

# **EMPIRICAL ANALYSIS OF RURAL ELECTRIFICATION AND ENERGY POVERTY IN NIGERIA**

**BY**

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A Thesis submitted to the Centre for Petroleum, Energy Economics and Law (CPEEL) in partial fulfilment of the requirements for the degree of

**DOCTOR OF PHILOSOPHY**

of the

**UNIVERSITY OF IBADAN**

March 2018

## ABSTRACT

The last two decades have witnessed significant efforts in an attempt to boost access to rural electrification in Nigeria with the establishment of Rural Electrification Agency (REA) and the Rural Electrification Strategy and Implementation Plan. Despite these initiatives, the rural communities in Nigeria are still characterised by inadequate access to electricity thereby aggravating energy poverty. There is a dearth of studies on the impact of rural electrification on energy poverty in Nigeria. This study therefore was designed to examine the determinants of energy poverty in rural communities, as well as the impact of rural electrification on energy poverty in the on-grid and off-grid rural communities.

Adopting the fuel stacking framework, a random sampling technique was employed to select 3,600 households from 72 rural communities equally distributed into on-grid and off-grid locations in a state in each of the six geopolitical zones: Abia (S/E), Akwa Ibom (S/S), Kaduna (N/W), Kwara (N/C), Oyo (S/W) and Yobe (N/E). Structured questionnaire was used to collect information which includes marital status, level of education, gender, expenditure (education, transportation, and food) and energy choice. Two indices of energy poverty, Energy Inconvenience Index (EII) and Multidimensional Energy Poverty Index (MEPI), were computed. The EII was employed to measure the level of energy poverty in the sampled areas before the rural electrification intervention (off-grid locations), while the MEPI computed the level of energy poverty after rural electrification intervention. The post-intervention energy poverty index for the off-grid location was compared with energy poverty in the on-grid locations. The logit regression estimation technique was employed to analyse the determinants of energy poverty in the on-grid and off-grid locations at  $p \leq 0.05$ .

Male household heads were 73.6% and 74.5% in on-grid and off-grid communities respectively. Primary education level was 69.6% and 42.6% for the on-grid and off-grid communities respectively. Firewood (50.0%) dominated the energy choice in the off-grid communities, while charcoal (58.7%) was the preferred energy choice in the on-grid communities. The average energy poverty for the off-grid was 0.370 compared with the threshold level of energy poverty index of 0.377 for EII. A total of 65.0% of the respondents in the off-grid locations had EII higher than the threshold, implying high energy poverty. The computed MEPI of 0.63 for the off-grid and 0.50 for on-grid indicated that energy poverty is prevalent in the off-grid communities. Being married ( $\beta = -0.599$ ), expenditure on education ( $\beta = 0.100$ ), food ( $\beta = 0.001$ )

and transportation ( $\beta=0.001$ ) were the significant determinants of energy poverty in the off-grid communities. Energy poverty was found to be decreasing for holders of higher levels of education ( $\beta=-0.862$ ), while only expenditure on education ( $\beta=0.100$ ) and food ( $\beta=0.001$ ) were found to be significant determinants of energy poverty in the on-grid communities. Energy poverty was found to be decreasing for holders of higher levels of education ( $\beta=-0.680$ ). The level of awareness ( $\beta=-0.040$ ) and access ( $\beta=-0.120$ ) reduces energy poverty after rural electrification intervention compared with the pre-intervention period.

There was high rate of energy poverty in the on-grid and off-grid sampled rural communities in Nigeria. It is imperative to adopt the use of renewable energy technologies and also strengthening the capacity of institutions responsible for rural electrification.

Keywords: Rural Electrification, Off-grid and On-grid communities, Energy poverty in Nigeria.

Word count: 498

## **DEDICATION**

This thesis is dedicated to God Almighty, the creator of Heaven and Earth. I also dedicate this work to my late parents, **Alhaji and Mrs. L.S. Akintunde**, whose immense love for me is unfathomable.

## ACKNOWLEDGEMENTS

Foremost, my gratitude goes to God who has brought me thus far. He has been awesome. I am grateful to Allah for His assistance and guidance. I want to express my deep gratitude to my supervisor, Dr. M.A. Babatunde for his continuous help in my work and in-depth constructive criticism and suggestions that challenged my undivided commitment to this thesis. I appreciate the totality of his contribution to the success of this work.

Special thanks to my wife, Alhaja Modinat Aduke Akintunde, she remains the pillar to my success through her love, care, support and motivation. Her efforts will not go unrewarded. Also, I wish to appreciate my children, Sherifat, Yusrah, Basitot and Azeezat. To my invaluable siblings, Alhaja Sarat Akanni, Yetunde Babatunde, Alhaji Quadri Akintunde and Alhaja Mutiat Kareem, they are simply the best. I thank them sincerely for their consistency over the years.

