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This book provides students and practicing engineers with a comprehensive guide to off-grid electrification: from microgrids and energy kiosks to solar home systems and solar lanterns. As the off-grid electrification industry grows, universities are starting and expanding courses and programs in humanitarian engineering and appropriate technology. However, there is no textbook that serves this growing market. This book fills that gap by providing a technical foundation of off-grid electrical systems, putting into context the technical aspects for developing countries, and discussing best practices by utilizing real-world data. Chapters expertly integrate the technical aspects of off-grid systems with lessons learned from industry-practitioners taking a pragmatic, data-driven perspective. A variety of off-grid systems and technologies are discussed, including solar, wind, hydro, generator sets, biomass systems, battery storage and converters. Realistic examples, case studies and practical considerations from actual systems highlight the interaction of off-grid systems with the economic, environmental, social and broader development aspects of rural electrification. Whole chapters are dedicated to the operation and control of mini-grids, load and resource estimation, and design of off-grid systems. Special topics focused on electricity access in developing countries are included, such as energy use in rural communities, technical and economic considerations of grid extension, electricity theft, metering, and best practices devoted to common

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problems. Each chapter is instructor-friendly and contains illustrative examples and problems that reinforce key concepts. Complex, open-ended design problems throughout the book challenge the reader to think critically and deeply. The book is appropriate for use in advanced undergraduate and graduate courses related to electrical and energy engineering, humanitarian engineering, and appropriate technology. Provides a technical foundation of off-grid electrical systems; Contextualizes the technical aspects for developing countries; Captures the current and state-of-the-art in this rapidly developing field.

The book analyzes energy technologies, business models and policies to promote sustainable development. It proposes a set of recommendations for further activities and networking on access to energy and renewable energies and promotes an integrated approach to sustainable resource management. The book discusses access to energy, as a precondition for socio-economic progress. It depicts the global dimension of the challenge in terms of access to electricity and other forms of energy in developing countries. The three main interlinked topics related to energy and sustainable growth are separately discussed: appropriate technologies for modern energy services, business models for the development of new energy markets, and policies to support new energy systems. The description of activities and programmes of some public and private Italian stakeholders is also included.

The energy policy of the Asian Development Bank (ADB) focuses on maximizing energy access, promoting energy efficiency and renewable energy, and promoting improved governance and capacity in the energy sector to strengthen the capacity of developing member countries to meet critical energy needs. This publication seeks to further ADB's efforts to promote knowledge sharing among stakeholders and help identify the policy, regulatory, and legal barriers to energy

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access, design and implement effective frameworks; and develop strategies to scale up energy access for all. This publication also seeks to serve as a reference for stakeholders and menu of options for further action.

This report describes the four basic types of on- and off-grid small power producers emerging in Africa and highlights the regulatory and policy questions that must be answered by electricity regulators, rural energy agencies, and ministries to promote commercially sustainable investments by private operators and community organizations.

The first comprehensive political science account of energy poverty, arguing that governments can improve energy access for their citizens through appropriate policy design. In today's industrialized world, almost everything we do consumes energy. While industrialized countries enjoy all the amenities of modern energy, more than a billion people in the developing world still lack energy access. Why is energy poverty persistent in some countries and not in others?

Offering the first comprehensive political science account of energy poverty, *Escaping the Energy Poverty Trap* explores why governments have or have not been able to lead in providing modern energy to their least advantaged citizens. Focusing on access to modern cooking fuels and household electrification, the authors develop a new political-economic theory that introduces government interest, institutional capacity, and local accountability as key determinants of energy access. They draw on case studies from India, East Asia, Africa, and Latin America to offer the optimistic conclusion that governments can improve institutional capacity and local accountability through appropriate policy design. Energy poverty is a policy problem, the authors assert, and engaging with it as such offers new opportunities not only for ensuring equal energy access, but also for political, economic, and environmental development.

