with Cardiff Metropolitan University, Wales, UK. SEB-19 invited contributions on a range of topics related to sustainable buildings and explored innovative themes regarding sustainable energy systems. The aim of the conference was to bring together researchers, and government and industry professionals to discuss the future of energy in buildings, neighbourhoods and cities from a theoretical, practical,

implementation and simulation perspective. The conference formed an exciting chance to present, interact, and learn about the latest research and practical developments on the subject. The conference attracted submissions from around the world. Submissions for the Full-Paper Track were subjected to a blind peer-review process. Only the best of these were selected for presentation at the conference and publication in these proceedings. It is intended that this volume provides a useful and informative snapshot of recent research developments in the important and vibrant area of Sustainability in Energy and Buildings.

Sustainability-oriented Innovation Systems in China and India

Sustainable Power Generation

Innovation for Sustainable Electricity Systems

Energy-Sustainable Advanced Materials

Renewable Energy Systems from Biomass

The Transition to a Sustainable Electricity System

Renewable Energy Uptake in Urban Latin America

This dissertation presents a set of analytical tools developed to investigate the energy system transition using a systems approach. The cases explored range from Kosovo, a country on the verge of new electricity supply investments, and future energy pathways to an analytical investigation of innovation in battery storage systems that could unlock the

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environmental and health benefits of intermittent renewable energy sources such as solar and wind technologies. The analytical tools compare existing metrics such as levelized cost of electricity with new metrics such as a two-factor learning curve of deployment and innovation and trace metal content of coal per final kWh of electricity delivered and energy return on investment of distributed energy systems. Chapter 1 investigates the case of Kosovo and introduces an analytic framework to analyze electricity costs and environmental impacts of future electricity options. The scheduled decommissioning of the Kosovo A coal-fired power plant provides an opportunity to investigate the changing cost of alternative energy options available in Kosovo for new energy infrastructure. I find that a range of investment pathways from international financial institutions and donor groups could meet the same projected electricity demand at a lower cost than building a new 600 MW coal fired power plant. The options include energy efficiency measures, combinations of solar PV, wind, hydropower, biomass, and the introduction of natural gas. The results indicate that financing a new coal plant is the most expensive pathway to meet future electricity demand in Kosovo. Chapter 2 utilizes the analytic framework developed to estimate the cost of future electricity pathways

and uses green chemistry and public health risk assessment to estimate trace metal content of coal and investigate the air-pollution-related-health risks of lignite coal in Kosovo. By utilizing ICP-MS, I sample lignite coal for trace metal content and develop a risk model to assess future health impacts of air pollution from the electricity options explored in Chapter 1. I find significant trace metal content normalized per kWh of final electricity delivered. I estimate that Kosovo could avoid 2300 premature deaths by 2030 when introducing energy efficiency and solar PV backed up by natural gas. The framework highlights that often multi-lateral development banks do not account for all health risks before guaranteeing loans on new electricity projects. The interest in finding sustainable options to balance the load of intermittent renewable energy options in Kosovo motivates further analysis to understand how battery storage technologies have developed over time in terms of performance and cost. Chapter 3 examines the dramatically falling cost of battery storage options. I develop a two-factor technological learning curve model that integrates the value of investment in materials innovation and technology deployment over time from an empirical dataset covering battery storage technology. I find and chart a viable path to dispatchable \$1/W solar with \$100/kWh battery

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storage that enables combinations of solar, wind, and storage to compete directly with fossil fuel-based electricity options. I highlight the co-evolutionary nature of the cost reductions of battery storage technologies and suggest the relative importance of sustained investment and integration of R&D and deployment to develop innovative low-carbon combined solar, storage, and wind systems. Chapter 4 highlights the changing energy return on investment of energy technologies by investigating a case in Thailand where distributed solar, mini-hydro, and battery storage mini-grids are becoming an attractive investment and serve as core options to meet growing demand for electricity. I compare the net energy return on investment (EROI) of mini-hydropower, solar PV, and battery storage. This study represents a direct application of the opportunities for battery storage technologies to enable cost-competitive mini-grids in Thailand and around the world. The dissertation highlights different plans, designs, and future management of cost-effective, sustainable, and healthy electricity systems for a clean energy transition worldwide. The analytical tools presented combine to integrate traditional economic, environmental, and health metrics into energy systems planning and innovation. By integrating these interconnected systems, it becomes

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possible to enable cleaner and more sustainable energy transitions. This book presents best selected research papers presented at Innovation in Sustainable Energy and Technology India (ISET 2020), organized by Energy Institute Bangalore (A unit of RGIPT, an Institute of National Importance), India, during 3–4 December 2020. The book covers various topics of sustainable energy and technologies which includes renewable energy (solar photovoltaic, solar thermal and CSP, biomass, wind energy, micro hydro power, hydrogen energy, geothermal energy, energy materials, energy storage, hybrid energy), smart energy systems (electrical vehicle, cybersecurity, charging infrastructures, IOT & AI, waste management, PHEV (CNG/EV) and mobility (smart grids, IOT & AI, energy-efficient buildings, smart agriculture).

