

# Part 2: Off-grid solar market potential & deployment in Africa



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# 1 - INTRODUCTION

## DEFINITION & CONTEXT

The term **Off-Grid Electricity** refers to not being connected to the main or national grid. Off-grid can be a standalone system (SAS) or a mini-grid (to provide electricity to a smaller community). In our analysis, the mini-grid installed capacity has not been taken into account and will not be analyzed. Our study is focused on Photovoltaic Off-Grid (Off-Grid PV) electricity, other sources of generation have not been studied.

- ❑ **Africa has one of the world's largest Off-Grid population, with 590 million of people living "off-the grid\*.** Today, fossil energy, diesel in particular, remains the main source of electricity generation. So this off-grid population represents a sizeable market opportunity for producers of PV Stand Alone Systems and their components (solar panels, batteries, solar pumps, etc.).
- ❑ **One of the barriers to Off-Grid PV industry development in Africa has been the lack of information** on which, manufacturers, OEMs and distributors can base their strategies and market development decisions.
- ❑ Infinergia aims at addressing these needs by providing a global view of Africa, by sub-region and country, in terms of volume and by relying of a macro-economic model tailored to Off-Grid PV market. We have conducted a market study **on 33 African countries** by both primary (interviews) and secondary research (documentary) on off-grid PV projects and actors (manufacturers, distributors, NGOs, governmental organizations, etc.).
- ❑ **From Off-Grid Installed PV capacity to forecasted capacity and potential modeling,** our analyses helps to understand market dynamics and potential for off-grid products.



# 1 - INTRODUCTION

## COUNTRY COVERAGE

REGIONS	COUNTRIES
Northern Africa	Algeria, Egypt, Libya, Morocco, Tunisia
Western Africa	Benin, Burkina Faso, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal
Central Africa	Cameroun, Chad, Democratic Republic of Congo
Eastern Africa	Ethiopia, Kenya, Madagascar, Mozambique, Rwanda, Tanzania, Uganda
Southern Africa	Angola, Botswana, Namibia, South Africa, Zambia, Zimbabwe

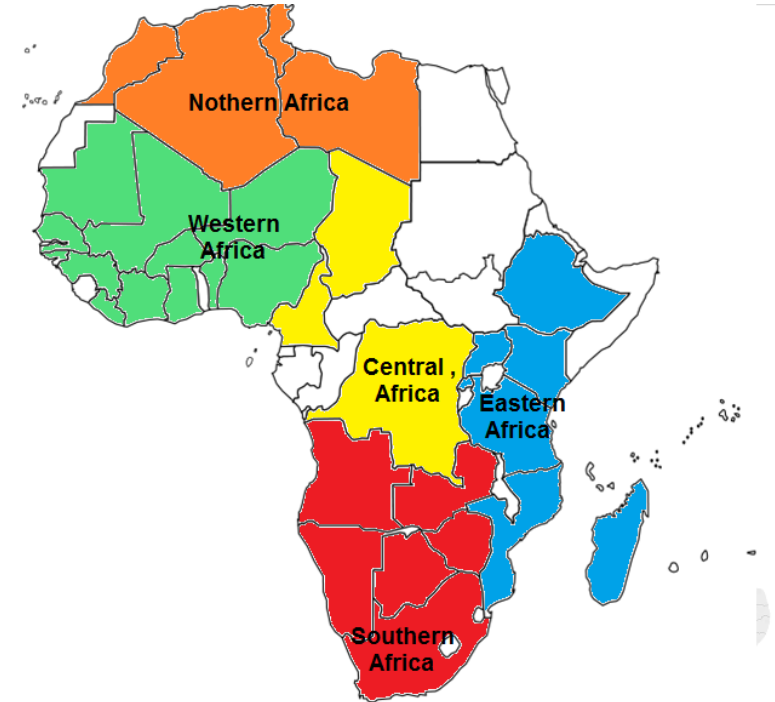


Figure 1: Regional map of Africa

- ❑ **33 countries are focused** as they represent the best potential in terms of Off-Grid PV deployment.
- ❑ The 21 remaining countries have been excluded due to low potential and/or economical/political instabilities, these includes: Burundi, Cape Verde, Central Africa Republic, Union of the Comoros, Djibouti, Equatorial Guinea, Eritrea, Gabon, The Gambia, Lesotho, Malawi, Mauritius, Republic of Congo, Sao Tome and Principe, Seychelles, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, Togo.