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In recognition of the fact that billions of people in the developing world do not have access to clean energies, the United Nations launched the Sustainable Energy for All Initiative to achieve universal energy access by 2030. Although electricity grid extension remains the most prevalent way of providing access, it is now recognized that the central grid is unlikely to reach many remote areas in the near future. At the same time, individual solutions like solar home systems tend to provide very limited services to consumers. Mini-grids offer an alternative by combining the benefits of a grid-based solution with the potential for harnessing renewable energies at the local level. The purpose of this book is to provide in-depth coverage of the use of mini-grids for rural electrification in developing countries, taking into account the technical, economic, environmental and governance dimensions and presenting case studies from South Asia. This book reports on research carried out by a consortium of British and Indian researchers on off-grid electrification in South Asia. It provides state-of-the art technical knowledge on mini-grids and micro-grids including renewable energy integration (or green mini-grids), smart systems for integration with the central grid, and standardization of systems. It also presents essential analytical frameworks and approaches that can be used to analyze the mini-grids comprehensively including their techno-economic aspects, financial viability and regulatory issues. The case studies drawn from South Asia demonstrate the application of the framework and showcase various successful efforts to promote mini-grids in the region. It also reports on the design and implementation of a demonstration project carried out by the team in a cluster of villages in Odisha (India). The book's multi-disciplinary approach facilitates understanding of the relevant practical dimensions of mini-grid systems, such as demand creation (through interventions in livelihood generation and value

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chain development), financing, regulation, and smart system design. Its state-of-the art knowledge, integrated methodological framework, simulation exercises and real-life case analysis will allow the reader to analyze and appreciate the mini-grid-related activities in their entirety. The book will be of interest to researchers, graduate students, practitioners and policy makers working in the area of rural electrification in developing countries.

As the global economy continues to grow and change, issues concerning sustainability practices have become more prevalent. The implementation of efficient sustainability procedures offers significant assistance in the development of modern economies. *Economic Modeling, Analysis, and Policy for Sustainability* focuses on interdisciplinary perspectives concerning the social, environmental, and economic spheres of sustainability science. Emphasizing economic models, as well as mitigation policies and practices from various regions of the world, this book is a pivotal reference source for researchers, policy makers, government officials, and corporate leaders.

Electrification can be a significant driver for improving livelihoods in rural communities. In rural Mali, where more than 80 percent of the country's population lives, the electrification rate is only 15 percent. Increasing access to electricity in rural Mali is crucial for economic development, social cohesion, and reconstruction following the country's recent period of conflict, political instability, and food insecurity. This note discusses an innovative output-based aid (OBA) project in rural Mali, the first such project in the energy sector to support development of mini-grids on a large scale. The project complements an innovative hybrid-system model

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supported by the International Development Association (IDA) and climate investment funds and scaling up renewable energy in low income countries program (SREP) to expand rural access to modern energy services and increase renewable generation.

This book gathers selected high-quality research papers presented at International Conference on Renewable Technologies in Engineering (ICRTE 2021) organized by Manav Rachna International Institute of Research & Studies, Faridabad, Haryana, India, during 15–16 April 2021. The book includes conference papers on the theme “Computational Techniques for Renewable Energy Optimization”, which aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of renewable energy integration, planning, control and optimization. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends and concerns as well as practical challenges encountered and solutions adopted in the fields of renewable energy and resources.

Uttar Pradesh, the most populous state in India, has among the lowest levels of electricity connection in the country. 1 Over 100 million people, at least half of the rural population, lack a formal connection to a distribution grid. The level of electricity services remains low despite the physical extension of the state-owned grid to all official villages. Unelectrified households are reluctant to apply for grid connection because they expect electricity