This book explores the perplexing question of how to increase sustainable energy technology use in the developing world, and specifically focuses on two megacities within Latin America. Renewable Energy Uptake in Urban Latin America examines the market and uptake of two sustainable energy technologies (solar water heaters and biogas to produce electricity) in two locations, Mexico City, Mexico and São Paulo, Brazil in the 2000s. Drawing from three systems-based analytical frameworks – including one developed

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by the author for the purpose of this study – the book examines the varying factors affecting the implementation of renewable energy technologies (RETs) in urban Latin America. These frameworks emphasize the importance of examining socio-political dimensions; rather than conventional explanations that focus on technical and economic aspects only. By doing so, the research improves explanations about renewable energy technology (RET) adoption in the global South. These findings are useful for scholars, policy makers and practitioners working on RET adoption; resulting in a book which helps to inform wider debates regarding innovation, decarbonization, sustainability transitions and energy system change. This book will be of great interest to students and scholars of energy transitions, energy policy, development studies and science and technology studies.

This book contains the proceedings of the 13th KES International Conference on Sustainability and Energy in Buildings 2021 (SEB2021) held in Split, Croatia, during 15–17 September 2021 organized by KES International. SEB21 invited contributions on a range of topics related to sustainable buildings and explored innovative themes regarding sustainable energy systems. The conference formed an exciting chance to

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present, interact and learn about the latest research and practical developments on the subject. The conference attracted submissions from around the world. Submissions for the Full-Paper Track were subjected to a blind peer-review process. Only the best of these were selected for presentation at the conference and publication in these proceedings. It is intended that this book provides a useful and informative snapshot of recent research developments in the important and vibrant area of sustainability in energy and buildings.

Case Studies in Sustainable Consumption and Production

Sustainable Entrepreneurship, Renewable Energy-Based Projects, and Digitalization

Addressing Energy Poverty Through Innovation

Sustainable Energy Systems: Innovative Perspectives

Innovations in Sustainable Energy and Technology

Innovating Our Way to Sustainability

This book addresses the reality that there is no consensus on the extent to which innovations can reconcile ever-growing energy consumption, the shrinking availability of resources, and the environmental consequences

of fossil-fuel energy use. The contributors explore how these conflicting scenarios could be reconciled; and how we might shape a more sustainable energy system from the existing one.

This book gathers the latest advances, innovations, and applications in the field of sustainable energy systems, as presented by researchers and engineers at the International Conference Sustainable Energy Systems: Innovative Perspectives (SES), held in Saint-Petersburg, Russia, on October 29-30, 2020. It covers highly diverse topics, including applications of renewable energy sources, recycling of solid municipal and industrial waste, circular economy based on agricultural waste, energy-efficient and sustainable buildings, innovation management and technologies of sustainable cities, sustainable construction, creative construction technology and materials, construction simulation and virtual construction, BIM and rapid prototyping for construction, consumption practices in the digital era, sustainable operations management, and supply chain management in the digital era. The contributions, which were selected by means of a rigorous international peer-review process, highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations. Electricity production and consumption are at the heart of modern life and are therefore of great interest to public policy. Threats such as security of supply concerns, the volatility of fuel and electricity prices,

and especially environmental concerns like climate change, are putting increasing pressure on current electricity systems. One key response by governments has been support for innovation. It is widely acknowledged that electricity systems will have to change fundamentally in order to deliver on political goals. This will require deep cuts in greenhouse gas emissions. Incremental change along established technological trajectories is unlikely to be sufficient. Instead 'system innovations' have been suggested as a solution by scholars and policy makers. What are the politics of such an endeavour? To answer this question this thesis looks at two distinct policy initiatives to promote more sustainable electricity systems: the 'Energy Transition' project in the Netherlands and the 'Carbon Trust' in the UK. While the aim of the two policy initiatives is similar, they try to tackle the challenge in very different ways. The analysis is based on semi-structured interviews as well as a review of documents and secondary literature and follows a process tracing method, combining within-case and cross-case analysis. By utilising a framework based on 'discursive institutionalism' (as per Hajer and Schmidt) the study aims to shed light on the importance of both discourses and institutional contexts in shaping policy initiatives to promote 'system innovations'. It demonstrates the mechanisms by which particular framings of the problem, expressed through new storylines, come to legitimate particular government policies. It emerges that

existing institutions not only shape which storylines are politically acceptable but also constitute tangible features of the organisational and technical environment which those initiatives must change. In conclusion, the thesis argues that the politics of governing 'system innovations' can usefully be conceptualised and explained by struggles about meaning. These are shaped in turn through discursive interactions between actors as well as existing institutions. By highlighting the interplay between discourses, interests and institutions, the results provide an input to scholarly debate and policy making alike, in ways that offer to help inform the rethinking of strategies for fostering socio-technical 'system innovations'.

Sustainable consumption and production (SCP) was adopted as a priority area during the World Summit on Sustainable Development in Johannesburg in 2002 and has since become one of the main vehicles for targeting international sustainability policy. Sustainable consumption focuses on formulating equitable strategies that foster the highest quality of life, the efficient use of natural resources, and the effective satisfaction of human needs while simultaneously promoting equitable social development, economic competitiveness, and technological innovation. But this is a complex topic and, as the challenges of sustainability grow larger, there is a need to re-imagine how SCP policies can be formulated, governed and implemented. The EU-funded project

