Sustainable Development in the 21st Century | 3

Jan-Niclas Gesenhues

Smart Energy in Mozambique

Drivers, Barriers and Options

Nomos

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For Annica and Carlotta

Preface

This thesis was accepted as a dissertation at the University of Münster in the summer semester of 2019. It is particularly dedicated to the analysis of decentralized and intelligently networked energy sectors.

Countries around the world are undergoing a paradigm shift in energy supply – from centralized, fossil-fueled supply systems to a decentralized, intelligently networked and climate-friendly structure. Some countries in the global south play a key role in this development. Using Mozambique as an example, this study shows how a digitally networked energy supply system can grow "from below". On this basis, strategies are developed that can contribute to achieving some of the United Nations' Sustainable Development Goals - especially in the areas of energy, climate, health, economy and poverty reduction.

My special thanks go to my two supervisors Prof. Dr. Norbert Kersting and Prof. em. Dr. Paul Kevenhörster, for their scientific and moral support throughout the research process.

I am also very grateful to Prof. Dr. Boaventura Chongo Cuamba from Eduardo Mondlane University of Maputo for his support, expertise and networks. Our scientific cooperation led into a partnership project between Mozambican and German institutions, funded by the German Ministry of Economic Cooperation and Development. This project addresses the needs of the renewable energy sector in Mozambique and is a great opportunity to use the scienfic insights of this thesis in practice.

This work could not have been done without intensive investigations and expert discussions on site in Mozambique. I would, therefore, like to thank all respondents and express my gratitude to the Heinrich Böll Foundation and the German Academic Exchange Service (DAAD) for funding part of my field research in Mozambique and South Africa.

I was priviledged to develop my thesis together with an international group of PhD students with a strong expertise in development politics, digitalization and with much experience from East-African countries. I am especially grateful to my colleagues Phillip Hocks M.A., Dr. Andrew Matsiko and Lia Polotzek M.A. for reviewing the manuscript and for very helpful comments and discussions.

Münster, January 2020 *Jan-Niclas Gesenhues*

Contents

List of acronyms

AU	African Union
AC	Alternating current
ALER	Associação Lusófona de Energias Renováveis
AMER	Associação Moçambicana de Energias Renováveis
App	Application
ARENE	Autoridade Reguladora de Energia
CIA	Central Intelligence Agency
CNELEC	Conselho Nacional de Electricidade
DC	Direct current
EDM	Electricidade de Moçambique
EnDev	Energising Development Program
FDI	Foreign direct investment
FUNAE	Fundo da Energia, National Energy Fund of Mozambique
FRELIMO	Frente de Libertação de Moçambique
GDP	Gross domestic product
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWh	Gigawatt hour
HCB	Hydroelectricity of Cahora Bassa
ICT	Information and communication technology
IMF	International Monetary Fund
INE	Instituto Nacional de Estatística
kV	Kilovolt
kWh	Kilowatt hour
MPD	Ministério de Planificação e Desinvolvimento
MZN	New Mozambican Metical
OAU	Organization of African Unity
OECD	Organization for Economic Co-operation and Development
PayGo	Pay-as-you-go technologies
RENAMO	Resistência Nacional Moçambicana
RSA	Republic of South Africa
SADC	South African Development Community
SASGI	South African Smart Grid Initiative
UN	United Nations

UNCTAD	United Nations Conference on Trade and Development
WLAN	Wireless Local Area Network
ZANLA	Zimbabwe African National Liberation Army

List of symbols

C	Cost function
D	Demand function
ε	Price-elasticity of demand
mc	Marginal costs
mr	Marginal revenue
n	Sample size
p	Price
p_o	Off-peak-price
p_p	Peak-price
π	Profit
R	Revenue
sd	Standard deviation
u	Utility
μ	Average value
x^D	Demanded quantity of the commodity
x_i	Quantity of the commodity i
x_o	Off-peak quantity
x_p	Peak quantity
x^S	Supplied quantity of the commodity
y	Number of clients