# 2 - ELECTRIFICATION ISSUE AND POPULATION

## OFF-GRID POPULATION AS OF 2012

### Off-grid population in 2012 (33 countries):

- About 590 million people in Africa had no access to the electricity grid in 2012. They instead relied on inefficient and often dangerous alternatives such as kerosene, diesel generators, candles, etc.
- We focused on 91% of this population spread over 33 countries to illustrate our Off-Grid PV quantitative dynamics model.



**Total African Off-Grid population** represents 57% of the total off-grid global population in the World in 2012 ([“WEO”, IEA, 2012](#)).



**33 African focused countries** represent 91% of the Total African off-grid population.



**Rural population** represents 82% of off-grid population above.



# 2 - ELECTRIFICATION ISSUE AND POPULATION

## ELECTRIFICATION ISSUE AS OF 2012

**Among these 33 countries, 17 had a rural electrification rate < 10%:**

- ❑ Only 4 countries, in Western Africa, reported an access rate above 20%: Ghana, Ivory Coast, Nigeria and Senegal.
- ❑ With a rural electrification rate above 20%, Nigeria remained the first country of Africa in terms of Off-Grid population.

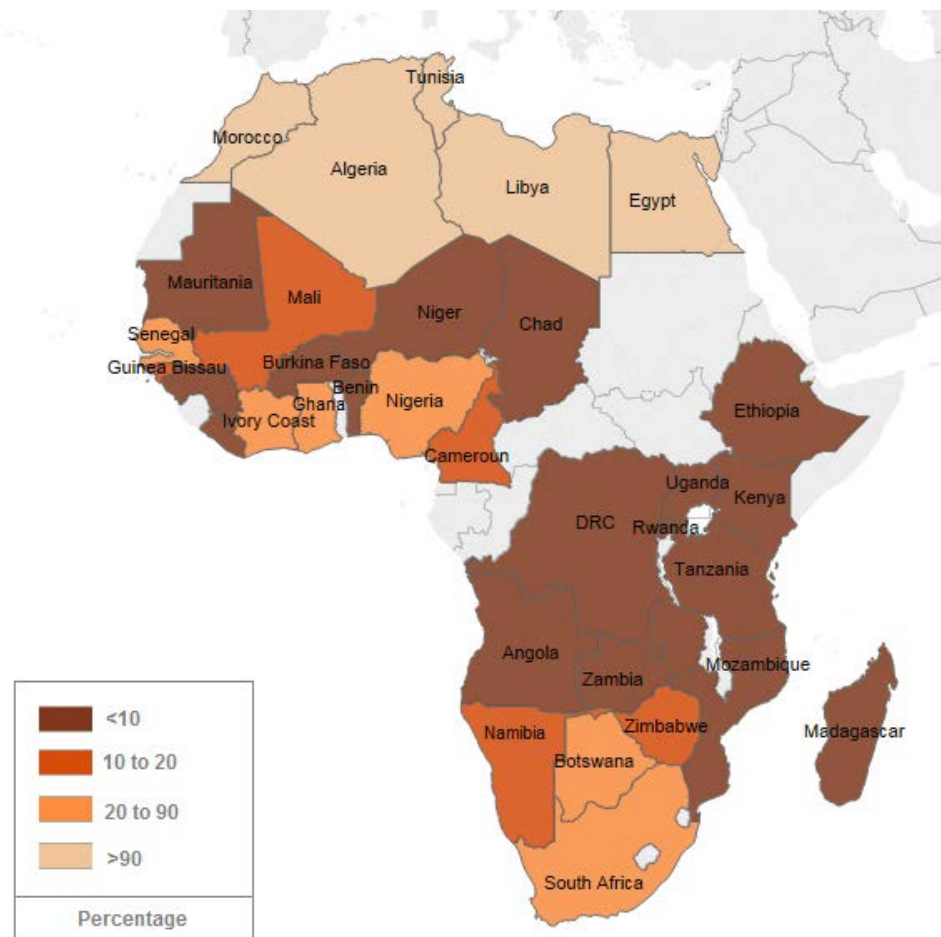


Figure 2: Rural electrification rate in Africa, 2012



# 3 - OFF-GRID PV CUMULATIVE INSTALLED CAPACITY IN MW BY REGION AS OF 2012

**Africa is still a small player on the global PV installations market.**

**For Off-Grid, roughly 168 MW of PV systems have been deployed in Africa at the end of 2012.**  
Representing:

- <1% (0,6 GW) of the total installed PV capacity of the world (102 GW)
- <10% (168 MW) of the off-grid cumulative installed capacity of the world (<2 GW)

