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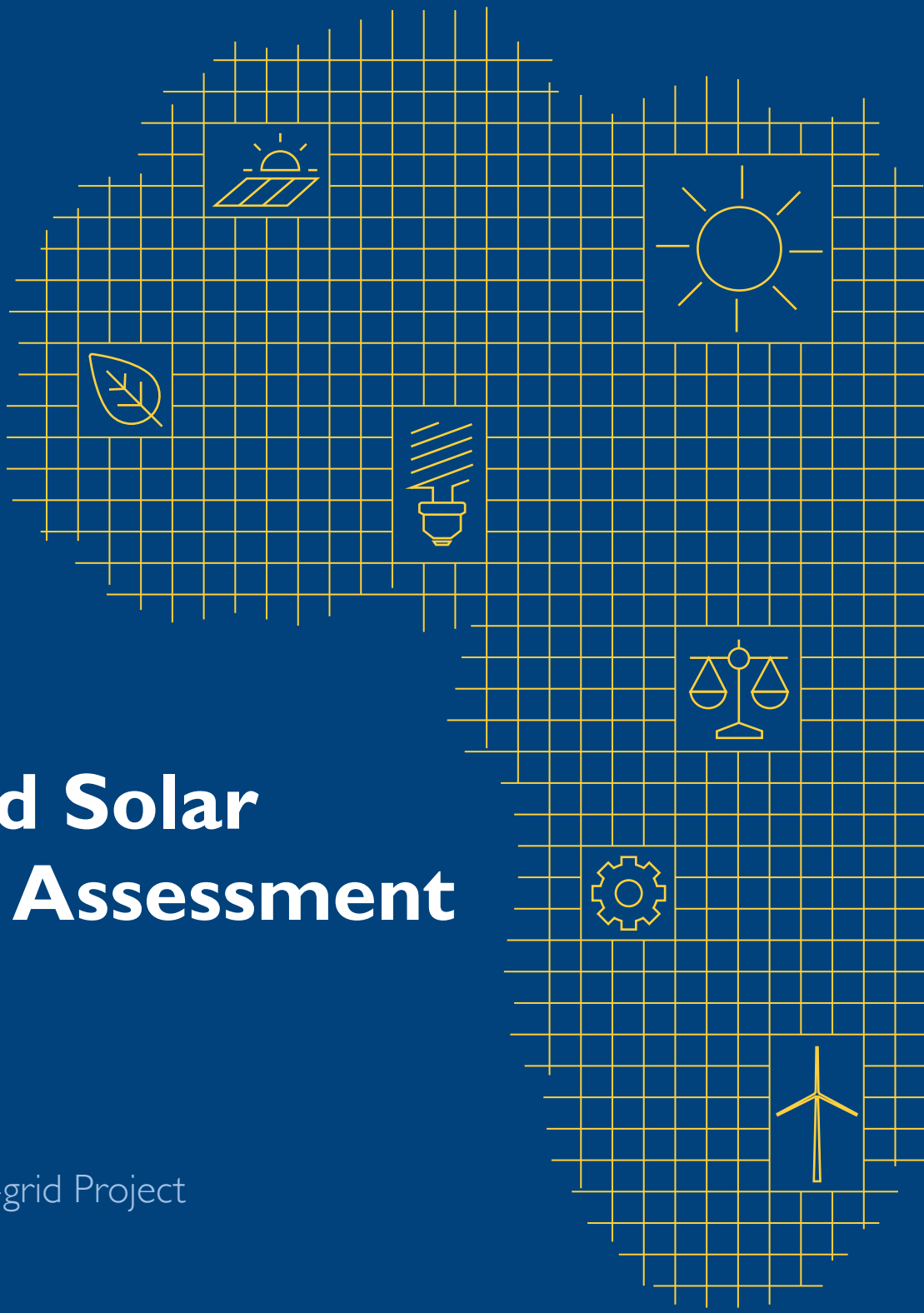

OCTOBER 2019

Off-Grid Solar Market Assessment

Ethiopia

Power Africa Off-grid Project

ABOUT POWER AFRICA

The Power Africa Off-grid Project is a four-year program that launched in November 2018 to accelerate off-grid electrification across sub-Saharan Africa. RTI International implements the project in collaboration with Fraym. Norton Rose Fulbright, Practical Action Consulting, and Tetra Tech. Power Africa is comprised of 12 U.S. Government agencies, over 145 private companies, and 18 bilateral and multilateral development partners that work together, supporting sub-Saharan governments to increase the number of people with access to power.

> *Power Africa aims to achieve 30,000 megawatts of new generated power, create 60 million new connections, and reach 300 million Africans by 2030.*

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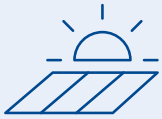
Abbreviations and Acronyms

ACC	Agricultural Commercialization Cluster
AfDB	African Development Bank
AFD	French Development Agency (Agence Française de Développement)
ATA	Agriculture Transformation Agency
ATM	Automated teller machine
CBE	Commercial Bank of Ethiopia
DBE	Development Bank of Ethiopia
ECAE	Ethiopia Conformity Assessment Enterprise
ECIC	Ethiopia Climate Innovation Center
EEA	Ethiopian Energy Authority
EEP	Ethiopian Electric Power
EEU	Ethiopian Electric Utility
EIB	European Investment Bank
EIC	Ethiopian Investment Commission
ETB	Ethiopian birr
EU	European Union
GDP	Gross domestic product
GIS	Geospatial Information System
GIZ	German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GOE	Government of Ethiopia
GTP II	Growth and Transformation Plan
IT	Information technology
km	Kilometer
kWh	Kilowatt hour
MFI	Microfinance institution
MOU	Memorandum of understanding

MOWIE	Ministry of Water, Irrigation, and Energy
NBE	National Bank of Ethiopia
NEP	National Electrification Plan
NGO	Nongovernmental organization
PAOP	Power Africa Off-grid Project
POS	Point of sale
PPP	Public-private partnership
PUE	Productive use of energy
PV	Photovoltaic
RE	Renewable energy
REF	Renewable Energy Fund
SACCO	Saving and credit cooperative
SHS	Solar home system
SNNP	Southern Nations, Nationalities, and Peoples' Region
TVET	Technical and vocational education and training
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WASH	Water, sanitation, and hygiene

INTRODUCTION

This report by Power Africa provides insights into the opportunities and risks associated with Ethiopia's off-grid solar energy market and gives companies, investors, governments, and other stakeholders a deeper understanding of the market. While other stakeholders (i.e., development partners) have conducted market assessments, Power Africa has identified market information gaps and seeks to bridge those gaps in the following ways:



This report provides a comprehensive and detailed review of solar home systems (SHSs), mini-grids, productive use of energy, and other aspects of the off-grid solar value chain. Additionally, this report includes details on policy and regulatory issues, the structure and historical context of the energy sector, and gender mainstreaming.

This report draws upon the most up-to-date sales and investment data from GOGLA in order to keep pace with the ever-changing dynamics of the off-grid solar sector. It also includes a geospatial analysis that highlights potential areas for off-grid solar market expansion.

Insights in this report help Power Africa Off-grid Project (PAOP) plan and prioritize activities across work streams of policy and regulations, market intelligence, business performance, access to finance, and cross-sectoral integration throughout sub-Saharan Africa.

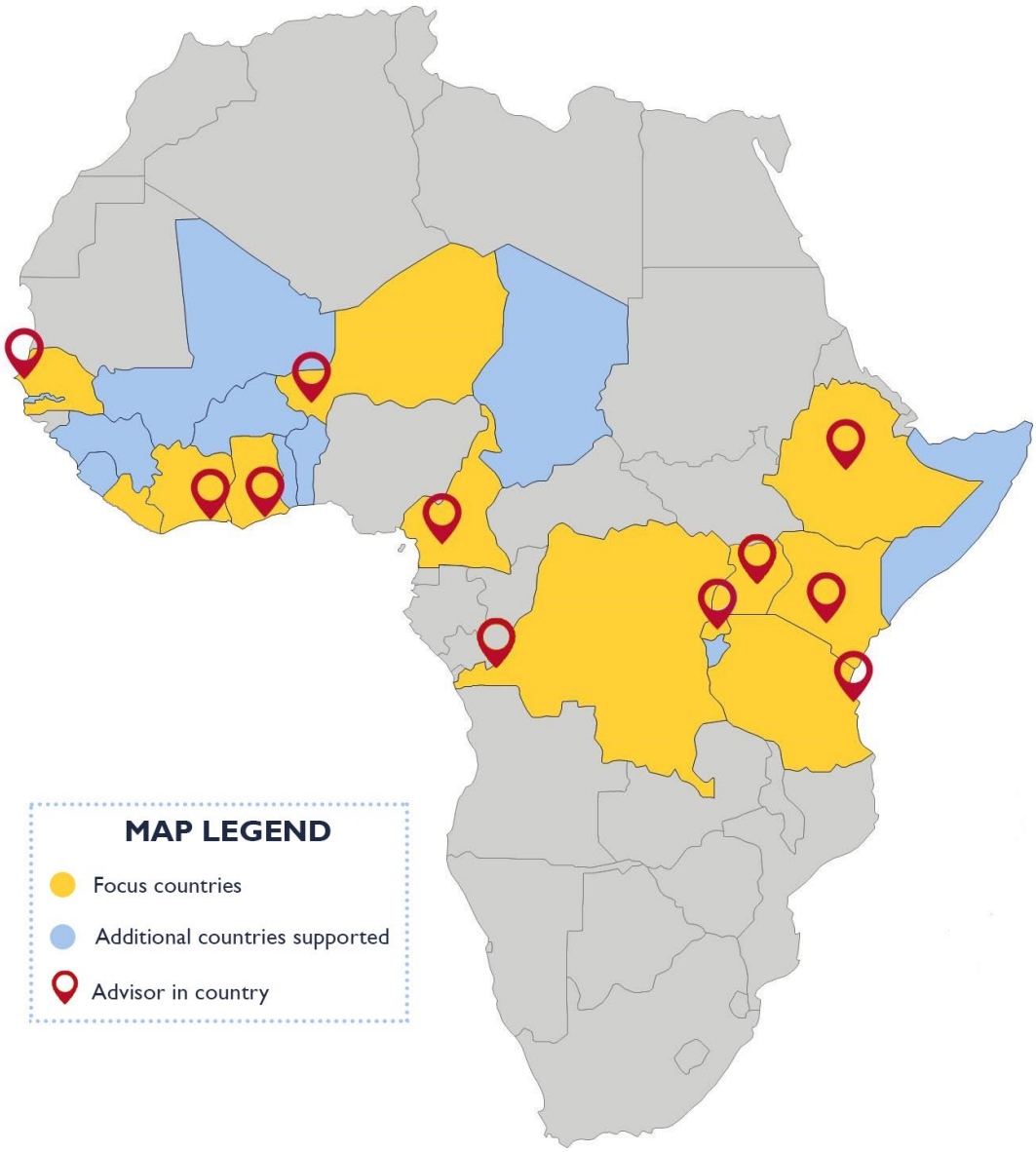
The report also serves as a baseline for Power Africa's technical advisors to guide their continuing work. It provides a snapshot that can be used to determine market growth and dynamics that change over time. Insights include characteristics of Ethiopia's electricity sector, electrification targets, government regulations, donor-funded activities, and details on subsectors of the off-grid solar energy market. Additionally, this report includes expert knowledge from Power Africa's lead advisors, information gathered from stakeholder interviews, and data from the Global Off-Grid Lighting Association (GOGLA). For five countries (Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Ethiopia, and Niger), the project performed a geospatial analysis that leveraged machine learning to identify potential local markets for off-grid solar energy. The geospatial analysis provides granular details (i.e., latent electricity demand by household income) that will help companies prioritize how to expand into new geographic markets.

About Power Africa and the Power Africa Off-grid Project (PAOP)

Power Africa aims to accelerate off-grid electrification across sub-Saharan Africa through targeted, context-specific interventions with private-sector companies, governments, investors, and donors. Power Africa's goal is to increase electricity access by adding 30MW of new generation capacity, and 60 million new connections through grid and off-grid solutions by 2030. The goal of the Power Africa Off-grid Project is to provide support to private off-grid companies and make the markets in sub-Saharan Africa more attractive for investment and operations. Power Africa defines "access" as the direct or actual number of new households and businesses connected to electricity via an on- or off-grid solution. The project focuses on

accelerating off-grid energy access through household SHSs and mini-grids, with the goal of facilitating six million new connections by 2022. The project aims to accelerate off-grid electrification across ten focus countries in Africa: Cameroon, the Democratic Republic of the Congo, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Niger, Rwanda, Senegal, and Tanzania. Figure ES-1 identifies the countries in Africa receiving Power Africa support, with the focus countries highlighted. The pins represent the locations of the project's in-country advisors.