I am indebted to a large number of people who channelled the course of writing this thesis; Messrs: Tola bickersteth, Wasiu Adebisi, Adelani Azeez, Kayode Ojoogun, Adeoye Idris, Adekola Moruf, Kazeem Adedeji, Shariff Adesokan, Monsur Sunmonu, Saheed Aremu, Saheed Adejumo, Biola Adeyemo and Taiwo Ibraheem. I thank them so much for contributing immensely to my academic prowess.

My sincere appreciation goes to all the members of academic staff of the Centre for Petroleum Energy, Economics and Law, University of Ibadan, whose love, dedication and patience have made this work become a reality. I acknowledge Prof. Adeola Adenikinju, the current director of the centre, Prof. Akin Iwayemi, Drs. Gbenga Falode, Peter Obutte, Femi Oresanya, Chuks Diji, Peter Oniemola and Lateef Akinpelu. In addition, I want to appreciate the contribution of all members of the non-teaching staff of the centre to the success of this study. I thank them all.

My challenges in the course of this work and its accomplishment reconfirm my belief that the roots of all goodness lie in the soil of appreciation for goodness. I appreciate you all.

**Yunus Abiodun Akintunde**

## **CERTIFICATION**

I certify that this work, being the effort of Yunus Abiodun AKINTUNDE (matriculation number 173322) of The Centre for Petroleum, Energy Economics and Law, University of Ibadan, was carried out under my supervision.

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## LIST OF ACRONYMS AND ABBREVIATIONS

AGECC	Advisory Group on Energy and Climate Change
ATE	Average Treatment Effect
ATT	Average Treatment on Treated
BPE	Bureau for Public Enterprise
CBO	Community-Based Organisation
CIF	Climate Investment Funds
DD	Difference-in-Difference
DISCOS	Distribution Companies
DMI	Double Median Indicators
ECN	Electricity Corporation of Nigeria
EDI	Energy for Development Indexation
EII	Energy Inconvenience Index
EISD	Energy Indicators for Sustainable Development
EPS	Energy Poverty Survey
EPSRA	Electric Power Sector Reform Act
ESI	Environmental Sustainable Index
FAO	Food and Agriculture Organisation
FGD	Focused Group Discussion
FGN	Federal Government of Nigeria
FMP	Federal Ministry of Power
GENCOS	Generating Companies
GJ	Gigajoules
GNP	Gross National Product
GPZ	Geopolitical Zone
GTZ	German Technical Cooperation Agency
GW	Gigawatt
HDI	Human Development Index
HPI	Human Poverty Index
IAEA	International Atomic Energy Agency
ICS	Improved Cooking Stove
IE	Impact Evaluation

IEA	International Energy Agency
IEDN	Independent Electricity Distribution Network
IETN	Independent Electric Transmission Network
IHC	Initial Holding Company
IPP	Independent Power Plant
KG	Kilogramme
KII	Key Informant Interview
KM	Kilometre
KV	Kilovolt
KW	Kilowatt
KWH	Kilowatt Hour
LGA	Local Government Area
LIHC	Low Income, High Cost
LPG	Liquefied Petroleum Gas
LTA	Logarithmic Trend Analysis
MDG	Millennium Development Goals
MEPI	Multidimensional Energy Poverty Index
MLS	Maximum Likelihood Squares
MVA	Multi Voltage-Ampere
MW	Megawatt
MYTO	Multi Year Tariff Order
NBS	National Bureau of Statistics
NDA	Niger Dams Authority
NDPHC	Niger Delta Power Holding Company
NEDECO	Netherlands Engineering Consultants
NELMCO	National Electricity Liability Management Company
NEPA	National Electricity Power Authority
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESCO	Nigeria Electricity Supply Company
NESI	Nigeria Electricity Supply chain Industry
NGEU	Nigerian Government Electricity Undertaking
NGO	Non-Governmental Organisation
NIPP	National Integrated Power Project

NLSS	Nigeria Living Standard Survey
NNM	Nearest Neighbour Matching
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
OPHI	Oxford Poverty and Human Development Initiative
OPS	Organised Private Sector
PPP	Public Private Partnership
PREDAS	Programme for the Promotion of Household and Alternative Energy Sources in the Sahel
PSM	Propensity Score Matching
RC	Rural Communities
RCT	Randomised Control Trial
RDD	Regression Discontinuity Design
RE	Rural Electrification
REA	Rural Electrification Agency
REF	Rural Electrification Fund
REP	Rural Electrification Policy
REPP	Rural Electrification Policy Paper
RESIP	Rural Electrification Strategy and Implementation Plan
SAP	Structural Adjustment Programme
SC	Successor Companies
SD	Senatorial District
SSA	Sub-Saharan Africa
ST	State
SUTVA	Stable Unit Treatment Value Assumption
TCN	Transmission Company of Nigeria
TCPC	Technical Committee on Privatisation and Commercialisation
TPR	Ten-Per cent-Rule
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
US	United States
WEO	World Energy Outlook