6 countries are among the largest markets, concentrating 52% of the total installed capacity:  
South Africa (18%),  
Kenya (8%), Morocco (7%), Egypt (7%)  
and Uganda (6%), Nigeria (6%).

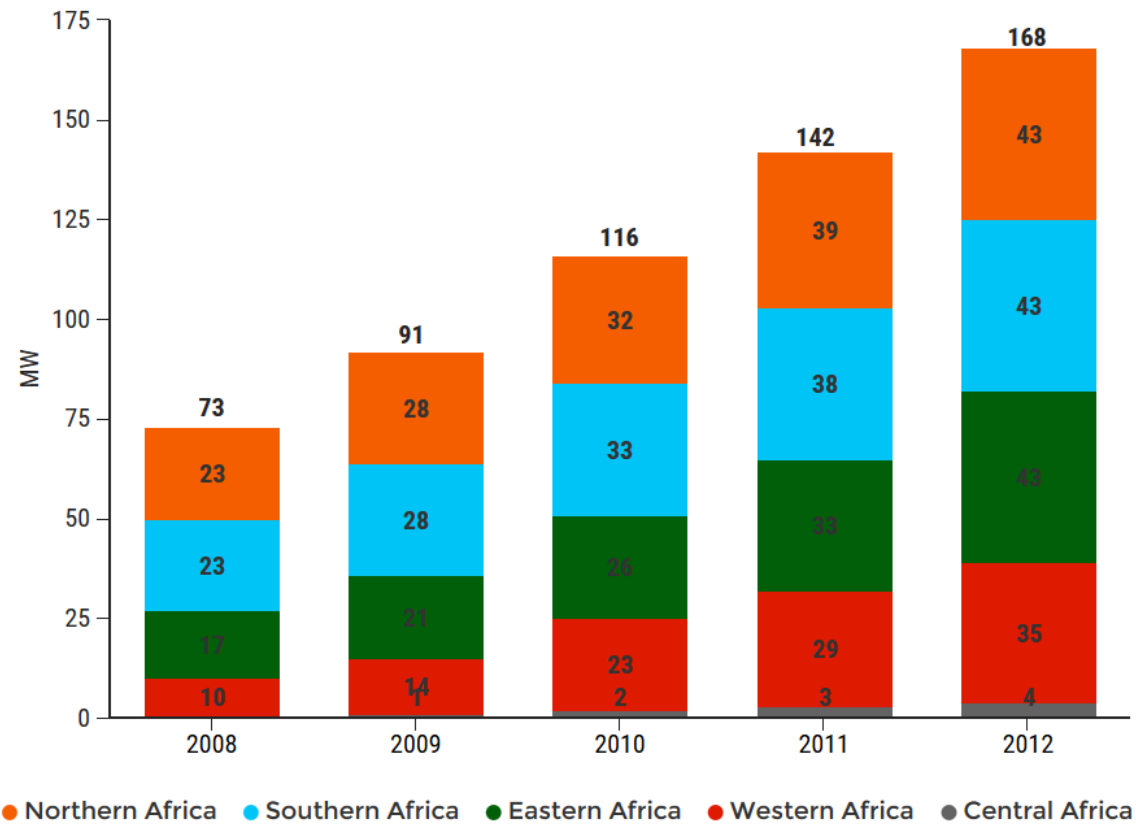


Figure 3: Off-grid PV cumulative installed capacity in Africa per Region

Sources: \* «Global Market Outlook for Photovoltaics, 2013-2017 », EPIA

\*\* Estimation Infinergia ©



# 4 - INFENERGIA'S MACROECONOMIC OFF-GRID MODEL (MOG)

## INFENERGIA'S MODEL DEFINITION

**Infinergia built a model that helps measuring and comparing the potential of development of Off-Grid PV installations in a given country.** This model was applied on the 33 countries mentioned earlier.