FIGURE ES-1. THE PROJECT PROVIDES SUPPORT TO 20 COUNTRIES IN AFRICA



The Power Africa Off-grid Project is a Power Africa project funded by the U.S. Agency for International Development (USAID). Power Africa brings together technical experts with stakeholders from the public and private sectors to increase energy access rates in sub-Saharan Africa. The Power Africa Off-grid Project is implemented by RTI International and headquartered in Pretoria, South Africa.

1 EXECUTIVE SUMMARY

Ethiopia is Africa's oldest independent country and its second largest in terms of population, while also being one of the poorest countries in Africa. The Government of Ethiopia (GOE) is currently implementing the second phase of its Growth and Transformation Plan II (GTP II), which aims for Ethiopia to achieve lower middle income and carbon-neutral status by 2025.[1] Along with Ethiopia's ambitious poverty reduction strategies and targets, the government has recently released its National Electrification Plan 2.0 (NEP 2.0), which strives for universal electrification by 2025 through a mix of on- and off-grid energy solutions. The following statistics provide insight into Ethiopia's country context:

- Gross domestic product (GDP) in 2018 was $84.4 billion, with an average per capita income of $772.
- In 2018, the estimated population was approximately 109 million people, with more than 80 percent living in rural areas.[2]
- From 2011 to 2016, poverty dropped by 20 percent in Ethiopia. However, poverty in rural areas increased during the same time frame.[3]
- Over 15 languages are spoken in Ethiopia, the primary languages are Oromo and Amharic.[4]

Grid Electrification. The Ministry of Water, Irrigation, and Energy (MOWIE) is the overall governing body of the energy sector in Ethiopia. Under MOWIE, sit the Ethiopian Electric Utility (EEU), which is in charge of power distribution, the Ethiopian Energy Authority (EEA), which is the regulator, the Ethiopian Electric Power (EEP), which oversees power generation and transmission, and the State Minister, which is in charge of the electricity sector.

In Ethiopia, overall grid access to electricity is estimated at 34 percent (2018). However, rural and urban access to the grid differ drastically, with urban grid access between 80 percent and 90 percent (in Addis Ababa it is 99.9 percent), while rural grid access ranges from five percent to 20 percent.[5] In addition to overall low electricity access rates, the grid electricity can also be unreliable, with the majority of grid-connected customers experiencing between four and 14 power outages a week.

Geospatial Analysis. The Power Africa team conducted an analysis that indicates that adults in households without electricity also have less financial inclusion than grid connected households. Although, as mobile phone ownership is relatively high and mobile banking is on the rise, there is an opportunity for the pay-as-you-go (PAYGO) market.

Support Programs. There are a range of support programs for off-grid energy solutions in Ethiopia which are largely financed by the international donor community, such as IFC's Lighting Africa, and the U.S. Government's Power Africa initiative. Support from the international community covers broad areas, such as technical assistance to small and medium enterprises, grant funding, capacity building, implementation support for the NEP 2.0, access to finance, and many others.

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[1] National Planning Commission, "Ethiopia Growth and Transformation Plan II (GTP II)."
[2] The World Bank, "Population, Total | Data."
[3] The World Bank, "Poverty and Household Welfare in Ethiopia, 2011-2016."
[4] Central Intelligence Agency, "Africa :: Ethiopia — The World Factbook - Central Intelligence Agency."
[5] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report."

Additionally, the Solar Energy Development Association (SEDA-E) is a non-profit association formed by stakeholders in the off-grid energy sector in Ethiopia to promote the interests of the solar industry to the government and public sectors.

Pico-Solar Sector Overview. Ethiopia's pico-solar sector has seen strong growth in the last few years, with the most growth pertaining to systems ranging in size from 0 to 1.5 watt-peak (Wp) systems. Large systems over 20 Wp have seen virtually no sales according to GOGLA sales data for 2017 and 2018.

There are eight companies profiled in this assessment that are well-established in the off-grid sector. These companies range in age from one to 18 years of operation. These companies operate mostly as PAYGO, cash and carry, and partnership business models for SHS and lantern technologies.

The main barriers to growth in the off-grid sector in Ethiopia are the closed trade system in the country, which does not allow foreign companies to be involved in the distribution of solar systems, as well as the lack of access to foreign exchange, which limits cash flow in the country, thereby limiting sales growth.

Another limiting factor in Ethiopia is the lack of financial services and access to banking, especially in rural areas: 65 percent of Ethiopian adults are "unbanked," meaning they do not use any banking services, only four percent of adults reported having a debit card, and no credit cards are available. Only 11 percent of adults reported borrowing money from a formal financial institution. There are 17 commercial banks in Ethiopia, one development bank, 35 microfinance institutions (MFIs), and 19,000 saving and credit cooperatives (SACCOs). Of the MFIs, less than half lend specifically for energy. However, those that do provide loans for energy are eligible from loans from the Development Bank of Ethiopia (DBE).

Mobile money in Ethiopia is limited to banks and MFIs, and access to mobile money in Ethiopia is extremely low compared to its East African neighbors. Between one and three percent of Ethiopians have a mobile money account. However, there are nine mobile money companies operating in Ethiopia, some of which are able can receive remittances using mobile accounts.

An area that could boost sales and access in Ethiopia is remittances. Ethiopia has one of the largest first-generation diaspora populations from an Africa country, and between 2017 and 2018, the Ethiopian diaspora sent more than $5 billion in remittances through both formal and informal methods, according to the National Bank of Ethiopia.

Mini-Grid Sector Overview. Currently, there are only two companies operating in the mini-grid space in Ethiopia, with a total of two operational mini-grids, and four more under construction. This market assessment contains an analysis by Power Africa that identifies areas with high concentrations of high consumer power households that are beyond ten kilometers (km) from medium voltage grid lines as particularly attractive sites for mini-grids, particularly in the Eastern Oromia region and the Northern Amhara region, to highlight a few.

Currently, the licensing process for mini-grids is prohibitively cumbersome, and specific policies within the energy regulations for off-grid technologies have been drafted but not yet approved, including the Directive for Off-grid and Tariff Methodology Guidelines.

Productive Use Sector Overview. Agriculture comprises about 40 percent of total GDP in Ethiopia and continues to dominate employment, with 78 percent of the population employed in agricultural activities. There are three main companies in the off-grid sector that offer productive use solutions, such as solar pumps and cold chain solutions.

The NEP 2.0 includes a rapid assessment of productive uses location and electricity needs to inform the design of mini-grid sites for piloting of the mini-grid program. However, access to finance for productive use solutions is difficult, and smallholder farmers are often part of the "unbanked" sector and not eligible for loans or other financing from microfinance institutions (MFIs) or other financial institutions.

The Government of Ethiopia has taken concrete steps to mainstream gender, including the production of the National Gender Mainstreaming Guidelines. The Ministry of Women and Children Affairs is the focal point for gender within the government. The DBE mapped barriers and opportunities for women entrepreneurs with respect to access to finance. Based on the mapping, it has taken specific actions to ensure that women entrepreneurs are able to access, and benefit from, the $45 million Market Development for Renewable and Energy Efficient Product credit line. The Government of Ethiopia (GOE) is also partnering with networks such as the Ethiopian Chamber of Commerce, Alliance of Women Enterprise Program, and the Association of Women in Business to create awareness of the credit line among women entrepreneurs. International institutions such as the World Bank, IFC, and Power Africa have provided technical assistance for MFIs to engage women, as well as by contributing to gender analysis and plans that were incorporated into the NEP 2.0.

2 COUNTRY CONTEXT

2.1 SOCIOECONOMIC AND DEMOGRAPHIC CONTEXT

Ethiopia is Africa's oldest independent country and its second largest in terms of population. With a gross domestic product (GDP) of $84.4 billion and a per capita income of $772 in 2018, Ethiopia remains one of the poorest countries in the world. However, in the past decade, the country has made great strides in development, with an average GDP growth rate of about ten percent between 2006 and 2017.[6] Additionally, poverty dropped by 20 percent between 2011 and 2016 in Ethiopia. Yet, poverty in rural areas increased during the same time frame.[7]

These drastic leaps in growth and poverty reduction can be attributed largely to ambitious government interventions and private sector participation in the Ethiopian market. The Government of Ethiopia (GOE) is currently implementing the second phase of its Growth and Transformation Plan II (GTP II), which aims for Ethiopia to achieve lower middle income and carbon neutral status by 2025.[8] Along with Ethiopia's ambitious poverty reduction strategies and targets, the government has recently released its National Electrification Program 2.0 (NEP 2.0), which strives for universal electrification by 2025 through a mix of on- and off-grid energy solutions.

2.1.1 SOCIOECONOMIC INDICATORS

TABLE 1. SOCIOECONOMIC INDICATORS OF ETHIOPIA

Population size	109.22 million people[9]
Population distribution	~80% of population lives in rural areas[10]
Age demographics	>40% of population under 14 years old[11]
Human Development Index	0.463 (173 out of 188 countries)[12]
Local main languages spoken	15+ spoken languages (primarily Oromo and Amharic)[13]

Table 1 outlines Ethiopia's main socioeconomic indicators, including population size, distribution, age demographics, Human Development Index and local main languages spoken.

[6] The World Bank, "World Bank Country Overview: Ethiopia."
[7] The World Bank, "Poverty and Household Welfare in Ethiopia, 2011-2016."
[8] National Planning Commission, "Ethiopia Growth and Transformation Plan II (GTP II)."
[9] The World Bank, "Population, Total | Data."
[10] The World Bank, "Rural Population (% of Total Population) | Data."
[11] Index Mundi, "Ethiopia Demographics Profile 2018."
[12] United Nations Development Programme, "Human Development Reports: Ethiopia."
[13] Central Intelligence Agency, "Africa :: Ethiopia — The World Factbook - Central Intelligence Agency."

2.2 ENERGY SECTOR OVERVIEW

2.2.1 GRID ELECTRIFICATION SUMMARY

In 2018, the overall grid access to electricity in Ethiopia was estimated at 34 percent. However, rural and urban access to the grid differ drastically, with urban grid access between 80 percent and 90 percent (in Addis Ababa it is 99.9%), while rural grid access ranges from 5 percent to 20 percent.[14] The GOE unveiled NEP 2.0 at the end of March 2019, which sets out targets for universal electrification by 2030 through a mix of on- and off-grid solutions.

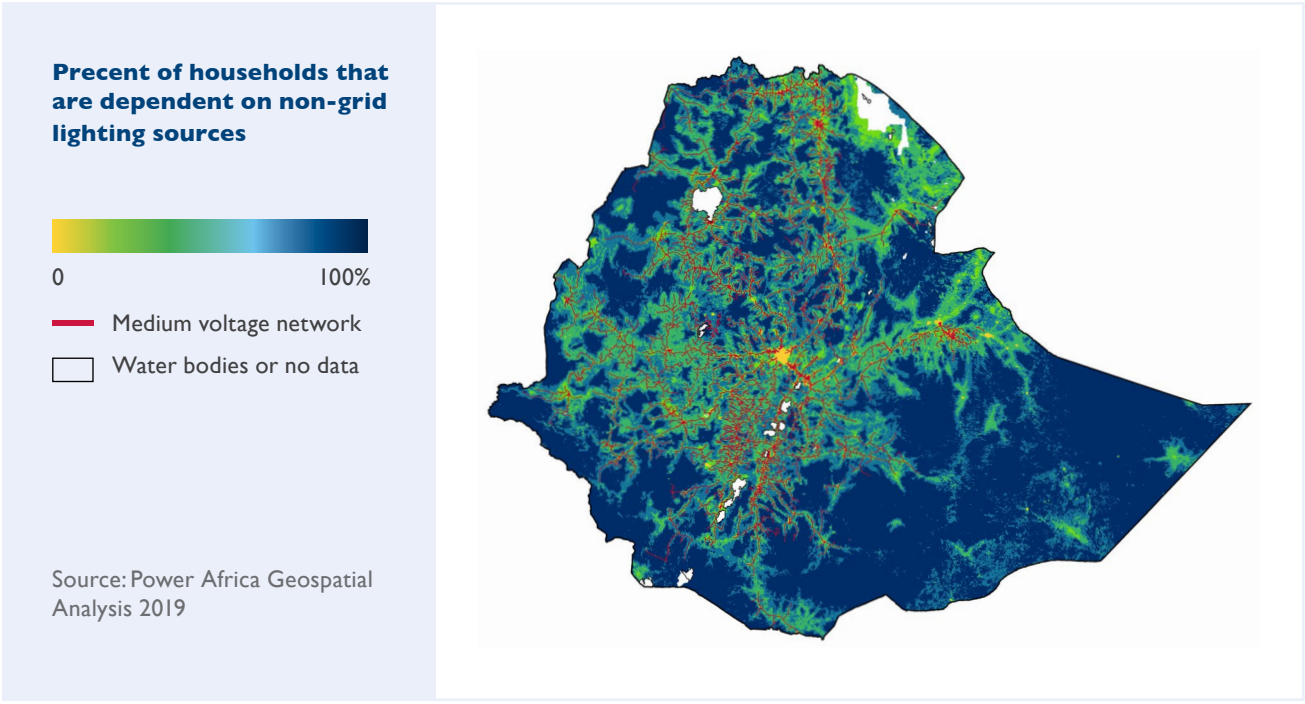
More than 90 percent of the population lives within 10 kilometers (km) of the national grid, with 60 percent living within 2.5 km (Figure 1). Due to the wide reach of the electricity grid, NEP 2.0 aims to connect 96 percent of the population to grid electricity by 2030, with the remaining 4 percent served by off-grid solutions. However, in addition to electricity access, grid reliability is also a priority of NEP 2.0, as 57.6% of the grid-connected population has between 4 and 14 power outages a week, and 2.8 percent of the grid-connected have more than 14 power outages per week. Inadequate voltage supply resulting from low or fluctuating grid electricity also limits the use of appliances for around 15 percent of grid-connected households. Of households within 2.5 kilometers of the medium voltage network, 45 percent are dependent on lighting sources other than the national grid.