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supply to be unreliable, and they would have to spend money on coping strategies to replace electricity. In addition, connecting individual households in each village is costly to the state-owned distribution utilities. Highly regulated tariffs and a high cost of servicing remote areas mean that rural connections promise few returns to the utilities. Electrification has been a public policy priority for decades of successive state and central governments across the political spectrum. Public policy has maintained ambitious objectives to expand grid services from the state-owned medium-voltage (MV) distribution grid to rural areas. The state-owned grid has electrified all cities and surrounding towns. The high-voltage (HV) transmission grid extends throughout most of the state, in contrast to other energy-poor countries in Asia such as Cambodia, Indonesia, and Sri Lanka. Private mini grid operators have occupied a small but growing space in the rural electricity market in Uttar Pradesh since around 2010. Several small companies, as well as individual entrepreneurs, are now providing electricity services in almost 1,900 settlements (villages and hamlets) in the state, and have made about 37,000 connections (and growing). Independent mini grid operators in Uttar Pradesh have proven they can earn rural customers' trust and their business. Rural consumers' simple energy needs can absorb up to a third of households' monthly expenditure without an electricity connection. Mini grid operators are addressing these gaps in service through renewable-based systems that deliver power to underserved villages. They have gained credibility as a more reliable service than the

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state-owned grid in rural areas by providing a reliable solution to residents' and businesses' lighting, phone charging, and appliance-powering problems. They provide basic light-emitting diode (LED) home lighting and a mobile phone charging outlet to a household for a scheduled 6 to 8 hours a day.

Mini-Grids for Rural Electrification of Developing Countries Analysis and Case Studies from South Asia Springer

This book presents new research on solar mini-grids and the ways they can be designed and implemented to provide equitable and affordable electricity access, while ensuring economic sustainability and replication.

Drawing on a detailed analysis of solar mini-grid projects in Senegal, the book provides invaluable insights into energy provision and accessibility which are highly relevant to Sub-Saharan Africa, and the Global South more generally. Importantly, the book situates mini-grids in rural villages within the context of the broader dynamics of national- and international-level factors, including emerging system innovation and socio-technical transitions to green technologies. The book illustrates typical challenges and potential solutions for practitioners, policymakers, donors, investors and international agencies. It demonstrates the decisive roles of suitable policies and regulations for private-sector-led mini-grids and explains why these policies and regulations must be different from those that are designed as part of an established, centralized electricity regime. Written by both academics and technology practitioners, this book will be of great interest to those

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researching and working on energy policy, energy provision and access, solar power and renewable energy, and sustainable development more generally. The record of concession arrangements in stimulating faster and more effective rural electrification in Sub-Saharan Africa is mixed at best: More concessions have failed than have been implemented--and among concessions that have been implemented, none can be considered an unequivocal success. Still, properly structured agreements can expand electrification by connecting more households to the national grid or to mini-grids. Lessons from case studies shed light on the circumstances under which concessions work best. Rural electrification enjoys high priority on Indonesia's development agenda. In remote villages located beyond the reach of national electricity grids, mini hydropower offers an environmentally friendly alternative to decentralized electricity generation. Technical assistance programs have successfully introduced mini hydro technology in developing countries but have often failed to attain sustainable plant operation. This book provides insight into the multifaceted conditions under which village communities are struggling to keep systems running. A new approach linking productive electricity use and mini hydro operation is developed which incorporates experiences of market-oriented approaches in small enterprise development. Village communities are no longer left alone after the commissioning of the plants but are continuously provided need-oriented services. The study is exceptional in that the approach is experimentally applied in an actual project involving a

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village-owned coffee roastery. It is shown that the new approach not only contributes to a sustainable electricity supply but also to village development.

This open access book presents the proceedings of the 2nd Africa-EU Renewable Energy Research and Innovation Symposium (RERIS 18), held in Maseru, Lesotho in January 2018. The symposium aimed to foster research cooperation on renewable energy between Africa and Europe – in academia, as well as the private and public sectors. Addressing thematic areas such as • Grid-connected renewable energy; • Decentralised renewable and household energy solutions; • Energy socioeconomics; and • Promotion of energy research, innovation, education and entrepreneurship, the book brings together contributions from academics and practitioners from the EU and Africa to enable mutual learning and knowledge transfer – a key factor in boosting sustainable development in the African renewable energy market. It also plays a significant role in promoting African renewable energy research, which helps to secure energy supply in both rural and urban areas and to increase generation capacities and energy system resilience. This book is an invaluable resource for academics and professionals across the renewable energy spectrum.