"Sustainable Consumption Research Exchanges" (SCORE!) consists of around 200 experts in the field of sustainable innovation and sustainable consumption. The SCORE! philosophy is that innovation in SCP policy can be achieved only if experts that understand business development, (sustainable) solution design, consumer behaviour and system innovation policy work together in shaping it. Sustainable technology design can be effective only if business can profitably make the products and consumers are attracted to them. To understand how this might effectively happen, the expertise of systems thinkers must be added to the mix. System Innovation for Sustainability 1 is the first result of a unique positive confrontation between experts from all four communities. It examines what SCP is and what it could be, provides a state-of-the-art review on the governance of change in SCP policy and looks at the strengths and weaknesses of current approaches. The SCORE! experts are working with actors in industry, consumer groups and eco-labelling organisations in the key consumption areas of mobility, food and agriculture, and energy use and housing - responsible for 70% of the life-cycle environmental impacts of Western societies - with the aim of stimulating, fostering or forcing change to SCP theory in practice. The System Innovation for Sustainability series will continue with three further volumes of comprehensive case studies in each of these three critical consumption areas. Each chapter of this book examines problems

and suggests solutions from a business, design, consumer and system innovation perspective. It primarily examines the differing solutions necessary in the consumer economies of the West, but also comments on the differing needs in rapidly emerging economies such as China, as well as base-of-the-pyramid economies. The System Innovation for Sustainability series is the fruit of the only major international research network on SCP and will set the standard in this field for some years to come. It will be required reading for all involved in the policy debate on sustainable production and consumption from government, business, academia and NGOs for designers, scientists, businesses and system innovators.

Sustainability in Energy and Buildings 2021

SES 2020

Product Innovation in Sustainable Energy Technologies

Sustainable Development and Innovation in the Energy Sector

Innovation and Institutional Change

Technical, Market and Policy Innovations to Address Risk

The Power of Design

Despite decades of effort and billions of dollars spent, two thirds of people in sub-Saharan Africa still lack access to electricity, a vital pre-cursor to economic development and

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poverty reduction. Ambitious international policy commitments seek to address this, but scholarship has failed to keep pace with policy ambitions, lacking both the empirical basis and the theoretical perspective to inform such transformative policy aims. Sustainable Energy for All aims to fill this gap. Through detailed historical analysis of the Kenyan solar PV market the book demonstrates the value of a new theoretical perspective based on Socio-Technical Innovation System Building. Importantly, the book goes beyond a purely academic critique to detail exactly how a Socio-Technical Innovation System Building approach might be operationalized in practice, facilitating both a detailed plan for future comparative research as well as a clear agenda for policy and practice. Chapter 1 of this book is freely available as a downloadable Open Access PDF under a Creative Commons Attribution-Non Commercial-No Derivatives 3.0 license. https://s3-us-west-2.amazonaws.com/tandfbis/rt-files/docs/Open+Access+Chapters/9781138656925_oachapter01.pdf Chapter 6 of this book is freely available as a downloadable Open Access PDF under a Creative Commons Attribution-Non Commercial-No Derivatives 3.0 license. <https://s3-us-west-2.amaz>

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This book addresses the rapidly changing citizen roles in innovation, technology adoption, intermediation, market creation, and legitimacy building for low-carbon solutions. It links research in innovation studies, sustainability transitions, and science and technology studies, and builds a new approach for the study of user contributions to innovation and sociotechnical change. Citizen Activities in Energy Transition gives detailed and empirically grounded overall appraisal of citizens' active technological engagement in the current energy transition, in an era when Internet connectivity has given rise to important new forms of citizen communities and interactions. It elaborates a new way to study users in sociotechnical change through long-term ethnographic and historical research and reports its deployment in a major, decade-long line of investigation on user activities in small-scale renewables, addressing user contributions from the early years to the late proliferation stages of small-scale renewable energy technologies (S-RETs). It offers a much-needed empirical

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and theoretical understanding of the dynamics of the activities in which users are engaged over the course of sociotechnical change, including innovation, adoption, adjustment, intermediation, community building, digital communities, market creation, and legitimacy creation. This work is a must-read for those seeking to understand the role of users in innovation, energy systems change and the significance of new digital communities in present and future sociotechnical change. Academics, policymakers, and managers are given a new resource to understand the "demand side" of sociotechnical change beyond the patterns of investment, adoption, and social acceptance that have traditionally occupied their attention. Innovation is key to achieving a sustainable electricity system. New technologies and organizational changes can bring about more sustainable, climate-friendly electricity structures. Yet the dynamics of innovation are complex, and difficult to shape. This book, written by experts in the field, sets out to explore the dynamics, the drivers and the setting of innovation processes. Case studies on micro cogeneration, carbon capture and storage, consumer feedback, network regulation and emissions trading

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provide insights into innovation dynamics in the electricity system and are analyzed to derive strategic implications for innovation policies. A special focus is placed on drivers and barriers of change, and their consequences for shaping the innovation process. This book is an indispensable source of information for researchers and decision makers in energy and climate change as well as for lecturers and students interested in the principles and ramifications of electricity innovation dynamics.