Source: Power Africa Geospatial Analysis 2019

2.2.2 ON-GRID AFFORDABILITY

The level of electricity tariff is one of the key factors private investors use to determine whether to invest in the power sector of countries. Although the Ethiopian Electrical Utility (EEU) increased the

FIGURE 1. PERCENT OF HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES PER SQUARE KILOMETER IN RELATION TO MEDIUM VOLTAGE LINES



[14] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report."

invest in the power sector of countries. Although the Ethiopian Electrical Utility (EEU) increased the electricity tariff at the beginning of December 2018, it is still relatively low compared to many other countries in the region. According to NEP 2.0, grid-connected households consume, on average, 120.7 kilowatt hours (kWh) of electricity per month, which corresponds to 3rd Block electricity tariffs, as shown in Table 2. Urban households spend about two percent of their income on electricity, while rural households spend a little over five percent.[15]

TABLE 2. ENERGY TARIFF FOR RESIDENTIAL CONSUMER CATEGORY

BLOCK	RANGE	BASE TARIFF (BIRR/KWH)	ENERGY TARIFF (BIRR/KWH)			
			December 2018	December 2019	December 2020	December 2021
1st block	Up to 50 kWh	0.27	0.27	0.27	0.27	0.27
2nd block	Up to 100 kWh	0.36	0.46	0.56	0.66	0.76
3rd block	Up to 200 kWh	0.50	0.7807	1.06	1.34	1.63
4th block	Up to 300 kWh	0.55	0.9125	1.28	1.64	2.00
5th block	Up to 400 kWh	0.57	0.9750	1.38	1.79	2.20
6th block	Up to 500 kWh	0.59	1.0423	1 50	1.95	2.41
7th block	More than 500KWh	0.70	1.1410	1.59	2.03	2.48

Source: [16]

2.2.3 DEMAND FOR ENERGY

The GOE's National Off-Grid Access Targets in Context

This report draws on analytics and data from Fraym, which uses methods including machine learning to weave together survey data and satellite imagery to provide hyper-local population-based information across Africa. Households that are dependent on non-grid lighting sources are categorized into three discrete groups based on proximity to national medium voltage grid lines and on the Ethiopian government's NEP 2.0.[17] These groups provide a more nuanced understanding of which types of off-grid solutions may be well-suited certain groups of households that depend on non-grid lighting sources based on their ability to pay. The three groups are described below and in Table 3.[18]

Short-term pre-electrification households are defined as households dependent on non-grid lighting sources, located within 2.5 km from the national medium voltage grid lines. Due to data limitations on the location of isolated settlements, some households within 2.5 km of the national grid may be included even if their isolation from other settlements. This will raise the cost of connectivity greatly and they are less likely to be connected by 2025. According to the NEP, these are households in communities that are

[15] National Electrification Program 2.0.

[16] Ethiopian Energy and Power Business Portal, "Electricity/Energy Tariff Adjustment in Ethiopia(Current -Effective as of December 2019) - Ethiopian Energy and Power Business Portal, EEPbp."

[17] These categories are based on medium voltage network maps provided by NRECA International, which did not include medium voltage line maps for Addis Ababa or Somali Region. As a result, the populations of both areas are excluded from the following calculations.

[18] National statistics on short-term, mid-term, and long-term pre-electrification households do not include households in Addis Ababa or Somali Region, where mapped national grid lines were not available.

expected to be connected to the grid by 2025, in communities planned for both intensification and densification of national gridlines. About 45 percent of households dependent on non-grid lighting sources are short-term pre-electrification households. About 31 percent of all Ethiopian households are in this group, for a total of approximately 6 million households.

Mid-term pre-electrification households are defined as households dependent on non-grid lighting sources, located 2.5 to 25 km from the national medium voltage grid lines. According to NEP 2.0, these are households in communities that are expected to be connected to the grid between 2025 and 2030. This group may also contain some households that are relatively isolated from other settlements, raising the cost of connectivity greatly. As a result, some of these households may be less likely to be connected by 2025. About 52 percent of households dependent on non-grid lighting sources are mid-term pre-electrification households. About 36 percent of all Ethiopian households are in this group, for a total of approximately 7 million households.

Long-term pre-electrification/off-grid households are defined as households dependent on non-grid lighting sources, located beyond 25 km from the national medium voltage grid lines. According to NEP 2.0, these households are not expected to be connected to the grid by 2030 and must therefore rely on other types of off-grid solutions. About three percent of households dependent on non-grid lighting sources are long-term pre-electrification/off-grid households. About two percent of all Ethiopian households are in this group, for a total of approximately 450,000 households.

TABLE 3. THE NATURE OF HOUSEHOLDS DEPENDENT ON LIGHTING SOURCES OTHER THAN NATIONAL GRID ELECTRICITY

GROUP	DISTANCE FROM NATIONAL MEDIUM VOLTAGE GRID LINES	YEAR TO BE CONNECTED	PERCENT OF NATIONAL HOUSEHOLDS	TOTAL HOUSEHOLDS IN GROUP	PERCENT OF HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES
Short term	2.5 km	2025	31%	6 million	45%
Mid term	2.5–25 km	2025–2030	36%	7 million	52%
Long term	25km +	2030+	2%	450,000	3%

Source: Power Africa Geospatial Analysis 2019

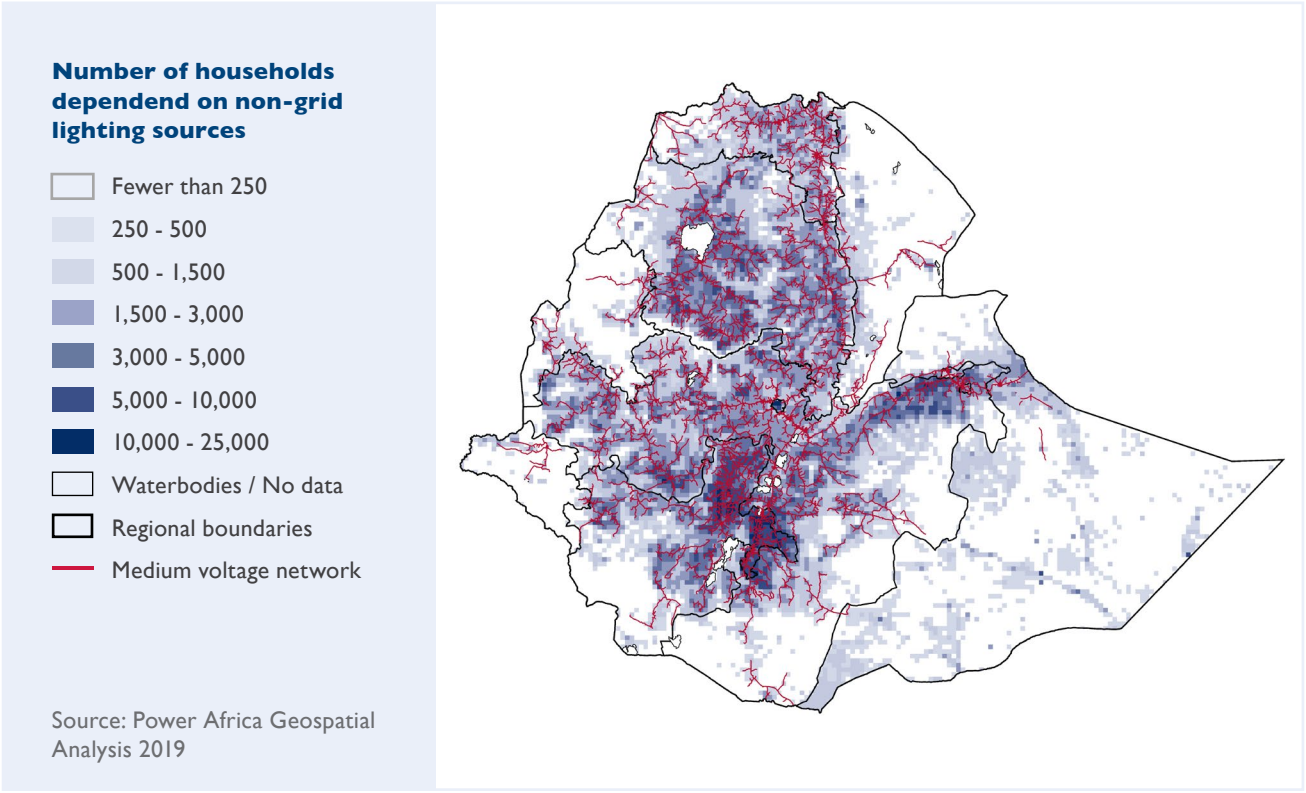
Nationally, about 14.6 million households in Ethiopia rely on lighting sources other than the national grid (Figure 2). These households are home to about 70.5 million people and make up about 67 percent of the total population of Ethiopia. In urban areas, only 10 percent of households aredependent on non-grid lighting sources, while in rural areas, 90 percent of households are dependent on non-grid lighting sources.

The average household dependent on non-grid lighting sources lights their home with either battery power, kerosene lamps, or solar energy, and spends about $10 per year on energy costs, which includes expenditures related to the purchase of kerosene, charcoal, firewood, and electricity. It is important to note, however, that two-thirds of these households report spending nothing on these energy costs. Overall, the average household dependent on non-grid lighting sources spends a total of $560 per year, about $220 of which is discretionary spending on expenditures unrelated to food, health, education, or housing.[20]

[19] The GOE's NEP 2.0 also includes in this group households that are within 2.5 km from the national grid, but whose isolation from other settlements will raise the cost of connectivity greatly and so are less likely to be connected to the grid by 2025. Fraym's calculations for this long-term group do not include households in these settlements.

[20] Total household spending and discretionary household spending are both median values of all households reliant on lighting sources other than national grid electricity.

FIGURE 2. NUMBER OF HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES PER 10 KM^2



Source: Power Africa Geospatial Analysis 2019

Households in communities that align with the NEP 2.0 off-grid pre-electrification framework offer significant markets for a wide range of solar products.

The 6 million short-term pre-electrification households, currently dependent on non-grid lighting sources, may have to wait up to seven years for grid connections to their communities. These households may be best served in the interim by more temporary and smaller solar lighting kits.

There are certain particularly attractive regions and chartered cities where the private sector may complement the grid rollout with these temporary or small kits:

- Dire Dawa: 15,000 of these households, or 88 percent of households are dependent on non-grid lighting sources in the city.
- Oromia: 2.2 million of these households, or 40 percent of households are dependent on non-grid lighting sources in the region.
- Southern Nations, Nationalities, and Peoples' Region (SNNP): 1.7 million of these households, or 58 percent of households are dependent on non-grid lighting source in the region.

The 450,000 long-term pre-electrification/off-grid households, currently dependent on non-grid lighting sources, are in communities that are not being targeted for electrification before 2030. These households may also be best served by longer-term off-grid solar and mini-grid systems in support of productive uses and social services, for example health centers and schools. Among this category, there are again some particularly attractive regions the private sector may consider targeting with off-grid solar or mini-grid systems:

- Oromia: 230,000 of these households, or 4% of households dependent on non-grid lighting sources in the region.
- Gambela: 20,000 of these households, or 28% of households dependent on non-grid lighting sources in the region.
- Afar: 60,000 of these households, or 18% of households dependent on non-grid lighting sources in the region.