The continued growth of any nation depends largely on the development of their built infrastructures and communities. By creating stable infrastructures, countries can more easily thrive in competitive international markets. Sustainable Infrastructure: Breakthroughs in Research and Practice examines

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sustainable development through the lens of transportation, waste management, land use planning, and governance. Highlighting a range of topics such as sustainable development, transportation planning, and regional and urban infrastructure planning, this publication is an ideal reference source for engineers, planners, government officials, developers, policymakers, legislators, researchers, academicians, and graduate-level students seeking current research on the latest trends in sustainable infrastructure.

More than 1.3 billion people worldwide lack access to electricity. Although extension of the electricity grid remains the preferred mode of electrification, off-grid electrification can offer a solution to such cases. *Rural Electrification through Decentralised Off-grid Systems in Developing Countries* provides a review of rural electrification experiences with an emphasis on off-grid electrification and presents business-related aspects including participatory arrangements, financing, and regulatory governance. Organized in three parts, *Rural Electrification through Decentralised Off-grid Systems in Developing Countries* provides comprehensive coverage and state-of-the-art reviews which appraise the reader of the latest trend in the thinking. The first part presents the background information on electricity access, discusses the developmental implications of lack of electricity infrastructure and provides a review of alternative off-grid technologies. The second part presents a review of experiences from various regions (South Asia, China, Africa, South East Asia and South America). Finally, the third part deals with business dimensions and covers

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participatory business models, funding challenges for electrification and regulatory and governance issues. Based on the research carried out under the EPSRC/DfID funded research grant for off-grid electrification in South Asia, *Rural Electrification through Decentralised Off-grid Systems in Developing Countries* provides a multi-disciplinary perspective of the rural electrification challenge through off-grid systems. Providing a practical introduction for students, this is also a key reference for engineers and governing bodies working with off-grid electrification.

A Guidebook on Grid Interconnection and Islanded Operation of Mini-Grid Power Systems Up to 200 kW is intended to help meet the widespread need for guidance, standards, and procedures for interconnecting mini-grids with the central electric grid as rural electrification advances in developing countries, bringing these once separate power systems together. The guidebook aims to help owners and operators of renewable energy mini-grids understand the technical options available, safety and reliability issues, and engineering and administrative costs of different choices for grid interconnection. The guidebook is intentionally brief but includes a number of appendices that point the reader to additional resources for indepth information. Not included in the scope of the guidebook are policy concerns about "who pays for what," how tariffs should be set, or other financial issues that are also paramount when "the little grid connects to the big grid."

This book covers multifaceted aspects of sustainable energy solutions for remote areas in the tropics,

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particularly focusing on Southeast Asia. With insights from both the academic world and real-life implementation, readers will gain an overview of the range of energy problems currently facing the remote tropics, and what potential solutions are available. The book provides a detailed overview of various energy needs in the Southeast Asian tropics, a region where a significant portion of the population still lives without access to electricity. It not only addresses technical solutions to the energy problems but also tackles the social and wider implications, offering readers a more holistic understanding of the potential held by renewable energy. The chapters are structured to present first an overview of the problem at hand, and then a description of the technologies that could potentially solve it. Applications of the technologies; business models that are now available or being developed; the impact of the technologies; and future, more sustainable solutions are all discussed. Given its in-depth analysis, the book will be of interest to energy professionals in the tropics, energy policymakers, and students studying sustainable energy.