Sustainable Power Generation: Current Status, Future Challenges and Perspectives addresses emerging problems faced by the transition to sustainable electricity generation and combines perspectives of engineering and economics to provide a well-rounded overview. This book features an in-depth discussion of the main aspects of sustainable energy and the infrastructure of existing technologies. It goes on to evaluate natural resources that are sustainable and convenient forms of energy, and finishes with an investigation of the environmental effects of energy systems and power generating systems of the future. Other sections tackle fundamental topics such as thermal power,

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nuclear energy, bioenergy, hydropower, challenges and risks to sustainable options and emerging technologies that support global power trends. Sustainable Power Generation explores the future of sustainable electricity generation, highlighting topics such as energy justice, emerging competences, and major transitions that need to be navigated. This is an ideal reference for researchers, engineers, and other technical specialists working in the energy sector, as well as environmental specialists and policy makers. Provides a multidisciplinary, structured approach to electricity generation, focusing on the key areas of technology, business, project management and sustainability Includes analytics and discussions of sustainability metrics, underlying issues and challenges Presents business cases, offering a mix of academic depth and practicality on energy options

User Innovation, New Communities, and the Shaping of a Sustainable Future

Sustainable Product-Service System Design Applied to Distributed Renewable Energy

Opportunities and Challenges for China and the United States

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Socio-Ecological Dimensions of Decarbonization

Insights from Agriculture, Health, Environment, and Energy
System Innovation for Sustainability 4

The Power of Renewables

This book examines the technical, market, and policy innovations for unlocking sustainable investment in the energy sector. While finalizing this book, the COVID-19 pandemic is cutting a devastating swath through the global economy, causing the biggest fall in energy sector investment, exacerbating the global trade finance gap, worsening signs of growing income inequality, and devastating the health and livelihoods of millions. What is the parallel between the COVID-19 pandemic and the climate change crisis? The impacts of the global pandemic are expected to last for a few years, whereas those associated with the climate crisis will play out over several decades with potentially irreversible consequences. However, both show that the cost of inaction or delay in addressing the risks can lead to devastating outcomes or a greater

probability of irreversible, catastrophic damages. In the context of sustainable energy investment and the transition to a low-carbon, climate-resilient economy, what ways can financial markets and institutions support net-zero-emission activities and the shift to a sustainable economy, including investment in energy efficiency, low-carbon and renewable energy technologies? This book provides students, policymakers, and energy investment professionals with the knowledge and theoretical tools necessary to address related questions in sustainable energy investment, risk management, and energy innovation agendas.

Global economic growth, recently fuelled by Asia's emerging economies, has greatly accelerated the accumulation of greenhouse gases in the atmosphere and boosted demand for scarce natural resources, including energy, food and mineral raw materials. These developments are pushing the planet close to its ecological boundaries. Transforming the world economy towards sustainability, while ensuring decent levels of resource use for all global citizens, is the

greatest challenge of our time. This book explores how innovation systems need to be adapted to successfully confront these challenges. The first chapter introduces the concept of sustainability-oriented innovation systems which highlights the systematic differences between systems that have developed along current resource-intensive technological trajectories and those that address the impending environmental mega-problems. The subsequent articles present case studies of sustainability-oriented innovations in a number of policy areas, including energy efficiency, electric mobility and generation of renewable energy, in China and India. These case studies confirm the specificities of innovation systems geared towards a green techno-economic paradigm. This book was originally published as a special issue of Innovation and Development. The volume presents innovative approaches to improving energy access in underprivileged communities. A core theme is the use of previously underutilized or unrecognized resources that can be found through synergies in supply and

value innovation, novel financing methods, and the use of leapfrog technologies. The contributors illustrate how decentralized approaches and small-scale localized solutions can promote climate change mitigation and adaptation and increase the resiliency of vulnerable communities. This book gathers selected articles from the 2014 Micro energy Systems Conference at UC Berkeley that focus on technical, financial, human, institutional, and natural resource capital. The contributions reflect the latest concepts, theories, methods and techniques, offering a valuable resource for researchers, practitioners and governmental institutions engaged in the field of energy access for developing countries.

As energy innovation becomes imperative for the environment and energy security, the law must be fleet-footed to evolve in an unwieldy area of policy. This much-needed text assembles experts to analyse the most recent developments, and to postulate how human rights, sustainable development, and the eradication of energy poverty could be achieved.

Renewable Electrification in Developing Economies
The Politics of Governing 'system Innovations' Towards
Sustainable Electricity Systems
Building Innovation Capabilities for Sustainable
Industrialisation
Sustainability in Energy and Buildings 2020
Case Studies in Sustainable Consumption and Production –
Energy Use and the Built Environment
Dynamic Solutions for Energy Transitions
Global Energy Interconnection

This textbook introduces the key concepts that underpin sustainable energy transitions. Starting with the basic biophysical principles, current sources and environmental consequences of existing energy resource use, the book takes readers through the key questions and topics needed to understand, prescribe, and advocate just and sustainable energy solutions. The interdisciplinary nature of the book aims to build bridges across the social and natural sciences and humanities, bringing together perspectives, ideas and concepts from engineering, economics, and life cycle assessment to sociology, political science, anthropology, policy studies, the humanities, arts, and some interdisciplinary thinkers that defy categories. This accessible approach fills the gap for a textbook that integrates sustainability science and engineering studies with strong empirical social

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science and it will be a useful tool to anyone interested in the socio-ecological dimensions of energy system transitions.

The world is entering the Third Industrial Revolution, an era of remarkable progress in science and technology that will require a global shift away from reliance on fossil-fuel and carbon-based energy. This book explains how America can lead the effort to reverse global warming and become the world leader in global energy innovation.