2.2.4 OUTLINING DIFFERENT TYPES OF HOUSEHOLDS THAT ARE DEPENDENT ON NON-GRID LIGHTING SOURCES

To understand the potential market for different types of off-grid solutions, households that are dependent on non-grid lighting sources are disaggregated by annual discretionary spending, classifying them into groups of modest, medium, and high consumer power households. Among households that are dependent on non-grid lighting sources:

- Sixty percent are classified as having modest consumer power.
  - This group has annual discretionary spending ranging from $60 to $75.
  - There are approximately 8.7 million households in this group.
- Twenty percent are classified as having medium consumer power consumption.
  - This group has annual discretionary spending ranging from $375 to $660.
  - There are approximately 2.9 million households in this group.
- Fourteen percent are classified as having high consumer power.
  - This group has annual discretionary spending above $660.
  - There are approximately 2 million households in this group.

Financial inclusion, which is defined as having access to formal financial services, is low among households that are dependent on non-grid lighting sources across Ethiopia: only about 22 percent of these households have a bank account, compared to about 65 percent of households that light their homes with electricity from the national grid.

Both types of households tend to use microfinance institutions (MFIs) at similar levels, with about ten percent of both groups reporting having an account at an MFI.

Use of mobile banking is very low among all Ethiopian households, particularly households dependent on non-grid lighting sources. Although fewer than 1 percent of Ethiopian households report using this type of service, about 50 percent of them own a mobile phone. This rate indicates a significant growth opportunity for mobile banking and mobile money, which could help facilitate payment plans for solar lights and home systems.

Among the household profiles based on discretionary spending, there are some substantial differences across aspects of savings and financial inclusion. Broadly, access to savings and financial services is highest for households with high consumer power and lowest for households with modest consumer power, as illustrated in Table 4 and Figure 3.

This information, both across all households dependent on non-grid lighting sources, as well as across these different profiles, offers important context for solar companies looking to market products to these potential target groups.

TABLE 4. CRITERIA FOR MODEST, MEDIUM, AND HIGH POWER CONSUMPTION HOUSEHOLDS

INDICATOR	MODEST CONSUMER POWER HOUSEHOLDS[21]	MEDIUM CONSUMER POWER HOUSEHOLDS	HIGH CONSUMER POWER HOUSEHOLDS
HOUSING QUALITY AND CHARACTERISTICS			
Household size	5.2	5.8	5.8
Number of rooms	1.8	2.0	2.0
Advanced finished floor	2%	4%	6%
Advanced finished walls	1%	2%	3%
Advanced finished roof	50%	65%	70%
Advanced finished house	0%	2%	2%
HOUSEHOLD LIGHTING SOURCE			
Solar	18%	24%	34%
Generator	1%	2%	2%
ASSET OWNERSHIP			
Mobile phone	37%	62%	78%
Radio	23%	34%	36%
Non-portable electronic appliance	1%	3%	6%
EDUCATION OF HOUSEHOLD HEAD			
Did not finish primary	94%	87%	81%
Finished primary	5%	8%	11%
Finished secondary	1%	3%	6%
At least secondary	0%	2%	3%
ACCESS TO SAVINGS AND FINANCING[23]			
Bank account access	19%	34%	41%
Household used mobile banking	0.3%	1.1%	3.3%
Account at an MFI	9%	11%	12%
Received a loan in the last 12 months	27%	29%	30%
Number of loans received in last 12 months[24]	1.07	1.1	1.02

Source: Power Africa Geospatial Analysis 2019

[21] Households grouped by consumer power only include households dependent on non-grid lighting sources.

[22] Asset ownership is at the household level. If any member of the household has a given asset, a household is classified as having that asset.

[23] Savings and finance related questions only refer to households whose head is 18 years old or older.

[24] Number of loans received is only for households that took loans, and for loans that were greater than 150 birr (about $7).

INDICATOR	MODEST CONSUMER POWER HOUSEHOLDS[21]	MEDIUM CONSUMER POWER HOUSEHOLDS	HIGH CONSUMER POWER HOUSEHOLDS
Average loan principal (nominal 2016 US$)	$120	$120	$200
Average loan payback period (months)	9	10	11
Household could save US$30 once a month	5%	14%	22%
Household could save US$30 every 3–6 months	15%	18%	15%
Household could save US$30 every 12 months	12%	15%	12%
Household could not save US$30	68%	53%	50%
HOUSEHOLD SPENDING (NOMINAL 2016 USD)			
Annual energy spending (mean)	$6	$15	$18
Annual discretionary spending (median)	$190	$475	$850
Total annual spending (median)	$490	$900	$1,630

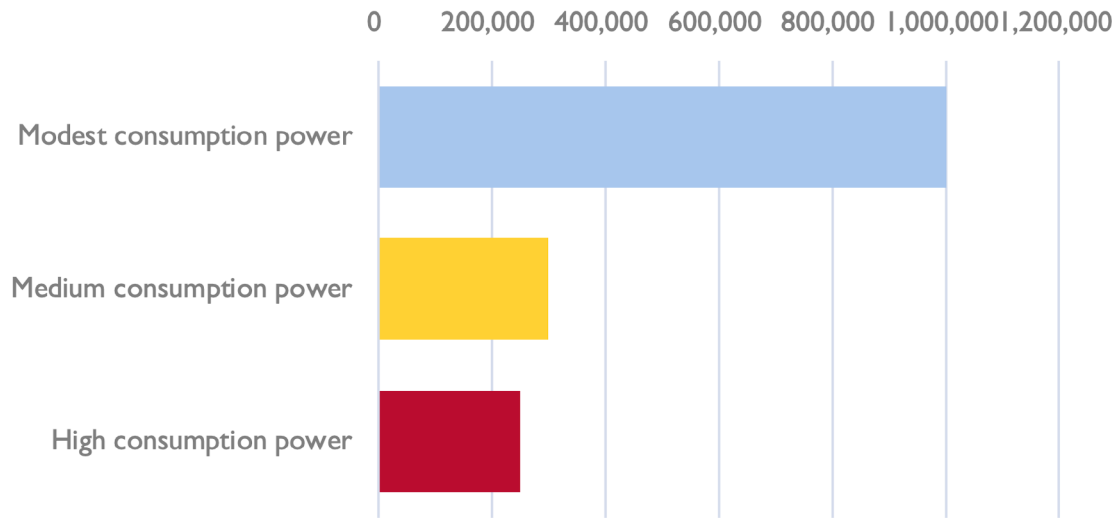
Source: Power Africa Geospatial Analysis 2019

[21] Households grouped by consumer power only include households dependent on non-grid lighting sources.

[22] Asset ownership is at the household level. If any member of the household has a given asset, a household is classified as having that asset.

Of all households dependent on non-grid lighting sources, 15 percent or about 1.8 million families, live farther than 10 km from the medium voltage power network. Mini-grids and various types of solar lighting kits and home systems may offer tailored solutions for these households, of which 60 percent have modest consumer power, 20 percent have medium consumer power, and 15 percent have high consumer power, totaling over 1 million, 300,000, and 250,000 families respectively.

FIGURE 3. CONSUMER POWER OF HOUSEHOLDS FARTHER THAN 10KM FROM MEDIUM VOLTAGE POWER GRID



Source: Power Africa Geospatial Analysis 2019

2.3 OVERALL POLITICAL LANDSCAPE

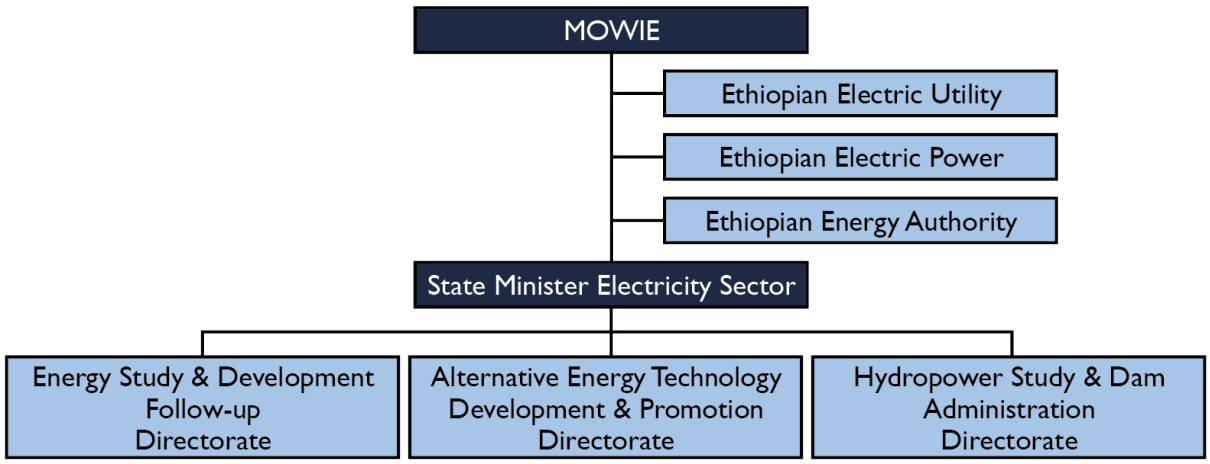
Ethiopia's political structure is a federal one; the country has nine regions and two administrative cities. All regions have autonomous power on most political decisions, giving the regions a high degree of authority in project planning.[25] There are high ethnic tensions in different regions of Ethiopia that can result in temporary political instabilities. In 2018 a new prime minister from the popular Ethiopian People's Revolutionary Democratic Front party was elected. The change in prime minister was followed by several changes of government officials in high ranking positions. These political changes have a history of impacting Ethiopia's general economy as well as the energy sector. The next federal election is planned for May 2020.[26]

National-level government offices that affect the energy sector in the country are impacted by the federal structure, making regional bureaus major decision makers when it comes to implementation of projects. The only regional bureaus that are exceptions to this are of the Ethiopian Investment Commission (EIC) and Ethiopian Standards Agency.

2.3.1 GOVERNMENT INSTITUTIONS

The Ministry of Water, Irrigation, and Energy (MOWIE) is the overall governing body of the energy sector in Ethiopia. MOWIE oversees the Ethiopian Electric Utility (EEU), which is in charge of power distribution, the Ethiopian Energy Authority (EEA), which is the energy regulator, EEP, which is in charge of power generation and transmission, and the State Minister, who oversees the electricity sector and manages three directorates (Figure 4).

FIGURE 4. MAIN ENERGY SECTOR GOVERNMENT STAKEHOLDERS



Source: MOWIE n.d.

[25] Central Intelligence Agency, "Africa :: Ethiopia — The World Factbook - Central Intelligence Agency."
[26] F.P. Editors, "Ethiopia's Year of Reckoning."

Table 5 provides details on government institution roles in and relevance for off-grid interventions.

TABLE 5. GOVERNMENT INSTITUTION ROLES AND OFF GRID RELEVANCE

INSTITUTION	MANDATE	RELEVANCE TO OFF-GRID
MOWIE[27]	The Ministry regulates planning, development and management of resources; preparation and implementation of guidelines, strategies, polices, and programs; and sectoral laws and regulations. It also conducts study and research activities and provides technical support to regional water and energy bureaus.	Coordination of off-grid energy solutions in the country with other organizations, including EEU.
EEU[28]	The Ethiopian Electric Utility (EEU) was established by regulation No. 18/1997 and conferred with the purpose to engage in the business of distributing and selling electrical energy in accordance with economic and social development policies and priorities of the government.	EEU has assigned a specific person who will be leading off-grid planning for the utility. EEU also plans to have a dedicated off-grid person in each of its main regions (11) and two major cities. EEU has been providing support to EEA in the development of regulations for mini-grids, in particular on tariffs and technical specifications.
EEP[29]	Responsible for generation, transmission, and system operation for the national electricity grid.	EEP's contribution to the mini-grid sub-sector is a better coordination with EEU and MOWIE for a better demarcation of off-grid areas in line with grid expansion plans.
EEA[30]	Energy sector regulator, under the oversight of MOWIE.	Regulates energy conservation and efficiency; is mandated to prioritize off-grid companies. EEA is also drafting the Directive for off-grid mini-grids, Tariff Methodologies for mini-grids as well as technical and safety standards for mini-grids.
Rural Electrification Executive Secretariat	Evaluates projects for funding by the Rural Electrification Fund (REF) and provides advisory services, capacity building, and training to regional energy bureaus and cooperatives.	Manages the Rural Electrification Fund, which finances projects for decentralized electricity generation.
EIC[31]	› Main services provided by EIC include: › Promoting the country's investment opportunities and conditions to foreign and domestic investors. › Issuing investment permits, business licenses, commercial registrations, and work permits, and registering technology transfer agreements and export-oriented non-equity-based foreign enterprise collaborations with domestic investors. › Negotiating and, upon government approval, signing bilateral investment promotion and protection treaties with other countries.	Facilitates investment in the mini- and off-grid sectors.
Ethiopian Standards Agency[32]	The Ethiopian Standards Agency is a governmental non-profit organization with the following duties: development of standards, training and technical support, dissemination of standards, and verification of compliance to standards.	Regulates quality of imported items for SHS. Works with EEA on the technical standards for mini-grids.

