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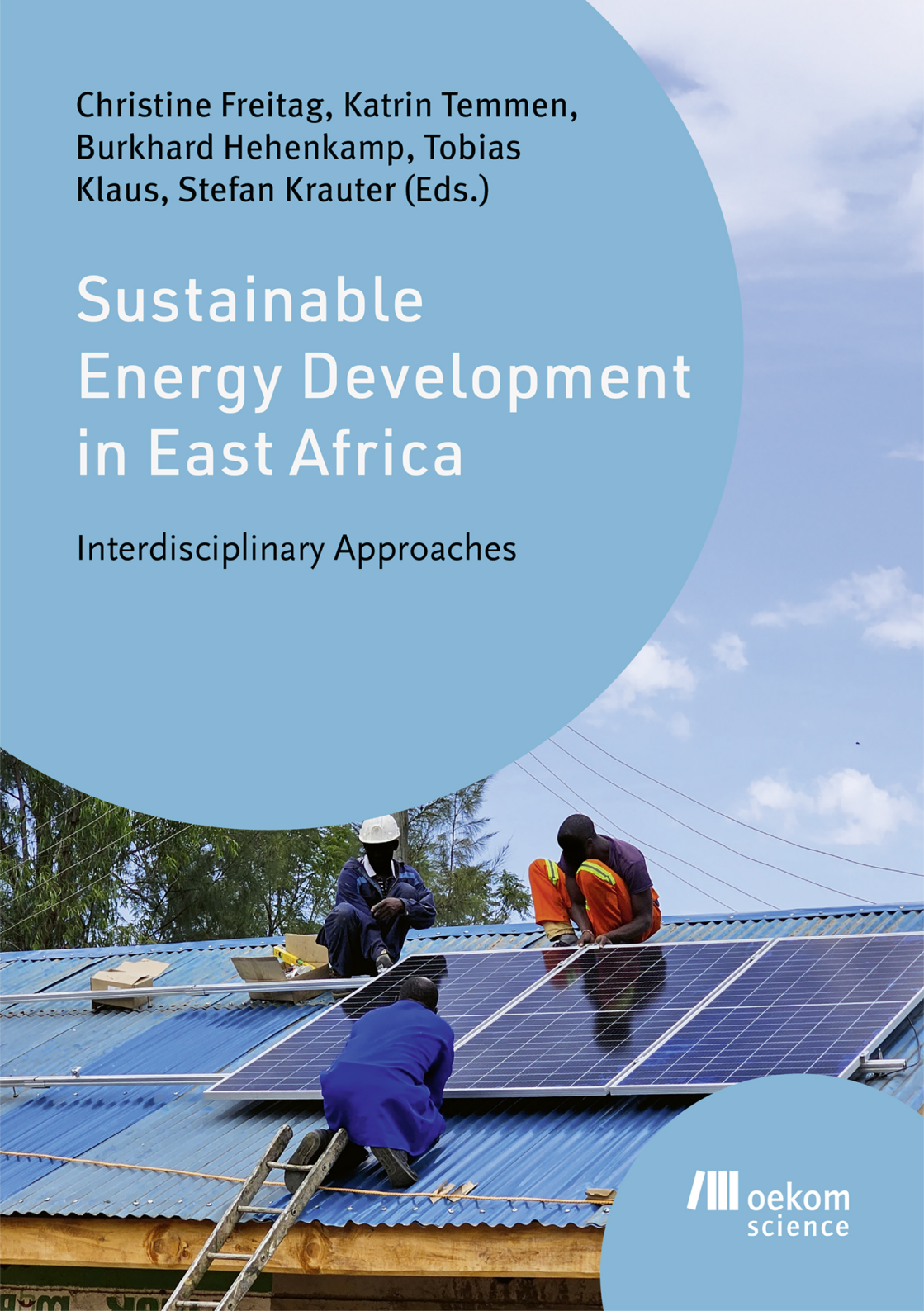
Sustainable Energy Development in East Africa

Interdisciplinary Approaches



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Inhalt

Abstract

This book explores sustainable energy development in East Africa from an interdisciplinary perspective. At its core lies the interaction between technological innovation and social, economic, cultural, and educational dimensions, which are crucial for the success of local and regional energy transitions. The contributions are based on the outcomes of the A:RT-D Grids project (2020–2024), an international partnership between East African and German universities, enterprises, and NGOs.