Der Tagungsband enthält die wissenschaftlichen Beiträge der Konferenz "Mikro-Perspektiven auf dezentrale Energieversorgung" vom 23. bis 24.4.2015 in Bangalore, Indien. Die Beiträge umfassen eine große Bandbreite an Themen von technischen Herausforderungen dezentraler Energieversorgung über Konzepte für DC Micro Grids bis zu Finanzierungs- und Geschäftsmodellen für die Implementierung dieser innovativen Technologien. Weiterhin enthält der Band

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Beiträge zu Planungs- und Governance-Strategien, historische Analysen der Infrastrukturentwicklung und Technologie-Bewertung. Mit Fallstudien zu dezentraler Energieversorgung von Indien, Bangladesch, Ägypten, Äthiopien, Kenia, Nigeria, Tansanie und Brasilien geben die Artikel einen guten Überblick über die globale Entwicklung in diesem Sektor. The Proceedings present the scientific contributions of the Conference "Micro Perspectives for Decentralized Energy Supply" from 23rd till 24th of April in Bangalore, India. The papers cover a broad range of topics ranging from technical challenges of decentralized energy supply and concepts for solar DC micro grids till financing and business models for the implementation of those innovative technologies. The volume also contains contributions about planning and governance strategies, historical analyses of the infrastructural development and technology assessments. With case studies on decentralised energy supply from e.g. India, Bangladesh, Egypt, Ethiopia, Kenya, Nigeria, Tanzania and Brazil the papers give a good overview of the development of this sector all over the world.

Presenting the best papers of the 3rd EPFL-UNESCO Chair Conference on Technologies for Development, this publication offers a valuable collection of innovative case studies exploring access to energy and renewable energy technologies in the Global South. It investigates the key determinants for successfully providing energy to resource-poor communities and examines a wide range of technologies for energy production, distribution, storage and efficient use. Taken together, these case

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studies deal with the entire life cycle of products and solutions, as well as the complete value chain including all relevant stake holders. The collection also draws upon empirical research conducted in Africa and South America to present critical perspectives on women's access to technologies in the renewable sector. This publication serves as a bridge between engineers, economists and other scientists involved in research on the interface between technology and human, social and economic development. It also provides a valuable resource to academics and researchers of the natural sciences, computer science, information management, quantitative social sciences and business studies.

How do we provide effective public services in a deeply neoliberal world? In the wake of the widespread failure of privatisation efforts, societies in the global south are increasingly seeking progressive ways of recreating the public sector. With contributors ranging from cutting-edge scholars to activists working in health, water, and energy provision, and with case studies covering a broad spectrum of localities and actors, *Making Public in a Privatized World* uncovers the radically different ways in which public services are being reshaped from the grassroots up. From communities holding the state accountable for public health in rural Guatemala, to waste pickers in India and decentralized solar electricity initiatives in Africa, the essays in this collection offer probing insights into the complex ways in which people are building

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genuine alternatives to privatization, while also illustrating the challenges which communities face in creating public services which are not subordinated to the logic of the market, or to the monolithic state entities of the past.

For those in developed nations, suddenly being without electricity is a disaster: power cuts have us fretting over the food stored in the freezer, and even a few hours without lights, televisions, or air conditioning is an ordeal. However, for an estimated 1.6 billion people worldwide, the absence of electricity is their daily experience. An untold number of others live with electricity that is erratic and of poor quality. How can electric power be brought into their lives when the centralized utility models that have evolved in developed nations are not an economically viable option? Poor, rural communities in developing nations cannot simply be 'plugged in' to a grid. Small-scale Distributed Generation (DG), ranging from individual solar home systems to village level grids run off diesel generators, could provide the answer, and this book compares around 20 DG enterprises and projects in Brazil, Cambodia and China, each of which is considered to be a "business model" for distributed rural electrification. While large, centralized power projects often rely on big subsidies, this study shows that privately run and localized solutions can be both self-sustaining and replicable. Its three sections provide a general