2.4 INTERNATIONAL DONOR PROGRAMS

Table 6 describes the various activities being implemented by international donor organizations to support the implementation of Ethiopia's NEP 2.0.

TABLE 6. INTERNATIONAL DONOR PROGRAMS SUPPORTING ETHIOPIA'S IMPLEMENTATION OF NEP 2.0 (NATIONAL ELECTRIFICATION PROGRAM 2.0 2019)

Support Area	Partner	Details	Timeline
Policy, strategy, and planning development	World Bank	› Technical assistance for development and launching of NEP. › Technical assistance for revisions focusing on off-grid sector under NEP 2.0. › National baseline survey for electrification under the Multi-Tier Framework for Access program. › National Geospatial Information System (GIS) platform for electrification and power sector planning. › Gender and citizen engagement programs.	Fiscal year 2018 (FY 2018) Launch in March 2019 FY 2018 FY 2018–2020 FY 2018–2023
	European Union (EU)	› Technical assistance for NEP 2.0 development. › Technical assistance for draft tender document development for minimum subsidy tenders.	To Be Confirmed (TBC) TBC
	United Kingdom Department for International Development	› Technical assistance for affordability of off-grid technologies.	TBC
	United States Agency for International Development (USAID)	› Support for medium voltage line and digitization of population location using GIS platform and development of a nationwide geospatial least-cost plan. › Business models for mini-grid development (Beyond the Grid study—already complete). › Technical assistance for national off-grid policies and regulations, and improved regulatory structures for micro-grid companies. › Gender and citizen engagement programs.	FY 2018–2019 FY 2017 FY 2019–2022 FY 2019–2022

Source: National Electrification Program 2.0 2019

[27] MOWIE, "About the Ministry - Mowie."
[28] Ethiopian Electric Utility, "Ethiopian Electric Utility: Home."
[29] Ethiopian Electric Power, "About EEP - Ethiopian Electric Power."
[30] Ethiopian Energy Authority, "Ethiopian Energy Authority."
[31] Ethiopia Investment Commission, "Ethiopia Investment Commission: Home."
[32] Ethiopian Standards Agency, "Welcome to Ethiopian Standard Agency."

2.5 SOLAR/RENEWABLE ENERGY ASSOCIATION(S)

The Solar Energy Development Association (SEDA-E) is an independent non-profit association, which is focused on supporting the growth and development of solar energy companies in Ethiopia.[33] SEDA-E was established in September 2010 by several leading solar energy companies in Ethiopia. The association was relaunched in 2019 as a business association and was renamed the Solar Energy Development Association (ESEDA).

Its key roles are promoting the interests of members of the Solar energy industry among government, public sector, the general public and any other organizations that may impact the development of the industry; and the creation of a forum for the dissemination and exchange of information and ideas on matters relating to Solar energy development and utilization in Ethiopia.

In addition to the ESEDA, there are region-based associations in Ethiopia working on region-specific issues. Most of these associations are member of the ESEDA to promote cross-regional collaborations in the solar sector.

[33] GOGLA, "Solar Energy Development Association (SEDA-E) | GOGLA."

3 OFF-GRID SOLUTIONS

3.1 DISTRIBUTION CHANNELS

Identifying and using the right kind of distribution channel is key to the success of off-grid energy companies.

3.1.1 CURRENT DISTRIBUTION CHANNELS

Solar companies currently rely on five distribution channels:

- Company sales agents
- Government-formed youth groups
- Hidasse Telecom agents
- Total gas stations
- Nongovernmental organization (NGO) programs focused on livelihoods

Table 7 describes each channel and the associated pros and cons according to the in-country technical advisor's expertise.

TABLE 7. DISTRIBUTION CHANNELS USED CURRENTLY BY SOLAR COMPANIES

NO	MODEL	DESCRIPTION	STRENGTHS	SHORTCOMINGS
1	Company sales agents	Solar companies hire sales agents in each region, zone, or woreda to sell products and provide on-the-ground customer support.	Helps the company form a direct relationship with customers, which could lead to brand loyalty.	Expensive and not scalable without high investment.
2	Government-formed youth groups	Regional governments formed groups in potential woredas to provide distribution and maintenance services that any solar company with a memorandum of understanding (MOU) with the regional government can use as a distribution channel.	Easy and cheap to establish a sales network; access to capacity building programs; knowledge of area sales.	Quality varies between groups; lack of brand visibility results from multiple products being sold by the same group and company; some groups are not engaged with customers at the ground level.
3	Hidasse Telecom agents	A government-formed company distributing telecom products such as scratch cards and SIM cards throughout Ethiopia; involved in the solar lantern/SHS distribution throughout Ethiopia with 800+ agents.	Strong network throughout Ethiopia; experience in solar product sales.	May have divided loyalty to own brands.

NO	MODEL	DESCRIPTION	STRENGTHS	SHORTCOMINGS
4	Total gas stations	Total gas stations in Ethiopia are selling solar products in selected stations throughout Ethiopia.	Great brand association for companies; experience in solar product sales.	Low sales in selected stations; may be difficult to form partnership.
5	NGO programs focused on livelihoods	There are hundreds of women organized by NGOs for employment and business creation who distribute small solar products in areas they live by buying them from solar companies.	High social impact and great brand association.	Expensive to implement unless funded by an external body.

Source: Power Africa in-country technical advisor

3.1.2 POTENTIAL DISTRIBUTION CHANNELS THAT HAVE NOT BEEN FULLY EXPLORED

Three more channels could be used to ensure sustainable distribution, as described in Table 8:

- Cooperatives
- Post offices
- Total gas stations, if used more effectively

TABLE 8. POTENTIAL DISTRIBUTION CHANNELS FOR SOLAR COMPANIES (GATHERED FROM INTERVIEWS CARRIED OUT BY POWER AFRICA IN COUNTRY TECHNICAL ADVISOR)

NO.	CHANNEL	OUTREACH	COST	EASE TO START	VALUE ADD	POSSIBLE CHALLENGES
1	Cooperatives	60,000 across Ethiopia (rural mostly) at the kebelle level.	Low	Easy	Strong network, managed by unions/ government; experience distributing small to large agricultural inputs; close to rural areas; 50% have hired employees.	50% of cooperatives are managed by farmers; most of them do not have access to the right kind of infrastructure.
2	Post offices	3,000 offices across Ethiopia at the woreda level.	Low	Medium	Signing up to be an agent of a mobile money service provider (Amole).	Lack of deep rural presence and low access points.
3	Total gas stations	250 at the zonal level.	Medium	Medium	M-Birr agents in the urban areas already have experience with solar product distribution.	May take too long to get decisions; lack of presence in the rural areas.

Source: Interviews conducted by Power Africa in-country technical advisor

3.2 PICO-SOLAR COMPANIES

Ethiopia's solar market is well developed, with at least eight significant players in the market offering a range of solar photovoltaic (PV) solutions for use at the household level or pico-solar. However, the majority of these companies operate in only four regions—Amhara, Oromia, SNNP, and Tigray. While the largest off-grid markets are in these regions, there are still opportunities for off-grid energy in markets that have been largely untapped by the larger, well-known solar companies. The reasons for these untapped markets vary, but one of the limiting factors is the instability of the regions (such as Benishangul-Gumuz and Gambela), and due to the remoteness of some areas, they are difficult to reach (Table 9).

TABLE 9. LOCATIONS WITH HIGH POPULATIONS DEPENDENT ON NON-GRID LIGHTING SOURCES

REGION OR CHARTERED CITY	TOTAL HOUSEHOLDS	HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES	HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES (PERCENT)	HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING SOURCES BEYOND 10KM OF POWER LINES
Addis Ababa	800,000	50,000	7%	-
Afar	410,000	310,000	74%	140,000
Amhara	5,000,000	3,600,000	73%	400,000
Benishangul-Gumuz	240,000	180,000	75%	40,000
Dire Dawa	100,000	17,000	16%	1,000
Gambela	100,000	70,000	73%	28,000
Harari	60,000	11,000	19%	-
Oromia	8,200,000	5,550,000	68%	850,000
SNNP	4,400,000	3,000,000	68%	200,000
Somali	1,300,000	1,000,000	77%	-
Tigray	1,200,000	800,000	62%	100,000

Below is a summary of pico-solar sales in Ethiopia obtained by GOGLA from their members (Table 10-Table 16).

From mid-2014 until late 2017, portable lanterns with single lights or single lights with mobile charging (0-3Wp) sold well in Ethiopia followed by SHS (3 – 20 Wp). Systems with more than 21 Wp have not been sold in Ethiopia. Sales of SHS have been increasing throughout the years. Most portable lantern products and multi-light systems are sold on a cash basis, with a small fraction sold using the PAYGO+cash model. The number of solar home system unit sales is still relatively small compared to the lanterns but the segment experiences growth largely due to conditional financing of the World Bank credit line that has a majority quota for imports of SHS vs. lanterns.

[34] GOGLA, "Standardized Impact Metrics for the Off-Grid Solar Energy Sector."

TABLE 10. GOGLA SALES DATA BY PRODUCT CATEGORY AND BUSINESS MODEL

TIME PERIOD	SUM OF TOTAL	SUM OF 0-1.5 WP	SUM OF 1.5-3 WP	SUM OF 3-10 WP	SUM OF 11-20 WP	SUM OF 21-49 WP	SUM OF 50-100 WP	SUM OF 100+WP
Total	2,478,383	835,452	380,896	454,310	13,620	0		0
Jul-Dec 2014	416,242	-	-	-	-	-	-	-
Jan-June 2015	346,000	-	-	-	-	-	-	-
Jul-Dec 2015	363,950	227,050	119,099	11,801	-	-	-	-
Jan-June 2016	231,097	98,940	18,588	111,904	-	-	-	-
Jul-Dec 2016	265,723	125,792	76,610	53,483	-	-	-	-
Jan-June 2017	210,913	104,745	42,406	63,761	-	-	-	-
Jul-Dec 2017	158,634	54,802	44,487	59,320	-	-	-	-
Jan-June 2018	147,647		69,639	63,694	-	0	-	0
Jul-Dec 2018	338,177	224,123	10,067	90,347	13,620	-	-	0

TABLE 11. GOGLA MARKET VALUE BY PRODUCT CATEGORY AND BUSINESS MODEL

SALES VOLUMES	BUSINESS MODEL		
TIME PERIOD	CASH+PAYGO	CASH ONLY	PAYGO- ONLY
Total	2,478,383	410,245	75,579
Jul-Dec 2014	416,242	-	-
Jan-June 2015	346,000	-	-
Jul-Dec 2015	363,950	-	-
Jan-June 2016	231,097	-	-
Jul-Dec 2016	265,723	-	-
Jan-June 2017	210,913	-	-
Jul-Dec 2017	158,634	-	-
Jan-June 2018	147,647	121,227	26,420
Jul-Dec 2018	338,177	289,018	49,159

For cash products, the value is calculated using the reported free on board price, while for PAYGO products, the value is the reported total cost of ownership (defined as the average amount of USD received from a customer repaying the product in full and on time without applying a financial discount rate).

TABLE 12. GOGLA SALES DATA BY QUALITY VERIFIED BY NON-QUALITY VERIFIED PRODUCTS

TIME PERIOD	SUM OF TOTAL	SUM OF QV	SUM OF NON-QV
Total	2,478,383	1,154,569	199,839
Jul-Dec 2014	416,242	-	-
Jan-June 2015	346,000	292,000	54,000
Jul-Dec 2015	363,950	303,705	60,245
Jan-June 2016	231,097	-	-
Jul-Dec 2016	265,723	-	-
Jan-June 2017	210,913	-	-
Jul-Dec 2017	158,634	158,634	0
Jan-June 2018	147,647	130,147	17,500
Jul-Dec 2018	338,177	270,083	68,094

TABLE 13. GOGLA SALES DATA BY APPLIANCE

APPLIANCE	PERIOD	SALES VOLUME
	Jul-Dec 2016	-
	Jan-June 2017	-
Fans	Jul-Dec 2017	27,140
	Jul-Dec 2016	21,042
	Jan-June 2017	113,502
TVs	Jul-Dec 2017	126,701

The table to the left features sales volumes from a range of off-grid solar appliances (TVs, fans, refrigeration units, and water pumps) sold targeting customers living in off- or weak-grid areas.

