

This is what energy poverty looks like.



PBL Netherlands Environmental Assessment Agency

Trade-offs and synergies between universal electricity access and climate change mitigation in Sub-Saharan Africa

ANTENEH G. DAGNACHEW PAUL L. LUCAS ANDRIES F. HOF DETLEF P. VAN VUUREN

> LCS-RNET 9TH ANNUAL MEETING 13 SEPTEMBER 2017

> **Twitter: @Antex_GD**

http://eoimages.gsfc.nasa.gov/





Introduction

Why?

Methodology

How?

Results

What?

Discussion and conclusion

Introduction



PBL Netherlands Environmental Assessment Agency

Energy- enabler for basic human needs

Correlation between HDI, electricity consumption, and electricity access

Energy features prominently in international goals and agreements Sustainable Development Goals







United Nations Framework Convention on Climate Change



Agenda 2063

Paris Climate

Agreement





ELECTRICITY ACCESS 2010





HAVE NO ACCESS TO ELECTRICITY

280 MILLION WITH ACCESS 600 MILLION WITHOUT ACCESS





PURPOSE OF THE STUDY

The purpose of the study is to identify key **Synergies** and **trade-offs** between providing universal electricity access and climate mitigation efforts in Sub-Saharan Africa



DISTANCE TO POWER LINE

Million people







SCENARIOS

Baseline (BL)

Universal Access (UA) Universal Access with global carbon price (UA-CP) Universal Access with global carbon price except for SSA (UA-NCP)



SSP2

100%

access in 2030

100%

access in 2030

Climate mitigation policies imposed in all regions 100%

access in 2030

Climate mitigation policies imposed in all regions except Sub-Saharan Africa





ACCESS RATE 2030 BL







HOUSEHOLD DEMAND 2030

kWh/Year/HH 6000 **Regional differences** 4000 Urban-Rural differences -6000 0 Republic of Western & Eastern The rest of Africa South southern central Africa Africa Africa





TOTAL DEMAND 2030

Carbon price stimulates efficiency improvements

21% less consumption







ELECTRIFICATION SYSTEMS







Niger, Chad, Ethiopia, Somalia, Angola, Namibia & Madagascar rely largely on standalone systems Southern and Western Africa can be economically connected to the central grid

Increase in the number of decentral systems

A considerable shift from fossil fuel to renewable under UA-CP!





FUEL MIX







EMISSION





The contribution of SSA's residential sector to global emissions in 2030

Sub-Saharan Africa regions

- The rest of southern Africa
- Republic of South Africa
- Eastern Africa
- Western & central Africa





ELECTRICITY COSTS



25-120% increase

The higher the fossil fuel share in the mix,

the higher the cost increase





ELECTRIFICATION INVESTMENT



27-33 billion USD/year

70-80% goes toward T&D

+ recurring costs- fuel, O&M
+ costs associated with
climate mitigation policy





CONCLUSIONS

- Synergies between climate mitigation and universal access to electricity
- Imposing carbon price can increase electricity prices in the regions
- The increase in CO₂ emissions due to achieving universal electricity access is small
- Achieving universal electricity access requires at least a tripling of the current annual investments
- RE decentralized systems will play an important role to meet the SDGs





STRENGTHS

- high resolution data
- dynamic elec. consumption levels
- various technologies

UNCERTAINTIES AND WEAKNESSES

- socio-economic projections
- some aggregated variables
- simplified network design



www.pbl.nl

Twitter: @Antex_GD

Thank you



IMAGE-TIMER MODEL



Western & central Africa



OREN

HydroWind

Solar

Biomass CCS

Natural Gas CCS

Natural Gas

Oil CCS

Coal CCS

• Share of RES

Oil

Coal

BiomassNuclear

Eastern Africa



Republic of South Africa





The rest of southern Africa