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introduction to the issue of electrification and rural development, set out the details of the case studies and compare the models involved, and discuss the important thematic issues of equity, access to capital and cost-recovery. Hisham Zerriffi shows that in each case, it is not simply a matter of matching a particular technology to a particular need. Numerous institutional factors come into play including the regulatory regime, access to financial services, and government/utility support or opposition to the DG alternative. Despite this, in many countries, the question is not whether DG has a role to play. Rather it is a question of how it will play a role. The evidence suggests that many solar programs are being designed and implemented in isolation and without reliance on published guidelines or the experience gained by others. The conclusion is obvious: the likelihood of a program being successful would be greatly improved if program implementers were made more aware of best practice guidelines and of the lessons and experience learned by others in implementing previous programs. Furthermore, the best practice guidelines not only need to be readily available but need to describe the stages, issues and the stakeholders' roles in designing and implementing a SHS program. This book showcases a detailed road map that has been developed for the implementation of rural electrification projects in developing countries using solar PV. Features of this

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book will be case studies derived from personal participatory observation of the authors on Solar Home Systems, their impact, their advantages and disadvantages and their operation.

Access to power and electricity is a vital resource for businesses and for sustaining the livelihood of consumers. However, producing reliable and renewable energy and distributing it in rural areas can be challenging. Such activities require special technical support measures for organizing a highly efficient and cost-effective production process.

Renewable Energy and Power Supply Challenges for Rural Regions provides innovative insights into energy production, consumption, and distribution in rural regions and examines sustainable and renewable power sources. The content within this publication explores such topics as renewable energy, electrical network, and thermal energy storage. It is designed for electricians, policymakers, state officials, professionals, researchers, and academicians.

This short open access book investigates the role of renewable energy in East Africa to provide policy-relevant inputs for the achievement of a cost-effective electrification process in the region. For each country, the authors review the current situation in the domestic power sector, adopt a GIS-based approach to plot renewable energy resources potential, and review currently planned projects and

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projects under development, as well as the key domestic renewables regulations. Based on such information, least-cost 100% electrification scenarios by 2030 are then modelled and comparative results over the required capacity additions and investment are reported and discussed. The authors also inquire into some of the key technological, economic, policy, cooperation, and financing challenges to the development of a portfolio of renewables to promote energy access in a sustainable way, including a discussion of the challenges and opportunities that might stem from the interaction between local RE potential and natural gas resources currently under development in the region. To conclude, policy recommendations based on the book's results and targeted at international cooperation and development institutions, local policymakers, and private stakeholders in the region are elaborated. This guidebook shares training materials and knowledge on mini-grid development for rural electrification. It documents experiences and lessons learned from developing 12 pilot mini-grid systems for off-grid energy access in Myanmar. This guidebook documents the experiences and lessons learned from developing 12 pilot mini-grid systems for off-grid energy access in Myanmar. Unelectrified rural communities typically located 10 kilometers from the national grid and without prospects of being connected to the grid in the next 5 to 10 years have

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been chosen for the project. This guidebook shares training materials and knowledge on the major aspects of mini-grid development for rural electrification. Further, it highlights the importance of community participation and discusses the main renewable energy technologies that are suitable for mini-grid development in Myanmar including solar, hydro, and biomass. This guidebook is intended to serve government officials, renewable energy developers, and potential investors in the development of mini-grid projects in Myanmar. Presenting a complete guide for the planning, design and implementation of solar PV systems for off-grid applications, this book features analysis based on the authors' own laboratory testing as well as their in the field experiences. Incorporating the latest developments in smart-digital and control technologies into the design criteria of the PV system, this book will also focus on how to integrate newer smart design approaches and techniques for improving the efficiency, reliability and flexibility of the entire system. The design and implementation of India's first-of its-kind Smart Mini-Grid system (SMG) at TERI premises, which involves the integration of multiple renewable energy resources (including solar PV) through smart controllers for managing the load intelligently and effectively is presented as a key case study. Maximizing reader insights into the performance of different