TABLE 14. GOGLA ESTIMATED MARKET PENETRATION

COUNTRY	WB ACCESS RATE (2017)	WB POPULATION WITHOUT ACCESS (2017)	MARKET PENETRATION ESTIMATION
Ethiopia	44.30%	58,461,293	17.02%

TABLE 15. GOGLA COUNTRY LEVEL TRENDS		
TRENT TYPE	% CHANGE H2 2018 TO H1 2018	% CHANGE H2 2018 TO H2 2017
Total sales	129%	113%
Solar lanterns	236%	136%
Multi-light systems	42%	52%
SHS sales	-	-

TABLE 16. GOGLA ESTIMATED ENERGY IMPACT FROM 2016 UP TO DEC 2018	
METRIC	RESULT
1ai. People with improved energy access - cumulatively	11,416,274
1aii. People with improved energy access - currently	9,950,682
1bi. People with access to Tier 1 energy services - currently	4,903,468
1bii. People with access to Tier 2 energy services - currently	50,008
2b. People that have started a new job - cumulatively	76,784
3. Additional income - cumulatively	$242,132,368
5ai. Change in light hours used - cumulatively	2,368,669,930
6ai. Change in energy spending - cumulatively	$391,110,422
6aii. Change in energy spending - household	$984
7. Greenhouse gas emissions avoided- cumulatively	2,504,024

3.2.1 COMMERCIAL OVERVIEW

Below is a summary of the main pico-solar companies currently operating in Ethiopia.

TABLE 17. PICO SOLAR COMPANY SNAPSHOT: LYDETCO

Company Logo	Lydetco
Years of operations	18
Regions of operations	Amhara, Tigray, Oromia, SNNP
Business model	PAYGO, cash-carry, partnerships
Brands distributed	Greenlight Planet
Products	SHS, solar pumps, lanterns, big systems for institution

Source: [35]

TABLE 18. PICO SOLAR COMPANY SNAPSHOT: SOLAR DEVELOPMENT

Company Logo	SOLAR DEVELOPMENT
Years of operations	8
Regions of operations	Amhara, Tigray, Oromia, SNNP
Business model	PAYGO (to be piloted soon), cash-carry, partnerships
Brands distributed	Little Sun, Omnivoltaic, Fosera
Products	SHS, lanterns, solar pumps, big systems for institutions

Source: [36]

[35] LYDETCO, "LYDETCO Ethiopia Solar."
[36] SOLAR DEVELOPMENT, "SOLAR DEVELOPMENT."

TABLE 19. PICO SOLAR COMPANY SNAPSHOT: VERA INTERNATIONAL BUSINESS AND RENSYS ENGINEERING AND TRADING

Company Logo	VERA INTERNATIONAL BUSINESS PLC Rensys Engineering and Trading PLC
Note	These are sister companies working together, Vera is an international importer and Rensys does the local market distribution and marketing.
Years of operations	Vera, 12; Rensys, 8
Regions of operations	Amhara, Tigray, Oromia, SNNP, Benishangul-Gumuz, Somali, Afar
Business model	PAYGO, cash-carry, partnerships
Brands distributed	d.light, Mobisol
Products	SHS, lanterns, solar pumps, big systems for institutions and mini-grids

Source: [37]

TABLE 20. PICO SOLAR COMPANY SNAPSHOT: ACME ENGINEERING & TRADING

Company Logo	Acme Engineering & Trading
Years of operations	15
Regions of operations	Amhara, Tigray, Oromia, SNNP
Business model	PAYGO, cash-carry, partnerships
Products	SHS, lanterns, solar pumps, big systems for institutions

Source: [38]

[37] Rensys Engineering & Trading PLC, "Rensys Engineering & Trading PLC."
[38] ACME Engineering & Trading Plc, "ACME Engineering & Trading Plc."

TABLE 21. PICO SOLAR COMPANY SNAPSHOT: GREEN SCENE	
Company Logo	
Years of operations	2
Regions of operations	SNNP, Oromia
Business model	PAYGO, cash-carry, partnerships, MFI loans
Products	SHS, lanterns, soon to expand to mini-grids and power-usage effectiveness

Source: [39]

TABLE 22. PICO SOLAR COMPANY SNAPSHOT: SUN TRANSFER TECH PLC	
Company Logo	
Years of operations	5
Regions of operations	Amhara, Tigray, Oromia, SNNP
Business model	PAYGO, cash-carry, partnerships
Products	SHS, lanterns, solar pumps, big systems for institutions

Source: ERAF 2018

TABLE 23. PICO SOLAR COMPANY SNAPSHOT: HELLOSOLAR	
Company Logo	
Years of operations	1
Regions of operations	Amhara, Somali
Business model	PAYGO, cash-carry, partnerships
Products	SHS and lanterns

Source: [40]

[39] Green Scene, "Green Scene: Get to Know Us."
[40] HelloSolar, "HelloSolar."

TABLE 24. PICO SOLAR COMPANY SNAPSHOT: FOSERA	
Company Logo	fosera
Years of operations	4
Regions of operations	Amhara
Business model	Cash-carry, partnerships and MFI loans
Products	SHS and lanterns

Source: [41]

3.2.2 GAPS AND BARRIERS

Table 25 outlines various gas and barriers that inhibit market growth for the pico-solar sector in Ethiopia as well as potential solutions to overcome these challenges.

TABLE 25. GAPS AND BARRIERS ANALYSIS FOR PICO SOLAR

GAPS/BARRIER	REASON	POTENTIAL SOLUTIONS
Policy and regulations	Inadequate policy and regulations to support renewable energy technologies.	Support the government to develop new regulations around service standards for the off-grid market.
Duties and taxes	Exemptions are not well-defined for solar products.	Update tax regulations to include exemptions for solar products and components.
Capacity building	Development of skills to support the off-grid sector remains a crucial challenge in local communities.	Develop skills in off-grid sector; companies installing the renewable energy systems, NGOs, academia, and local associations can play a crucial role in this regard.
Lack of foreign exchange	Ethiopia's negative trade balance makes foreign exchange unable to import solar systems into the country.	Work on creative ways to bring in directed foreign exchange for solar companies and link the private sector with local programs that enable the supply of foreign exchange loans. Work on implementation of remittance programs to bring in foreign exchange for private solar companies and link Ethiopian diaspora living abroad with local relatives using an eCommerce platform.
Closed trade system	Ethiopia does not allow foreign companies to be involved in distribution of solar systems, making it difficult to support international vertically integrated companies to enter the Ethiopian market.	Support companies setting up their business in a more creative way to ensure international supply.

Note: Information provided by the Power Africa technical advisory team

[41] Fosera, "Fosera."

3.2.3 SHS SOLAR-RELEVANT REGULATIONS

Table 26 details policies and regulations that pertain to the pico-solar sector.

TABLE 26. PICO-SOLAR POLICIES AND REGULATION

POLICY OR REGULATION	DESCRIPTION
NEP 2.0[42]	Aims for 100% electrification through on- and off-grid solutions by 2025. 35% electrification from stand-alone solar and mini-grid solutions.
National Energy Policy[43]	Promotes small-scale renewable energy, including solar technologies.
Electricity regulations	Council of Ministers Regulation No. 308/2014: establishes EEA.[44] Electricity Operations Regulation No. 49/1999: sets standards for licensing, standards, and tariffs.[45] Off-grid energy companies must go through the EEA licensing process, which can be a long and bureaucratic process.
Tax and import regulations	A Ministry of Finance and Economic Development MOU of 2010 allowed Lighting Africa-certified products to be imported duty-free. The MOU continues to apply; however, it is not uniformly implemented and lacks clarity. No official regulation exists; the MOU applies to all solar products but is inconsistently applied to components that are imported.
Quality control standards and regulations	CES 140:2015 Off-grid solar PV lighting kits—requirements.[47] Ethiopia Conformity Assessment Enterprise (ECAE) is responsible for ensuring adherence and testing for any standards developed by the Ethiopia Standards Agency. ECAE has a solar laboratory at its site that allows testing of a range of solar products; it can take four to seven days for testing. Testing of shipments containing solar products is done by ECAE, at the behest of the Ministry of Trade. This process has been undergoing revisions and is not yet well-defined.[48] Based on the Lighting Global quality assurance framework and implemented by the Ethiopian Standards Agency. Mandatory for systems of up to 15Wp; currently the standard is voluntary up to 350Wp.

[42] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report," 0.
[43] National Energy Policy, "Ethiopian National Energy Policy."
[44] Council of Ministers, "Regulation No. 308-2014."
[45] Council of Ministers, "Regulation No. 49-1999."
[46] ODI, "Accelerating Access to Electricity in Africa with Off-Grid Solar."
[47] CLASP, "Https."
[48] Ethiopia Conformity Assessment Enterprise, "HOME - ECAE."

POLICY OR REGULATION	DESCRIPTION
Financial regulations	A National Financial Inclusion Strategy was launched in April 2017. The headline indicator for the strategy is to increase the percentage of Ethiopian adults with a transaction account from 22% in 2014 to 60% in 2020. The strategy also seeks an increase from 12% to 40% by 2020 in the number of adults reporting use of electronic transactions. The National Financial Inclusion Strategy highlights four main strategies: › Strengthen financial and other infrastructure › Ensure supply of adequate range of suitable products, services, and access points › Build strong consumer protection framework › Improve financial literacy and education[49]
Mobile payment regulations	Mobile and Agent Banking Regulations were published in 2012 outlining a financial institution-led policy. Technology service providers must partner with a financial institution to provide e-wallet services. A final draft of Electronic Fund Transfer Directive by the National Bank of Ethiopia (NBE) was circulated in 2017. An eCommerce law allowing for e-signatures and electronic receipts has yet to be passed as of July 2019.[50]
E-waste regulations	None exist

Note: Information provided by the Power Africa technical advisory team

3.3 PICO-SOLAR FINANCING OVERVIEW

Access

Penetration of financial access points is relatively low in Ethiopia; per 100,000 adults, there are 7.2 commercial bank branches,[51] 3.7 MFI branches,[52] 16.3 points of sale (POS), and 3.6 automated teller machines (ATMs).[53] The government's GTP II includes a mandate for banks to increase their branch network by 30 percent each year over the next five years and develop 50 agents per branch.

Ownership/Usage

Use of financial services in Ethiopia is low; 65 percent of Ethiopian adults are unbanked,[54] principally due to a perceived lack of sufficient funds and distance to financial institutions. Only four percent of adults reported having a debit card,[55] and credit cards are very uncommon; only 11 percent of

[49] National Bank of Ethiopia, "Ethiopian National Financial Inclusion Strategy."
[50] National Bank of Ethiopia, "Regulation of Mobile and Agent Banking Services."
[51] National Bank of Ethiopia, "Macroeconomic and Social Indicators: Ethiopia 2017-18."
[52] Trading Economics, "Ethiopia Branches Microfinance Institutions Per 100000 Adults."
[53] United Bank S.C., "ATM Locator."
[54] The World Bank, "The Global Findex Database 2017."
[55] The World Bank, "Country Snapshot - Universal Financial Access - World Bank Group."

adults reported borrowing money from a formal financial institution.[56] However, use of informal financial services is common; 56 percent of adults over the age of 15 reported that while they did not have a bank account, they saved, borrowed, and insured their property through informal means. Of all adults, 62 percent reported some savings in the last year, but only 26 percent saved in financial institutions.[57] Additionally, as of September 2018 there were over 2 million mobile money accounts; however, less than 20 percent were active, as reported by the NBE.[58]

International Finance

Ethiopia has not liberalized its banking sector, unlike neighbors Kenya, Tanzania, Uganda, and other developing countries. As a result, the Ethiopian banking sector remains unaffected by global financial distress and impacts of globalization.[59] The GOE understands the potential benefits of financial liberalization but fears it could lead to losing control over the economy and may not be economically beneficial. As a result, the banking sector remains closed to foreign investment in Ethiopia. Foreign citizens may not own Ethiopian banks, in full or in part, including open banks or branch offices or subsidiaries of foreign banks. They are also restricted from purchasing shares of Ethiopian banks. However, the government is considering opening the financial sector up to allow diaspora Ethiopians to invest in the finance sector.[60]

Despite all the restrictions, there are some companies with foreign owners operating in Ethiopia as technology service providers for mobile or e-wallet banking. Because these technology service providers are not be regulated by the NBE, these foreigners are allowed to provide the technology as long as an Ethiopian financial institution accesses the accounts and handles agent recruitment.[61]

Commercial Banks

The NBE licenses, regulates, and oversees banks, MFIs, remittances, and insurers, and requires all banks to have core banking systems that interface with the central bank. There are eighteen banks, 3,282 commercial bank branches, 4,000 ATMs, and 7,500 POS terminals across the country.[62] The government-owned Commercial Bank of Ethiopia (CBE) controls 70 percent of deposits and 55 percent of loans and advances in the county, and together with Awash International Bank, it has the country's largest branch network. The physical footprint of regulated financial institutions is low and concentrated in the capital, with 36 percent of bank branches and 54 percent of insurance branches in Addis Ababa.

There is no comprehensive information available on which of the more than three commercial banks will lend to the solar sector. According to informal conversations Power Africa has had with representatives of three commercial banks, they will all lend to the solar sector if the loans meet their tight requirements and are not too small.