**It's calculated by combining several macro-economical indicators on a country basis.** These indicators have been carefully selected for their influence on the development of off-grid photovoltaic installations and this model has been confirmed with historical data.

**The score of each country is established via 3 parameters that structure the market of off-grid photovoltaic installations:**

- Electrical Issue (EI)
- Population needs based on the country Geography (PG)
- Solar potential (POT)

**This score is moderated with 5 additional parameters,** that are considered as having an influence on market development (positively or negatively). This establishes the final score in terms of development potential.

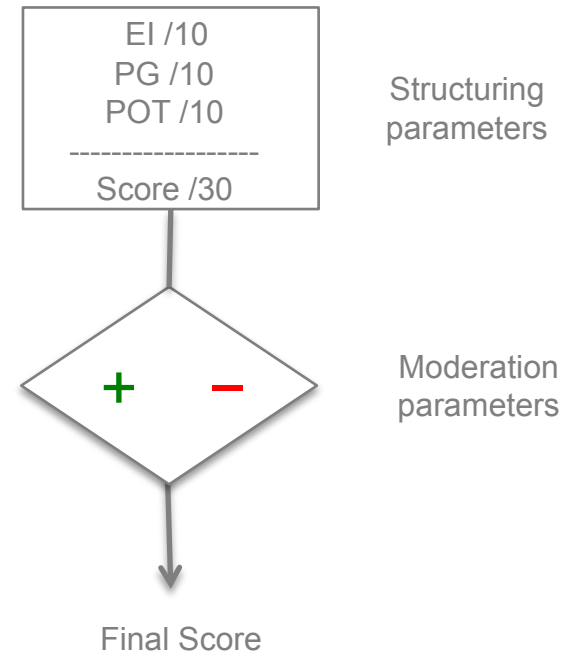


Figure 4: Off-grid PV dynamics scoring model





# 4 - INFENERGIA'S MACROECONOMIC OFF-GRID MODEL (MOG)

## INFENERGIA'S MODEL - STRUCTURING PARAMETERS

$$EI + PG + POT = \text{Score} / 30$$



### **EI: Electrical Issue**

- Calculation of the number off-grid people based on each country's electrification rate.
- The EI score ranges from 0 (below 100 000 people) to 10 (above 50 000 000 people).



### **PG: POPulation needs based on the country Geography**

- Population density (number of inhabitants/km<sup>2</sup>) and country area (km<sup>2</sup>; rural population (% of the total population) and large and low population density countries
- The PG score is based on the average of the 3 parameters, being scored from 0 to 10.



### **POT: Solar POTential**

- POT is based on the average solar irradiation in kWh/m<sup>2</sup>/year in order to integrate seasonal variations along the year.
- Its score ranges from 0 (<1 350 kWh/m<sup>2</sup>/y) to 10 (>2 250 kWh/m<sup>2</sup>/year).



# 4 - INFENERGIA'S MACROECONOMIC OFF-GRID MODEL (MOG)

## INFENERGIA'S MODEL - MODERATION PARAMETERS

$$\text{GDP} + \text{CORR} + \text{FOSS} + \text{IND} + \text{NAT} = \text{Moderation score}$$



**GDP: economical Gross Domestic Product, 0 to +20% moderation**



**CORR: CORRUpTion index, -15 to 0% moderation**



**FOSS: competition of FOSSil energy, -20 to +20% moderation**



**IND: PV INDUstry ecosystem, 0 to +20 % moderation**



**NAT: NATural aspects, 0 to +20% moderation**



# 5 - TOP 5 AFRICAN COUNTRIES BY MOG RATING

- ❑ **The 3 previous parameters:** Electrical Issue (EI), Population needs based on the country Geography (PG) and solar potential (POT), **moderated by the others parameters, allow the ranking of the 33 African countries** according to their **potential of off-grid PV development**.
- ❑ As a result, Infinergia identified the **5 most promising countries for Off-Grid PV market in Africa:** Tanzania, Ethiopia, Kenya, South Africa and Nigeria.