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components of solar PV systems under different operating conditions, the book will be of interest to graduate students, researchers, PV designers, planners, and practitioners working in the area of solar PV design, implementation and assessment. As the population and economies of Sub Saharan Africa continue to grow, the demand for modern energy will correspondingly increase. The current energy policy and limited overall access rate is not prepared for this massive demand increases and presents a major hindrance to country growth potential. This thesis focuses on the countries in East Africa (Kenya, Tanzania, Ethiopia), and compares their current energy policies and renewable energy potential within a historical context of the United States rural electrification of 1930s. It is clear that some progress has been made in plans to address the energy access concerns but there is still some delay in diversifying the energy mix with renewable sources and advancing the use of mini-grids. The use of mini-grids will provide a sustainable solution to the energy crisis by increasing electricity reliability and providing power to areas too remote for grid connection.

This volume centers on the idea that innovative approaches for energy access can work with previously underutilized or unrecognized resources, as this may lead to circumstances for the development of successful and sustainable energy programs. Such untapped resources may be seen in the discovering of synergies in areas such as pre-existing service infrastructures, supply chain and value chain management, natural resource availability, financing schemes, and leap frog technologies. Additionally, decentralized approaches can contribute to climate change adaptation measures and increase resiliency for vulnerable communities. Of course small-scale solutions have clear limitations in regard to global

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climate, and it is important to consider how far they can extend and aggregate impact. This book assembles a selection of articles, collected from the 2014 Energy Access Conference at UC Berkeley, aiming to consider technical, financial, human, institutional, and natural resource capital. Im Fokus der Konferenz "Innovating Energy Access for Remote Areas: Discovering Untapped Resources", die vom 10. bis zum 12. April 2014 an der University of California stattfand, war der Zugang zu moderner Energieversorgung in strukturschwachen Regionen. Dieser Tagungsband trägt eine Reihe von innovativen Ansätzen zusammen, die auf der Konferenz diskutiert wurden. In den Beiträgen spiegeln sich aktuelle Konzepte, Theorien, Methoden und Techniken im Bereich der dezentralen Energieversorgung. Im Mittelpunkt vieler Beiträge steht die Frage, wie sich vormals ungenutzte oder unbekannte lokale Ressourcen nutzbar machen lassen. Neue Potentiale ergeben sich aus Synergien zwischen supply and value innovation, neuen Finanzierungsansätzen und der Nutzung sogenannte „leapfrog technologies“. Die Beiträge zeigen, wie dezentrale Ansätze und kleinteilige lokale Lösungen zur Bekämpfung des Klimawandels und die Anpassung an seine Folgen beitragen und die Resilienz gefährdeter Gemeinschaften stärken können.

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 (S.PSS)

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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 the economic, environmental and socioethical benefits as well as its limitations and barriers to its 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 (S.PSS) 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.

The Reconstruction and Development Programme (RDP) White Paper of 1994 laid the foundation for South Africa's developmental trajectory, focussing inter alia on providing basic water-, electricity-, health care- and education infrastructure and services, to all the people of South Africa. In South Africa, the Government has over the last 20 years been able to provide at least a basic level of electricity service to 86% of the people, with the remaining backlog mainly lying in the rural areas of the country, where topography, location and available technology pose challenges to being able to extend the distribution grid. The Department of Energy (DoE) estimates that the total number of non-grid household connections to be connected between 2014 and 2025 amounts to approximately 300 000. Taking into consideration that between 2002 and 2013, approximately 68 000 non-grid household connections, mainly through stand-alone solar home systems were made, the non-grid electrification programme will need to scale-up considerably; to approximately 25 000 per annum for the period between 2013 and 2025. The DoE's 'New Household Electrification