The chapters address practice-oriented questions on energy generation, storage, and use, with a particular focus on microgrids in rural regions. Alongside engineering approaches, the book examines societal dynamics such as acceptance, gender equity, institutional frameworks, and stakeholder conflicts within energy communities. In addition, the role of education for sustainable development is emphasized, highlighting its importance for capacity-building, knowledge sharing, and the long-term establishment of sustainable practices.

The book demonstrates that sustainable energy development extends far beyond the deployment of renewable technologies: it requires collaboration across disciplines, cultures, and institutions. The insights gained contribute to bridging scientific concepts with local realities and to developing solutions that are ecologically viable, socially just, and economically feasible. In doing so, this volume contributes to the broader discourse on global sustainability goals and regional transformation processes in East Africa.

Table of Abbreviations and Formula Symbols

Abbreviation	Designation
A:RT-D Grids	Africa: Research and Teaching for Development Grids
A	Ampere (Electrical Current)
Ah	Ampere-hour (Unit of Charge)
AI	Artificial Intelligence
AMS	Accounts Management System
AR	Augmented Reality
ARFMS	Assessment, Results, and Feedback Management System
ATP	Ability to Pay
BMS	Battery Management System
CA	Constructive Alignment
CMS	Content Management System
CPR	Common-pool Resources
CuPayment	How Much Households Currently Pay for Electricity in a Month
DC	Direct Current
DEO	District Energy Office
DOD	Depth of Discharge
DSM	Demand-Side Management
DT	Didactics of Technology
DTTF	Democratized Technical Training Framework
EA	East Africa
ELP	Electronic Learning Platforms
ESD	Education for Sustainable Development
GT	Graduate Training

Abbreviation	Designation
HR	Human Resource
ICMS	Information and Communication Management System
IGO	Intergovernmental Organization
IIoT	Industrial Internet of Things
ILO	Intended Learning Outcomes
kW	Kilowatt (Power)
LFP	Lithium Iron Phosphate
LMS	Learning Management System
MS	Management System
MVC	Model View Controller
NIE	New Institutional Economics
NMC	Lithium Nickel Manganese Cobalt Oxide
O&M	Operation and Maintenance
OOPMS	Other Online Platforms Management System
PESTEL	Policy, Economic, Social, Technological, Environmental, and Legal
PUE	Productive Use of Energy
PV	Photovoltaic
REA	Rural Energy Agency
REC	Regional Economic Community
R-Labs MS	Remote Laboratories Management System
SACMS	Synchronous, Asynchronous, and Cooperative Classrooms Management System
SD	Sustainable Development
SDG	Sustainable Development Goal
SHS	Solar Home System
SNA	Social Network Analysis
SoC	Relative State of Charge of an Energy Storage (e.g. a Battery)
SSA	Sub-Sahara Africa
STEM	Science, Technology, Engineering, and Mathematics
STS	Socio-Technical System
TEAMS	Tests, Exams, and Assignments Management System

Abbreviation	Designation
TLS	Smart Metering—Traffic Light System
V	Volt (Voltage)
VEC	Village Electricity Committee
VIMLE	Virtual and Interactive Microgrids Learning Environment
V-Labs	Virtual VIMLE Laboratories
VR	Virtual Reality
VTC	Vocational Training Centre
W	Watt (Unit for Power)
WASH	Water, Sanitation, and Hygiene
WTP	Willingness to Pay