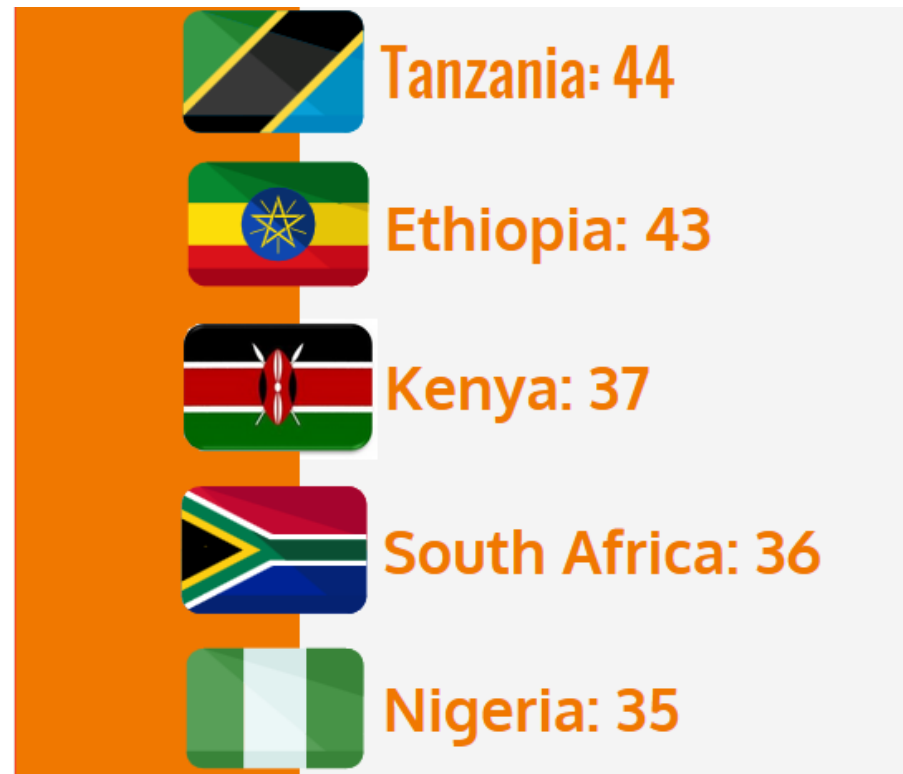


Figure 5: MOG's Global Note Moderated (top 5 countries)