This dissertation develops a set of analytical tools and conceptual frameworks to explore the socio-technical implications of transitioning to a low carbon energy future. The chapters here investigate the energy challenges in Sub-Saharan Africa and analyze power expansion pathways in Nigeria and Kenya, outline the development of a novel electricity modeling tool, and conceptualize an energy sovereignty framework to enable people-centered energy planning approaches. Chapter 2 presents an overview of Africa's energy systems and the role renewable energy can play in supporting sustainable development in Africa, with a main focus on the challenges in Sub-Saharan Africa. I synthesize the most prominent papers in the past five years. I review the literature concerning the scale of generation expansion needed to achieve universal access in the region, the challenges of power sector finance, and the need for people-centered planning paradigms. Through an extensive literature review, I assess the capacity expansion needs of the region and highlight the policy lessons that enable private power sector investment such as transparent regulatory and procurement policies. I also present a critique of the socio-political implications of increased foreign investment in the region's power sector. Finally, I present several studies that explore the need for people-centered planning approaches in order to achieve more

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equitable energy systems for all. I argue that renewable energy presents opportunities to achieve power systems expansion in an economically, environmentally and socially sustainable manner. To do this, Sub-Saharan Africa must adapt its planning strategies to holistically address the technical, economic and socio-political challenges it faces. Chapter 3 takes a deep-dive from an overview of Sub-Saharan Africa to a focus on Nigeria. I develop a first-order capacity expansion model to analyze power expansion scenarios in Nigeria. Nigeria serves as a case of countries with significant electricity demand growth that is constrained by under-developed grid infrastructure. I illustrate how the dependence on natural gas for generation has stifled the nation's power supply, assess the role of renewable energy in meeting the nation's electricity demand growth, and compare the cost of its current power generation expansion pathways to cost-optimized pathways. Using the capacity expansion model, I find that Nigeria's current energy policy, known as Vision 30:30:30, perpetuates this heavy reliance on natural gas and significantly underestimates the role of solar energy in the future electricity mix. I also identify and assess lower cost alternative pathways which do not require any coal and nuclear generation expansion unlike the Vision 30:30:30 pathway. The results show that Nigeria will have to install at least an additional 38 GW by 2030 to keep up with grid-based demand growth alone - about eight times the current operational capacity. This chapter reveals Nigeria's need for an energy policy reform that reduces its dependency on natural gas, eschews coal and nuclear expansion, and harnesses its abundant solar potential using centralized and distributed renewable energy technologies. Chapter 4 outlines my development of a novel open-access electricity modeling tool known as PROGRESS (Programmable Resource Optimization for

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Growth in Renewable Energy and Sustainable Systems). PROGRESS enables generation expansion modeling for countries with low availability and access to power systems data. The design of sustainable electricity systems needed to fuel development in regions with low electrification rates (such as Sub-Saharan Africa) requires context-specific power system modeling. Modeling data requirements for these regions, however, can be challenging for researchers and other stakeholders to access. This chapter presents a proof-of-concept description to show how PROGRESS works and then presents preliminary results for generation capacity expansion using the case of Kenya. Chapter 5 presents what is, for me, the most critical aspect of this dissertation. I explore how transitioning to low carbon energy systems and achieving universal electricity access will require not only an extensive redesign of the existing energy infrastructure but also a rethinking of energy planning approaches. I argue that innovation in decentralized and distributed energy technology transforms people from mere consumers to prosumers by empowering them to plan for their energy autonomously. I aim to connect the rise of prosumers with long-standing social movements that call for just, fair and sustainable energy systems. I draw from a rich literature of socio-energy concepts that aim to incorporate social and human dimensions into energy planning. I focus on energy justice, energy democracy, and I introduce energy sovereignty. I synthesize how these concepts together emphasize critical considerations for energy planning: “energy for whom, for what, and at whose costs?” I also introduce an additional consideration: “energy by whom?” and I conceptualize its framework in relation to electricity provision. I propose that “energy by whom?” is an essential question for re-envisioning a new energy paradigm and designing a low-carbon energy future. Overall, this

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dissertation contributes analytical and conceptual tools for low carbon energy systems, which together provide novel socio-technical approaches for planning towards a low carbon energy future, and urge on the paradigm shift to just and sustainable energy for all. Electricity transmission and distribution (T&D) networks carry electricity from generation sites to demand sites. With the increasing penetration of decentralised and renewable energy systems, in particular variable power sources such as wind turbines, and the rise in demand-side technologies, the importance of innovative products has never been greater. Eco-design approaches and standards in this field are aimed at improving the performance as well as the overall sustainability of T&D network equipment. This multidisciplinary reference provides coverage of developments and lessons-learned in the fields of eco-design of innovation from product-specific issues to system approaches, including case studies featuring problem-solving methodologies applicable to electricity transmission and distribution networks. Discusses key environmental issues and methodologies for eco-design, and applies this to development of equipment for electricity transmission and distribution. Provides analysis of using and assessing advanced equipment for wind energy systems. Includes reviews of the energy infrastructure for demand-side management in the US and Scandinavia.