MFIs and Saving and Credit Cooperatives (SACCOs)

There are 35 MFIs in Ethiopia that collectively hold 6 percent of all financial sector assets. The five largest MFIs are also state-owned and have 11.4 million accounts. The government has a plan for creating access to financial institutions that aims to place an MFI branch in each woreda of the country, serving an average

[56] The World Bank, "The Global Findex Database 2017."
[57] The World Bank.
[58] Informed by Power Africa in-country advisor's interviews with National Bank of Ethiopia.
[59] Fick and Maasho, "Exclusive."
[60] Solomon, "Ethiopia Invites Investment from Diaspora, and Beyond."
[61] Fox, "Mobile Money Revolution Hits Ethiopia."
[62] National Bank of Ethiopia, "Macroeconomic and Social Indicators: Ethiopia 2017-18."

household number of 24,000 each. Some MFIs are opening satellite offices to be closer to the people. One satellite office serves 3,600 to 6,000 households (or one to five kebelles). MFIs that are involved in providing loans to energy companies and end consumers have access to loans from the Development Bank of Ethiopia (DBE). Most MFIs have no issue with mobilizing loanable funds for renewable energy, but the lack of off-grid solar product supply in the market makes the demand for loans lower than anticipated. Of the 35 MFIs, 11 to 14 lend to off-grid solar companies and their customers. Most of the MFIs have access to the credit line DBE offers to help end users afford renewable energy products such as SHS. The main MFIs lending for energy are Amhara Credit and Saving Institution, Dedebit Saving and Credit Institution, Oromia Credit and Saving Share Company and Omo Microfinance Institution, although several smaller MFIs are also active.

In addition, there are 19,000 SACCOs nationwide, representing 3.8 million active savers, but they are considered weak and do not provide services on a sustainable basis. NBE would like to leverage these SACCOs for financial inclusion. Knowledge of the sector has shown that the GOE's aim to place at least one SACCO in each kebelle to serve 1,000 to 1,400 households seems to be working in most areas. Oromia and Tigray regional states put the most effort in capacitating SACCOs for better financial inclusion, while other regions are catching up.

Ethiopia's National Payment System

The Ethiopian Automated Transfer System was launched in May 2011 and comprises two main systems:

- Real Time Gross Settlements—for low volume, high value transactions (above 200,000 Ethiopian Birr (ETB) [$7,100]).
- Automated Clearing House—for high volume, low value transactions.

EthSwitch is Ethiopia's national retail payments switch, which is a payment/settlement system that enables different bank systems to interact with each other and has been operational since July 2016.

- The NBE is the administrator of the national switch and is also responsible for regulating, licensing, and supervising EthSwitch.
- EthSwitch provides clearing and settlement functions for retail payments.
- Third party payment service providers can link to the switch.
- To date, only ATM integration has been achieved, with 99 percent of transactions cash withdrawals. Point of sale integration has been tested and was ready for deployment in early 2019, although this has not happened to date.[66]

As outlined in Table 27-Table 31, 2018 was generally a positive year for fundraising for the East Africa off-grid solar sector, despite totals not exceeding the previous record year of 2017. The year witnessed a growth in debt investments, mainly driven by development finance institutions.

Major increases in debt investment included both debt raised from banks/financing institutions and debt raised through crowdfunding platforms, which increased by 57 percent and more than 600 percent respectively.

[66] ATM Marketplace, "EthSwitch, BPC Partner to Create National Switch Infrastructure for Ethiopia."

TABLE 27. GOGLA BREAKDOWN OF EAST AFRICA REGION FUNDING TYPES, TRANSACTIONS, BUSINESS MODEL, USE OF FUNDING AND FUNDING FLOW BY INVESTOR TYPE

TYPE OF INVESTMENT	2012	2013	2014	2015	2016	2017	2018
Total	$9,164,448	$9,340,391	$47,517,751	$158,733,313	$146,884,361	$172,223,400	$153,712,881
Grant	$2,642,965	$5,875,826	$4,929,570	$6,500,000	$3,000,000	$0	$1,458,211
Equity - Common Shares	$6,521,483	$1,900,000	$27,458,230	$91,476,170	$97,533,144	$45,585,405	$16,076,046
Equity - Preferred Shares	$0	$0	$0	$0	$5,575,000	$0	$0
Debt - Note / Bond	$0	$0	$350,000	$6,957,143	$12,940,000	$5,936,940	$1,693,556
Debt - Bank or FI Loan	$0	$1,564,565	$5,000,000	$13,300,000	$24,692,315	$45,146,950	$71,109,311
Debt - Crowdfunding	$0	$0	$0	$0	$1,143,902	$2,554,104	$19,728,048
Debt - Securitization and/ or Factoring	$0	$0	$9,779,951	$40,500,000	$2,000,000	$73,000,000	$43,647,710
Other	$0	$0	$0	$0	$0	$0	$0

Source: [67]

Another impressive shift was the increase in the number of off-grid transactions, which went from 36 reported in 2017 to 107 in 2018. Scaling up their businesses, geographic market expansion and bridging working capital needs were key uses of funds. Governments including development finance institutions remain top investors in the off-grid space with investment growth of eight percent in 2018.

TABLE 28. GOGLA BREAKDOWN OF EAST AFRICA REGION FUNDING TYPES, TRANSACTIONS, BUSINESS MODEL, USE OF FUNDING AND FUNDING FLOW BY INVESTOR TYPE – TRANSACTIONS

TRANSACTIONS	2012	2013	2014	2015	2016	2017	2018
Number of transactions	7	10	10	21	42	36	107
Average transaction size	$1,309,207	$934,039	$4,751,775	$7,558,729	$3,497,247	$4,783,983	$1,436,569
Median transaction size	$642,965	$925,000	$3,629,115	$4,500,000	$997,439	$743,470	$182,664

Source: [68]

[67] GOGLA, "Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data."
[68] GOGLA.

TABLE 29. GOGLA BREAKDOWN OF EAST AFRICA REGION FUNDING TYPES, TRANSACTIONS, BUSINESS MODEL, USE OF FUNDING AND FUNDING FLOW BY INVESTOR TYPE – BUSINESS MODEL

BUSINESS MODEL	2012	2013	2014	2015	2016	2017	2018
Total	$9,164,448	$9,340,391	$47,517,751	$158,733,313	$146,884,361	$172,223,400	$153,712,881
PAYGO	$3,364,448	$8,590,391	$47,517,751	$158,733,313	$144,821,783	$171,993,068	$138,781,163
Non-PAYGO	$5,800,000	$750,000	$0	$0	$2,062,578	$230,331	$14,931,718

Source: [69]

TABLE 30. GOGLA BREAKDOWN OF EAST AFRICA REGION FUNDING TYPES, TRANSACTIONS, BUSINESS MODEL, USE OF FUNDING AND FUNDING FLOW BY INVESTOR TYPE – USE OF FUNDING

USE OF FUNDING	2012	2013	2014	2015	2016	2017	2018
Total	$9,164,448	$9,340,391	$47,517,751	$158,733,313	$146,884,361	$172,223,400	$153,712,881
Uncertain	$0	$0	$0	$0	$0	$0	$0
Business plan development, corporate set up, and proof of concept	$400,000	$1,900,000	$7,000,000	$0	$0	$0	$441,332
Introduction of product to the market and/or product refinement	$8,764,448	$7,440,391	$17,479,570	$49,750,000	$180,346	$964,632	$2,724,169
Scale up business and reach critical mass of customers	$0	$0	$13,258,230	$42,883,313	$44,828,456	$36,819,877	$54,061,278
Geographic expansion, add new products and/or make acquisition	$0	$0	$0	$15,100,000	$79,485,181	$37,936,940	$17,509,157
Bridge working capital needs including financing of consumer loans extended	$0	$0	$9,779,951	$48,500,000	$22,390,378	$96,501,950	$66,676,945
Refinancing existing liabilities	$0	$0	$0	$2,500,000	$0	$0	$12,300,000
Other	$0	$0	$0	$0	$0	$0	$0

Source: [70]

[69] GOGLA.
[70] GOGLA.

TABLE 31. GOGLA BREAKDOWN OF EAST AFRICA REGION FUNDING TYPES, TRANSACTIONS, BUSINESS MODEL, USE OF FUNDING AND FUNDING FLOW BY INVESTOR TYPE – FUNDING FLOW BY INVESTOR TYPE

FUNDING FLOW BY INVESTOR TYPE	2012	2013	2014	2015	2016	2017	2018
Total	$9,164,448	$9,340,391	$47,517,751	$158,733,313	$146,884,361	$172,223,400	$153,712,881
Crowdfunding	$0	$0	$0	$0	$1,143,902	$2,554,104	$20,062,280
Government including development finance institutions	$1,642,965	$5,125,826	$4,929,570	$23,383,313	$24,735,181	$57,154,050	$61,947,724
Strategic corporates	$0	$750,000	$0	$1,500,000	$0	$22,000,000	$0
For profit finance	$400,000	$1,564,565	$9,779,951	$2,500,000	$54,000,000	$34,000,000	$4,410,930
Family office/ foundation	$7,121,483	$0	$6,150,000	$54,100,000	$23,690,000	$1,406,940	$1,514,639
Impact finance	$0	$1,900,000	$26,658,230	$75,050,000	$36,965,378	$55,108,305	$38,167,710
Unknown	$0	$0	$0	$2,200,000	$6,349,900	$0	$27,609,598

Source: [71]

3.4 ACCESS TO FINANCE – MOBILE MONEY

The only regulated bodies in the country that can directly engage in mobile and agent banking are banks, MFIs, and insurance companies. Ethiopia is an outlier among its peers when it comes to usage of digital financial services. Only 0.3 percent of Ethiopians have a mobile money account, whereas 73 percent of Kenyans do. Similarly, no one in Ethiopia reported paying for a utility bill using a mobile phone account in a 2017 survey, while 82 percent of Kenyans had used this technology for this purpose.[72] Ethiopia is mostly a cash-based society due to low financial literacy, the government's heavy restrictions on the digital financial sector, and the unreliability of internet connectivity and electricity. Tables 32-40 provide details on mobile money companies operating in Ethiopia.

[71] GOGLA.

[72] The World Bank, "The Global Findex Database 2017."

TABLE 32. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: CBE BIRR	
Strategy	In-house system provided through CBE branches and agents
Transaction channels used	Unstructured Supplementary Service Data (USSD) and mobile application
Partner financial institutions	CBE
Services	Deposit, withdraw, transfer money, make payments, buy mobile airtime, and pay bill
Number of agents	6,000 agents, over 1,350 merchants
Signed up businesses	Dumblo online marketplace, OilLibya gas station, Ethiopian Airlines
Status	Active since early Dec. 2017
Able to transact in forex?	Yes
Interoperability	Not interoperable with the bank's core banking system or with other mobile money services.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 33. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: M BIRR (MOSS ICT CONSULTANCY)	
Strategy	Software as a service model of delivery to financial institutions Initial focus on MFI partnerships Channels include USSD, SMS, web
Transaction channels used	USSD
Partner financial institutions	Amhara Credit and Saving Institution, Oromia Credit and Saving Share Company , Dedebit Saving and Credit Institution, Addis Credit and Saving Institution , Omo Microfinance Institution, and Poverty Eradication and Community Empowerment MFI
Services	Transfer money, buy mobile top-up, pay bills, buy goods, repay loans, check balance, get a statement
Number of agents	7,000 (30% activity rate)
Signed up businesses	Total gas station, DSTV, Mekina.net (vehicle sales website), Ethio suq (online store), Lydetco, GreenScene, and Rensys (with Angaza and Mobisol platforms), Ethiopian Airlines
Status	Active since 2012
Able to transact in forex?	No
Interoperability	Not interoperable with core banking system of the MFI but is interoperable within M-Birr accounts of MFIs.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 34. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: HELLO CASH (BELCASH)	
Strategy	Network approach, with its own network and brand. Although partner banks own their agent locations, Hello Cash does its own marketing and sales
Transaction channels used	USSD and mobile application
Partner financial institutions	Lion Bank, Wegagen Bank
Services	Send cash, withdraw cash, bill pay, airtime purchase, business advisory services including agent management
Number of agents	7,000
Signed up businesses	Ze-lucy meter taxi, Selam Bus, Bishoftu town water bill payment, Ethiopian Airlines
Status	Active since 2015
Able to transact in forex?	Yes
Interoperability	Is interoperable with the bank's core banking system but not with other mobile money services or among the banks providing HelloCash services.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 35. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: AMOLE (FETTAN, DASHEN BANK)	
Strategy	Had worked on partnership with Safaricom (M-Pesa), but agreement fell apart.
Transaction channels used	USSD, mobile application and web-based platform
Partner financial institutions	Dashen Bank
Services	Utility bill payments, person-to-person transfers, electronic mobile top-up, cash-in and cash-out
Number of agents	3,000 merchants and 1,000+ agents
Signed up businesses	Hidasse Telecom, DStv, Shoa Supermarket, Lomi, ETTA, Zmall, Meda and, SamiDan Media, Ethiopian Airlines
Status	Launched July 2018
Able to transact in forex?	Yes
Interoperability	Not interoperable with the bank's core banking system or with other mobile money services.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 36. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: KIFIYA (KIFIYA FINANCIAL TECHNOLOGIES)	
Strategy	Focused on automating transactions Strong business development capabilities Claims to have a mobile payment platform
Partner financial institutions	None
Services	Monopoly' on utility payments through public-private partnership (PPP) with government, bus tickets, stadium ticketing, mass transit (WIP), crop insurance, airtime sales
Number of agents	50 bill payment collection centers (Addis Ababa, Bahir Dar, and Mekelle)
Signed up businesses	Addis Ababa, Bahir Dar, Mekelle; water, electricity and telecom bill payment, traffic fine payment, AA stadium, intra-region bus payments
Status	A number of operational projects
Able to transact in forex?	Have a pilot with Master Card to enable diaspora to pay utilities for someone living in Ethiopia
Interoperability	N/A