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Strategy? allows for any appropriate and affordable technology option to be applied towards achieving the non-grid electrification target. An appropriate energy solution could entail the application of small-scale hydropower (SHP) technology, either on its own or in hybrid formation, in conjunction with a mini-grid distribution system. Based on personal experience, risk management on any project is paramount to ensure the success of a project; with risks commonly being identified within specific project work-streams. Risks associated with technical and financial work-streams can traditionally be clearly quantified and mitigated, whereas risks associated with institutional work-streams are often more challenging to identify, quantify and mitigate due to subjective and often political influences. The necessity therefore of understanding the institutional environment within which small-scale hydropower projects would be implemented, in order to navigate through the complex maze of South Africa's vertically- and horizontally co-ordinated Government architecture, is important. It was hypothesised that South Africa's robust legislative-, policy- and planning architecture would allow socially driven stand-alone, small-scale hydropower projects with mini-grids, to provide electricity to those sparsely populated areas with low demand potential where it is not economically feasible to provide grid connected electricity. The primary objective of the research was to develop an institutional roadmap illustrating potential approaches for the implementation of small-scale hydropower electricity generation and distribution projects within the ambit of South Africa's complex legislative-, policy- and planning environment; towards achieving an accelerated rate of delivery of non-grid electrification connections in the deep rural areas of South Africa. The Study considered National Government planning- and legislation across sectors that have an influence on rural electrification projects, as well as

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the point where all the national planning, legislation, policies and strategies are to be implemented and operationalised at Local Government level. This institutional setting within which rural electrification projects in South Africa would need to be implemented, is applied to analyse ownership and operator model options, specifically focussed on small-scale hydropower projects with a mini-grid distribution system. The outcome of the Study showed that within the ambit of South Africa's current legislative-, policy- and planning environment in South Africa, potential approaches to opportunities exist to implement socially driven, small-scale hydropower projects, as part of the 'New Household Electrification Strategy'.

"Affordable, reliable, and sustainable energy service is fundamental to human, social and economic development. Approximately 1.2 billion people lack access to basic energy services. There exists a huge energy access gap between urban centers and rural areas. Approximately 84% of the people deprived of energy access live in rural areas. Existing rural electrification options including grid extension, mini-grids, and stand-alone solar home systems, have limited penetration in rural regions. Entrepreneurs, with support from governments and international institutions, have experimented with different business mechanisms to facilitate energy delivery. A significant amount of investment is being made for rural electrification but many projects are not self-sustaining. This research develops a new approach, 'Wireless Community Grid', to provide basic energy services to rural households and evaluates if the approach meets the desired features of affordability, profitability, and scalability. The approach comprises of a central charging station operated by local vendors, where portable power systems are charged and rented to homeowners. Each portable power system provides power to each home in the form of indoor lighting and device charging. Each power system is swapped

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from the station at a regular interval. To understand the energy needs and expenses of a rural population, surveys were conducted in Borgne, Haiti. The major sources for lighting are kerosene lamps, rechargeable bulbs and candles. For charging lights and phones, people have to walk to a vendor with solar systems or generators. Based on three surveyed communities, each household typically spends \$2.50 a week on energy services and local vendors make \$0.70 a week from each household served. To explore the sustainability of the Wireless Community Grid approach, three preliminary evaluation models were developed. First, a techno-economic tool was used to evaluate the relationship between reliability and cost. Based on the developed tool, a system consisting of 350 W solar array and 58 portable power units with 283 Wh capacity would meet the basic energy needs of a community of 49 households at the lowest present value. Second, a life cycle assessment was performed to study the environmental impacts. It was observed that the proposed system would provide a yearly reduction of 382 kg of CO₂ equivalents and 197 kg of crude oil equivalents for each household served compared to the current energy state. Finally, a social business structure was proposed to maximize the number of people impacted while keeping the system affordable and self-sustainable. While keeping the household energy cost level at \$2.50/week for energy services, the capital investment of \$6100 for a community system, could be recovered in less than 2 years. Over 10 years, the returns on a single investment would be able to expand to 64 similar communities and provide energy services to around 19,000 people. The wireless community grid approach appears to be affordable for end-users and provides profits for local vendors while being financially and environmentally sustainable and highly scalable."--Abstract.

Contributed articles presented at workshop on "Governance

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in Rural Electricity" on December 15-16, 2004, IRMA,
Anand, India as part of Silver jubilee celebration of the
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