Sustainable Technology in Mexico and Brazil
Decentralized Solutions for Developing Economies
Exploring the Dynamics of Energy Transitions
Renewable Energy and Energy Efficiency
Efficiency, Innovation and Sustainability

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Sustainability Innovations in the Electricity Sector Policies and Programs for Sustainable Energy Innovations

New innovations are needed for the invention of more efficient, affordable, sustainable and renewable energy systems, as well as for the mitigation of climate change and global environmental issues. In response to a fast-growing interest in the realm of renewable energy, *Renewable Energy Systems: Efficiency, Innovation and Sustainability* identifies a need to synthesize relevant and up-to-date information in a single volume. This book describes a systems approach to renewable energy, including technological, political, economic, social and environmental viewpoints, as well as policies and benefits. This unique and concise text, encompassing all aspects of the field in a single source, focuses on truly promising innovative and affordable renewable energy systems. Key Features: Focuses on innovations in renewable energy systems that are affordable and sustainable Collates the most relevant and up-to-date information on renewable energy systems, in a single and unique volume Discusses lifecycle assessment, cost and availability of systems Emphasizes bio-related topics Provides a systems approach to the renewable energy technologies and discusses technological, political, economic, social, and environmental viewpoints as well as policies

ICT Innovations for Sustainability is an investigation of how information and communication technology can contribute to sustainable development. It presents clear definitions of sustainability, suggesting conceptual frameworks for the positive and negative effects of ICT on sustainable development. It reviews methods of assessing the direct and indirect impact of ICT systems on energy and materials demand, and examines the results of such assessments. In addition, it investigates ICT-based approaches to supporting sustainable patterns of production and consumption, analyzing them at various levels of abstraction – from end-user devices, Internet infrastructure, user behavior, and social

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practices to macro-economic indicators. Combining approaches from Computer Science, Information Systems, Human-Computer Interaction, Economics, and Environmental Sciences, the book presents a new, holistic perspective on ICT for Sustainability (ICT4S). It is an indispensable resource for anyone working in the area of ICT for Energy Efficiency, Life Cycle Assessment of ICT, Green IT, Green Information Systems, Environmental Informatics, Energy Informatics, Sustainable HCI, or Computational Sustainability.

The EU-funded project "Sustainable Consumption Research Exchanges" (SCORE!) consists of around 200 experts in the field of sustainable innovation and sustainable consumption. The SCORE! philosophy is that innovation in SCP policy can be achieved only if experts that understand business development, (sustainable) solution design, consumer behaviour and system innovation policy work together in shaping it. Sustainable technology design can be effective only if business can profitably make the products and consumers are attracted to them. To understand how this might effectively happen, the expertise of systems thinkers must be added to the mix. The publication in 2008 of System Innovation for Sustainability 1 was the first result of a unique positive confrontation between experts from all four communities. It examined what SCP is and what it could be, provided a state-of-the-art review on the governance of change in SCP policy and looked at the strengths and weaknesses of current approaches. System Innovation for Sustainability 4 is the third of three books of case studies covering respectively the three key consumption areas of mobility, food and agriculture, and energy use and the built environment – responsible for 70% of the life-cycle environmental impacts of Western societies – with the aim of stimulating, fostering or forcing change to SCP theory in practice. Energy consumption is obviously a key issue for sustainability, primarily because it depletes non-renewable fossil fuels, produces CO₂ and other pollution. As climate change is becoming a key political issue, and as oil prices

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rise, society has become acutely aware of this issue. Energy is a special case because it is a key input to almost all other consumption and production processes. Housing is, with transport and food, a major consumer of energy, accounting for about one quarter of the environmental impact from the general consumption of products in the European Union, on a par with food and transport. Energy use in houses and buildings is also set to rise as populations – and the buildings they need – continue to increase. In France, for example, energy consumption in houses and offices accounts for 43% of the total national energy consumption, and one-quarter of national greenhouse gas emissions. The UK's 21 million homes consume around 50 million tonnes of oil equivalent (responsible for 27% of UK CO₂ emissions); this energy use has increased steadily by about 1.3% per year since 1990. Germany's buildings contribute one-fifth of the country's CO₂ emissions. Beyond this, buildings are the environment where we spend most of our lives; they deeply influence many other consumption patterns, and are an important factor for life and comfort. The societal function and nature of buildings as they are currently constructed presents some key difficulties in moving towards sustainable consumption and production. Buildings have a long lifetime; and therefore they are a major target for any structural changes in consumption patterns. Conversely, long lifetimes come with associated strong inertia; therefore the stock of existing buildings is often an obstacle to policies aimed at behavioural change. This book examines, through a case study approach, opportunities to influence energy consumption in housing and buildings and thereby provide options for implementation at a macro, meso and micro level. A growing body of evidence shows that cases demonstrating action towards SCP in energy use in housing can inspire innovation through a range of actors. The cases include examples of steps towards the sustainable use of energy in houses and buildings, from "local experiments", to "innovative communities", to wider regime or non-local scale change in Europe and North America. The System Innovation for Sustainability series

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is the fruit of the first major international research network on SCP and will set the standard in this field for some years to come. It will be required reading for all involved in the policy debate on sustainable production and consumption from government, business, academia and NGOs for designers, scientists, businesses and system innovators.