# 6 - FORECAST UP TO 2020 FOR OFF-GRID PV CUMULATIVE INSTALLED CAPACITY IN MW BY AFRICAN REGION

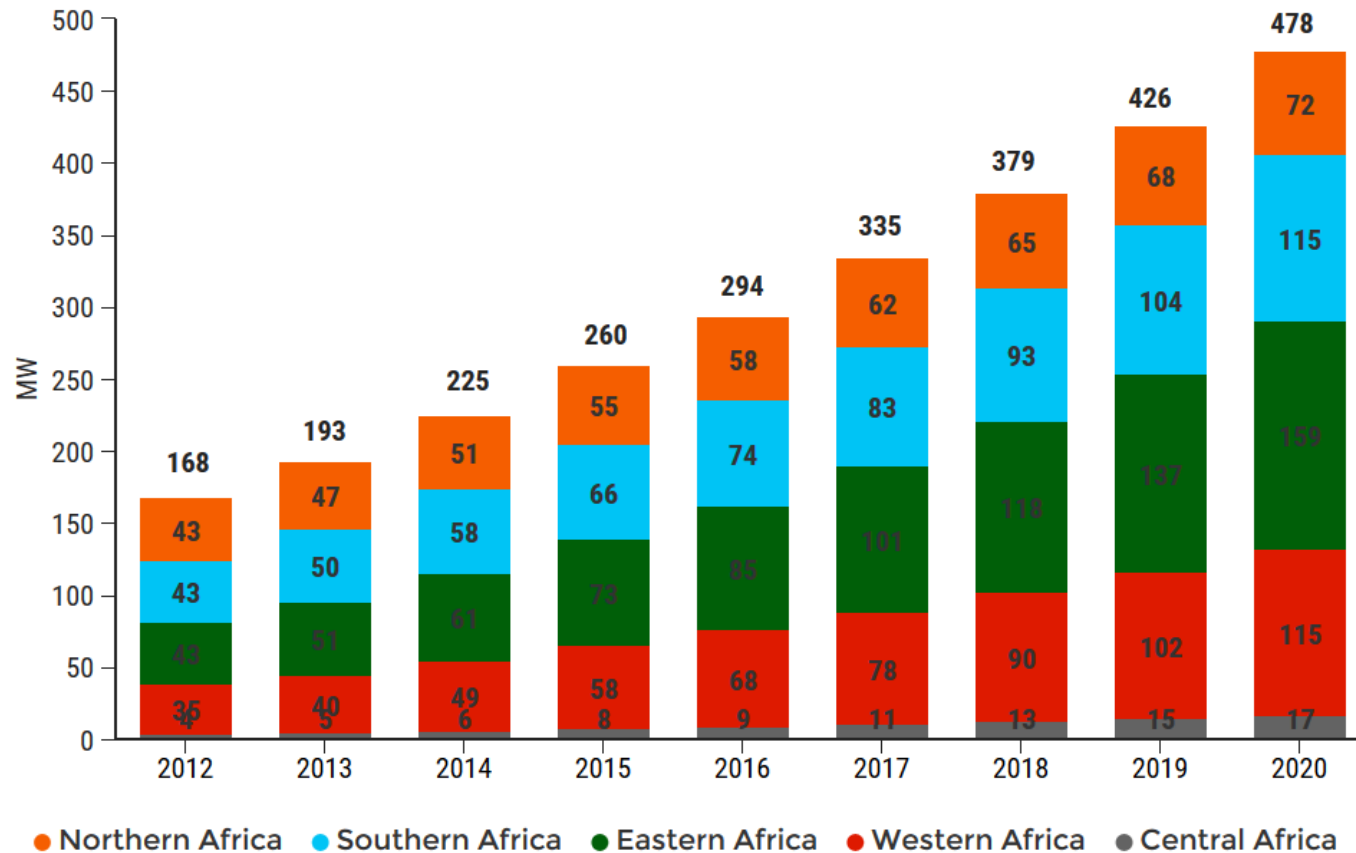


Figure 6: Regional Off-grid PV installed capacity forecast 2012 to 2020

We combined the MOG score with the MW installed capacity in 2012 to build this growth hypothesis. Besides Nigeria, Eastern Africa PV markets offer the most interesting opportunities: Kenya, Tanzania and Ethiopia in particular.





### **African off-grid photovoltaic market has seen an important growth from 2010 to 2016**

It's supported by more than 500 companies in the World focus on off-grid PV market, of which, over 100 focusing on systems. There is also increasing efforts from development institutions such as the World Bank Group, the American Initiative "Power Africa" and private company investments as well.



### **Market development is unequal on Africa**

Kenya, Tanzania, Ethiopia and Nigeria are leading in terms of recent deployments (as of 2016). Development is not always linked to needs!





### New Offers on the market

Solar Home Systems (SHS) become larger, Diesel Power Generators are increasingly hybridized with batteries and Systems are optimized for efficiency.



BUSINESS MODELS

### New business models & access to finance

Specialized Energy Services Companies (ESCO) for Off-Grid or Microgrids and Pay-as-You-Go Solar Home Systems are new ways to make business. Access to capital is eased by crowdfunding and Venture Capital interest is stronger.



### Continued cost reductions

Off-Grid benefits from cost reduction from Grid-connected solar thanks to level of scale effect



### Larger scale development for mini-grid

Second market after off-grid systems. Mini-grids operators and regulators are preparing for larger scale deployments. More than 800 mini-grids projects have been identified in the coming years (as of October 2016).



## CHALLENGES



### Access to finance challenge

For the development of off-grid start-ups and for poorest people's access to finance.



### Institutional challenge

Regulation framework (quality standard, VAT removal, import duties), off-grid solar development plan (electrification roadmap, energy access strategy), reduction of fossil fuel subsidies...



BUSINESS MODELS

### Business model challenge

Success and proper scale up of Energy Service Company (ESCO) and Pay-As-You-GO business models...



### Industrial challenge

From a niche market to a main stream market with higher quality products plus larger range of product and services (premium)



# THANK YOU FOR YOUR ATTENTION



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