This book argues that renewable electrification in developing countries provides important opportunities for local economic development, but new pathways are required for turning these opportunities into successful reality. *Building Innovation Capabilities for Sustainable Industrialisation* offers a novel input into the debate on development of capabilities for sustainable industrialisation and delivers key insights for both researchers and policy makers when it comes to the question of how to increase the economic co-benefits of renewables expansion. The chapters in the book use a tailored analytical framework in their studies of renewable electrification efforts in Kenya and other countries in sub-Saharan Africa. They draw on a mix of project, sector and country level case studies to address questions such as: What capabilities are developed through on-going renewable electrification projects in developing economies? How can the expansion of renewable electrification be supported in a way that also encourages sustainable economic development? What role do international linkages (South-South and North-South) play and what role should they play in the greening of energy systems in developing economies? The authors provide a new understanding of how green transformation and sustainable industrialisation can be combined, highlighting the opportunities and constraints for local capability building and the scope for local policy action. This book will be of great interest to students and scholars of development studies, energy studies, sustainability and sustainable development, as well as practitioners and policy makers working in development organisations and national governments.

Socio-Technical Innovation for a Low Carbon Energy Future

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Can Business Save the Earth?

Sustainable Energy Transitions

Innovation, technology and pro-poor green transformations

Global Energy Innovation

Proceedings of ISET 2020

Sustainable Energy for All

Continuation along current development pathways is not sustainable. Available technology and production practices and the consumption patterns of modern societies are leading to global warming and ecological destruction. Business as usual is not an option. There is an urgent need to find a new development paradigm that ensures environmental sustainability while managing to provide, now and in the future, a decent livelihood for all of humanity. In *Technology and Innovation for Sustainable Development*, experts in the area provide a variety of insights about the technical transformation needed for sustainable development. It spells out the behavioural and policy changes that would need to accompany the next technological transformation, taking into account the complexity of inducing technological change in the energy and agricultural sectors. The assessment suggests that this will require major, but doable improvements in national innovation systems and major, but affordable shifts in investment patterns and related macroeconomic adjustments.

This book highlights progress towards the capture, storage, and utilization of energy through the development of advanced materials and systems based on abundant elements, materials, and commodities. Energy is critical to human sustainability and a global-scale deployment

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renewable energy systems will be required. Hence, the chapters integrate the fundamental aspects that enable the technical advancements in detail, along with an emphasis on innovation for highly sustainable materials to enable real impact for humankind: To determine innovation of energy capture and storage through characterizations of materials in an electrical generation and electrical storage systems; To demonstrate better performance, economic and environmental advantages than the current state of the art; To define new chemistries and materials for innovations in energy density design through lower operating temperatures, improve safety, expanding operational voltage, battery durability lifetime, and reduce system costs. Advances critical technical and commercial objectives for novel high energy density materials; Evaluates operational material models for optimizing energy capture that are integrated by configurations as a system; Illustrates utilization of material life cycle assessment for high energy outputs generators for sustainable materials. Global energy network is an important platform to guarantee effective exploitation of clean energy and ensure reliable energy supply for everybody. Global Energy Interconnection analyzes the current situation and challenges of global energy development, provides strategic thinking, overall objective, basic pattern, construction method and development mode for the development of global energy network. Based on the prediction of global energy and electricity supply and demand in the future, with the development of UHV AC/DC smart grid technologies, this book offers new solutions to drive the safe, clean, highly efficient and sustainable development of global energy. The concept and development ideas

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concerning global energy interconnection in this book are based on the author's thinking on strategic issues about China's and the world's energy and electricity development for many years, especially combined with successful practices of China's UHV development. This book is particularly suitable for researchers and graduated students engaged in energy security, as well as energy economics researchers, economists, consultants, and government energy policy makers in relevant fields. Based on the author's many years' experience in developing smart grid solutions within national and international projects. Combines both solid background information and cutting-edge technology progress, coupled with a useful and impressive list of references. The key energy problems which are challenging us nowadays are well stated and explained in this book, which facilitates a better understanding of the development of global energy interconnection with UHV AC/DC and smart grid technologies. This open access book addresses the issue of diffusing sustainable energy access in low- and middle-income contexts. Access to energy is one of the greatest challenges for many people living in low- income and developing contexts, as around 1.4 billion people lack access to electricity. Distributed Renewable Energy systems (DRE) are considered a promising approach to address this challenge and provide energy access to all. However, even if promising, the implementation of DRE systems is not always straightforward. The book analyses, discusses and classifies the promising Sustainable Product-Service System (SPSS) business models to deliver Distributed Renewable Energy systems in an effective, efficient and sustainable way. Its message is supported with cases studies and examples, discussing

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economic, environmental and socioethical benefits as well as its limitations and barriers to implementation. An innovative design approach is proposed and a set of design tools are supplied, enabling readers to create and develop Sustainable Product-Service System (SPSS) solutions to deliver Distributed Renewable Energy systems. Practical applications of the book's design approach and tools by companies and practitioners are discussed and the book will be of interest to readers in design, industry, governmental institutions, NGOs as well as researchers.

Proceedings of SEB 2019

Sustainable Energy Investment

Technology and Innovation for Sustainable Development

Sustainability in Energy and Buildings

Energy Use and the Built Environment

Designing Sustainable Energy for All

ICT Innovations for Sustainability

System innovation for sustainability 4 is the third of three books of case studies covering respectively the three key consumption areas of mobility, food and agriculture, and energy use and the built environment responsible for 70% of the life-cycle environmental impacts of Western societies with the aim of stimulating, fostering or forcing change to SCP theory in practice. Energy consumption is obviously a key issue for sustainability, primarily because it depletes non-

renewable fossil fuels, produces CO₂ and other pollution. As climate change is becoming a key political issue, and as oil prices rise, society has become acutely aware of this issue. Energy is a special case because it is a key input to almost all other consumption and production processes. Housing is, with transport and food, a major consumer of energy, accounting for about one quarter of the environmental impact from the general consumption of products in the European Union, on a par with food and transport. Energy use in houses and buildings is also set to rise as populations and the buildings they need continue to increase. This book contains the proceedings of the 12th KES International Conference on Sustainability and Energy in Buildings 2020 (SEB20) held in Split, Croatia, during 24–26 June 2020 organized by KES International. SEB20 invited contributions on a range of topics related to sustainable buildings and explored innovative themes regarding sustainable energy systems. The aim of the conference is to bring together researchers, and government and industry professionals to discuss the future of energy in buildings, neighbourhoods and cities from a theoretical, practical, implementation and simulation perspective. The conference formed an exciting chance to present, interact and learn about the latest research and practical developments on the subject. The conference attracted submissions from around the world. Submissions for the Full-Paper Track were subjected to a

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blind peer-review process. Only the best of these were selected for presentation at the conference and publication in these proceedings. It is intended that this book provides a useful and informative snapshot of recent research developments in the important and vibrant area of sustainability in energy and buildings.

"Unique in linking sustainable energy technologies with innovation and product design, this book offers clear explanation of both and case studies enabling readers to understand and design energy-efficient products in several different markets. The book integrates the subject areas that are necessary for the design of sustainable and energy-efficient products based on sustainable energy technologies. The theory provided is illustrated by cases of design projects and concepts in practice. With the book's methodological approach, the reader is able to apply the information and examples in their research projects or product design processes. This book fills a void in existing literature at the intersection of innovation processes, sustainable energy technologies, energy demand reduction, product development, and user behaviour, which requires an integrated view on the development of sustainable energy solutions. As such, the editors offer a unique publication in "product innovation in sustainable energy technologies and energy-efficiency" that corresponds to the growing interest in

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the field"--

After the United Nations adopted the 17 Sustainable Development Goals (SDGs) to "end poverty, protect the planet, and ensure prosperity for all," researchers and policy makers highlighted the importance of targeted investment in science, technology, and innovation (STI) to make tangible progress. Science, Technology, and Innovation for Sustainable Development Goals showcases the roles that STI solutions can play in meeting on-the-ground socio-economic and environmental challenges among domestic and international organizations concerned with the SDGs in three overlapping areas: agriculture, health, and environment/energy. Authors and researchers from 31 countries tackle both big-picture questions, such as scaling up the adoption and diffusion of new sustainable technologies, and specific, localized case studies, focusing on developing and middle-income countries and specific STI solutions and policies. Issues addressed include renewable energy, automated vehicles, vaccines, digital health, agricultural biotechnology, and precision agriculture. In bringing together diverse voices from both policy and academic spheres, this volume provides practical and relevant insights and advice to support policy makers and managers seeking to enhance the roles of STI in sustainable development.

Perspectives on Radical Changes to Sustainable Consumption and Production

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Science, Technology, and Innovation for Sustainable Development Goals

Energy Systems Integration and Innovation for a Clean Energy Transition

Innovation in Energy Law and Technology

Why America Must Lead

Current Status, Future Challenges, and Perspectives

Citizen Activities in Energy Transition

Innovation for Sustainable Electricity Systems Exploring the Dynamics of Energy Transitions Springer Science & Business Media

Sustainable Entrepreneurship is nowadays considered as a discipline at the cross-roads of many others. This book describes recent cases, techniques and tools proposed for leaders, entrepreneurs, and practitioners who are involved and responsible for making strategic decisions in their companies and aiming at sustainable development. This book highlights the use of new business models/methods that can be employed by organizations and researchers to save millions of dollars, to enhance the economic growth, as well as to resolve environmental and social issues, via sustainable networks, renewal energy distribution, and social/green entrepreneurship. It will provide a comprehensive discussion of practical techniques, like Machine Learning, Robotics, Photovoltaic solar energy, in the field of renewable energy, and other digital tools, such as digital marketing,

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crowdsourcing platforms, and digital currency. Meanwhile, it will enlighten the way for entrepreneurs and decision makers by helping them to learn how to grow their business. The focus will be on how to benefit from these techniques to develop sustainable and renewable energy-based projects, as well as digitalized new ventures. The book walks the reader through the latest emerging trends in digitalization that can support practitioners, managers, entrepreneurs, and researchers to help them appreciate the application of sustainable solutions in various functional domains.

*Increasingly, business leaders are tasked with developing new products, services, and business models that minimize environmental impact while driving economic growth. It's a tall order—and a call that is only getting louder. In *Can Business Save the Earth?*, Michael Lenox and Aaron Chatterji explain just how the private sector can help. Many believe that markets will inevitably demand sustainable practices and force them to emerge. But Lenox and Chatterji see it differently. Based on more than a decade of research and work with companies, they argue that a bright green future is only possible with dramatic innovation across multiple sectors at the same time. To achieve this, a broader ecosystem of players—including inventors, executives, customers, investors, activists, and governments—all must play a role. The book outlines how and the*

extent to which each group can serve as a driver of green growth. Then, Lenox and Chatterji identify where economic incentives currently exist, or could exist with institutional change, and ultimately address the larger question of how far well-coordinated efforts can take us in addressing the current environmental crisis.

System Innovation for Sustainability 1

Eco-friendly Innovations in Electricity Transmission and Distribution Networks