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 37. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: HIBIR (UNITED BANK)	
Strategy	In-house system provided through United Bank branches and agents
Transaction channels used	USSD
Partner financial institutions	United International bank SC
Services	Cash-in, cash-out, person-to-person money transfer, send cash to walk-in customer, receive cash by walk-in customer, money transfer between own accounts, bulk payment dispatch– business-to-people (for salary, remittance, etc.). Account opening /customer registration, account balance inquiries
Number of agents	460 agents
Signed up businesses	Ethiopian Airlines
Status	Active since 2015
Able to transact in forex?	Yes
Interoperability	Is interoperable with the bank's core banking system but not with other mobile money services.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 38. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: AWASH BANK MOBILE BANKING	
Strategy	In-house system provided through Awash Bank branches and agents
Partner financial institutions	Awash International bank
Services	Balance inquiry, exchange rate inquiries, money transfer, withdraw cash, money sending, and other services
Signed up businesses	Ethiopian Airlines
Status	Active since 2018
Able to transact in forex?	Yes
Interoperability	Is interoperable with the bank's core banking system but not with other mobile money services.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 39. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: YENE PAY	
Strategy	Account-based online payment platform for Ethiopian businesses to sell and collect payment electronically using web and mobile technologies.
Transaction channels used	Web platform
Partner financial institutions	Hello Cash, Amole, and CBE Birr
Services	Online payment for online purchase
Number of agents	N/A
Signed up businesses	Balesuq
Status	Active since 2016
Able to transact in forex?	Yes
Interoperability	Interoperability function being rolled out within the services that signed up with Yene Pay.

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

TABLE 40. MOBILE MONEY COMPANIES OPERATING IN ETHIOPIA: ZBIRR	
Strategy	Zeman Bank led, revenue share agreement with technology provider, partnership with EPS for agent locations
Services	Send cash, withdraw cash, bill pay, airtime purchase
Status	Never got off the ground
Services	Online payment for online purchase

Source: Global Findex Database 2017, information from company websites, in addition to interviews conducted by Power Africa in-country technical advisor

3.4.1 REMITTANCES

In 2017, remittance flows from around the world to low- and middle-income countries increased by an estimated 8.5 percent to reach $466 billion. Remittances are now more than three times the size of official development assistance. In sub-Saharan Africa, provisional numbers reached $38 billion in 2017 and are estimated at $41-43 billion in 2018 and 2019. However, remittance costs across many African corridors remain above ten percent, because of the low volumes of formal flows, inadequate penetration of new technologies, and the lack of a competitive market environment. In sub-Saharan Africa, Ethiopia ranks in the top five least expensive remittance corridors.[73]

Ethiopia has one of the largest first-generation diaspora populations from any African country, and between 2017 and 2018, the Ethiopian diaspora sent more than $5 billion in remittances through both formal and informal methods (National Bank of Ethiopia, 2018). In the United States, the largest communities of Ethiopian diaspora are located in Washington DC, Virginia, Maryland, California, Texas, Minnesota, and Colorado, with over half sending remittances monthly and annually to friends and family according to the International Organization for Migration.[74]

Because remittances from abroad are so important to the income of Ethiopian households, a team of dedicated solar companies and practitioners is championing remittance programs that can support rural households with gaining access to energy. Some potential components of such programs include:

- Creating a new platform to link remittances to clean energy products. Remittances are already used to pay for school fees, visas, mobile top-ups, bills, etc., but no program enables remittances to pay directly for clean energy.
- Enabling relatives in Ethiopia who do not necessarily have the resources to finance or to pay for a solar device to have access to it by providing a source of financing for products that may be generally out of their reach.
- Generating foreign currency. Remittances can be a way for a local importer or partner to access foreign currencies, and therefore accelerate the importation of solar products.
- Providing control to diaspora Ethiopians over where the money goes. By sending a solar product directly to a family member, the sender can avoid misuses of small amounts of money by relatives in Ethiopia.

For these programs to be successful, it is necessary to:

- Develop partnerships with platforms that enable the diaspora to pay via remittances, mobile money, and payment platforms.
- Understand the diaspora Ethiopians, how they pay and the modalities they use for payments, and remittances as well as to build an understanding of the opportunity and benefits of solar energy for their families.
- Identify partners who have a solid distribution network in Ethiopia to facilitate delivery and after-sale services to households.
- Ensure products are good quality (Lighting Global Certified), and to make sure that a warranty process is in place and is being implemented.

[73] The World Bank and Knomad, "Migration and Remittances: Recent Developments and Outlook."
[74] Williams, "Mapping of Ethiopian Diasporas Residing in the United States of America."

› Integrate IT systems of various partners to ensure smooth implementation. This could be accomplished by creating a new online platform for eCommerce that enables payments, oversees order placements, and keeps track of sender and beneficiary information. It could also be done by ensuring the partners (diaspora and local) have a communication tool in place to allow for flows of information and, eventually, payments.

3.5 MINI-GRIDS

3.5.1 MINI-GRIDS COMMERCIAL OVERVIEW

Table 41 details the two main companies in Ethiopia that develop mini-grids

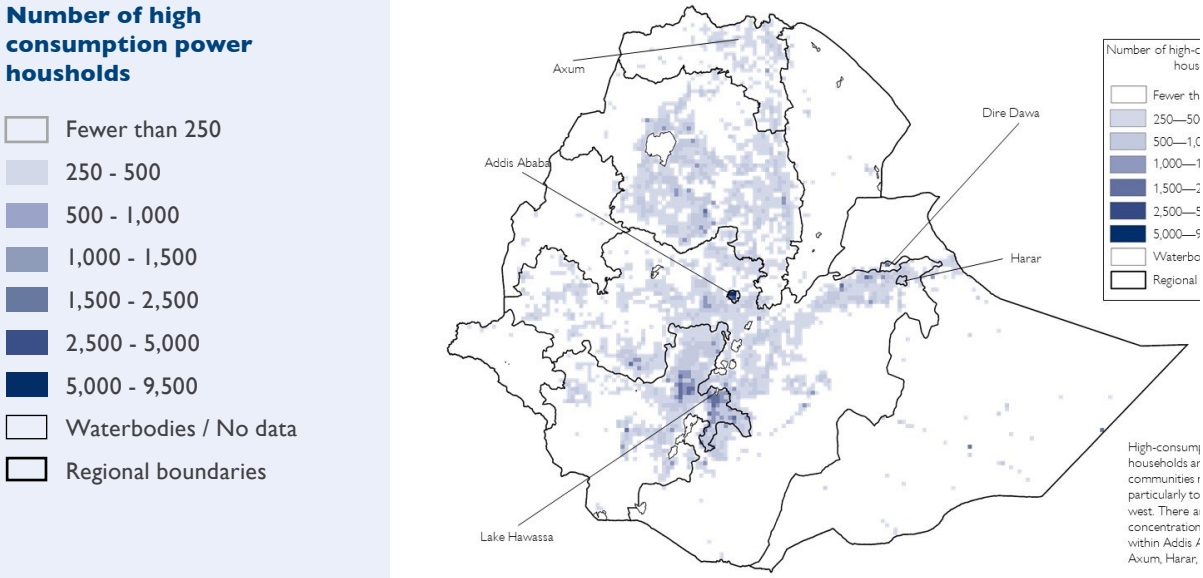
TABLE 41. COMPANY SNAPSHOTS FOR MINI GRIDS

COMPANY LOGO	YEARS OF OPERATIONS	REGIONS OF OPERATION	NUMBER OF MINI-GRIDS ON THE GROUND
Ethio Resource Group	2	Amhara	1
Rensys Engineering and Trading PLC	3	Amhara and Tigray	5 (1 running and 4 under construction)

Identifying Promising Locations for Mini-Grid Development

From the Power Africa geospatial analysis, the communities with high concentrations of high consumer power households that are beyond 10 km from medium voltage grid lines may be particularly attractive sites for mini-grids. These are communities where grid expansion is less likely to occur, or where expansion of the national grid may not be completed for several years. They also have large concentrations of households with high discretionary spending. These characteristics signal a promising consumer market for mini-grid electricity. A number of woredas were identified where such communities exist, with at least 2,000 households that are beyond 10 km from the medium voltage network, and with concentrations of households that lack electricity access but have discretionary spending greater than $660 annually.

FIGURE 5. NUMBER OF HIGH CONSUMER POWER HOUSEHOLDS PER 10KM^2

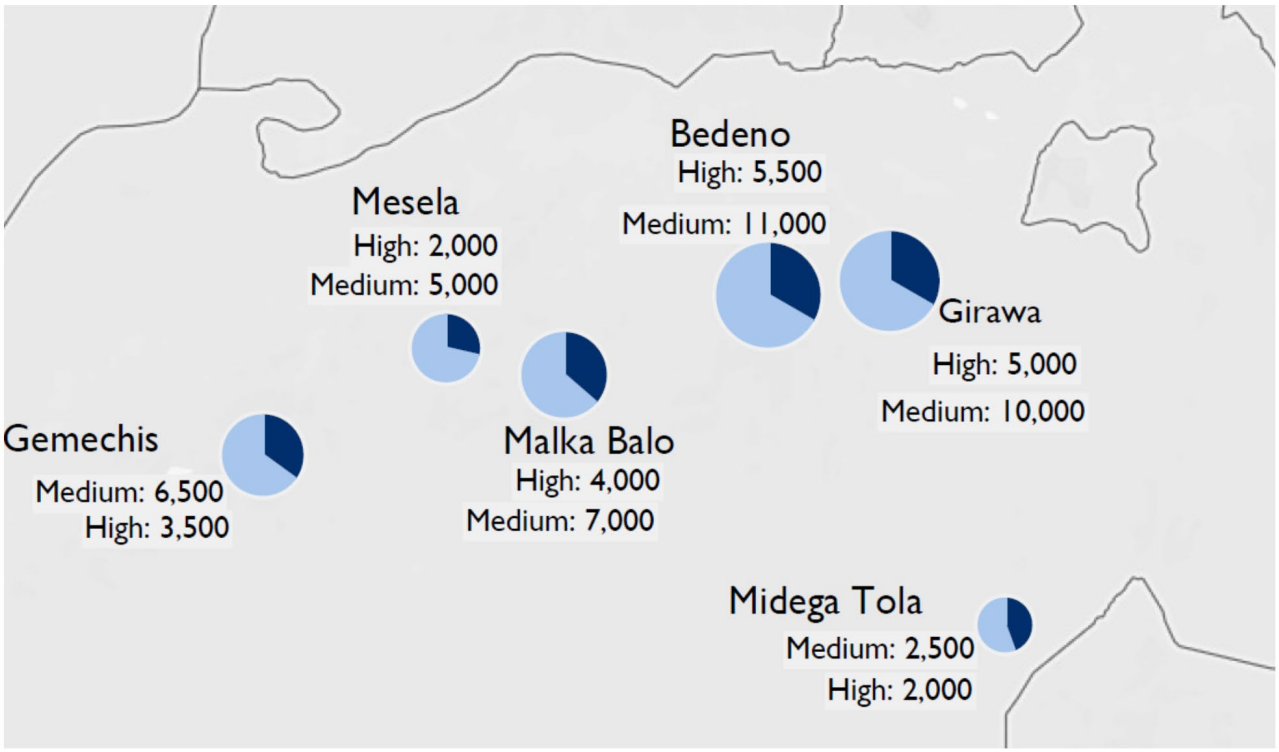


Source: Power Africa Geospatial Analysis 2019

High-consumption power households are concentrated in communities near Lake Hawassa, particularly to the south and west. There are also concentrations of communities within Addis Ababa, and near Axum, Harrar, and Dire Dawa

The woredas of Bedeno, Gemechis, Girawa, Malka Balo, Mesela, and Midega Tola are in eastern Oromia (Figure 6). These woredas contain communities far from the medium voltage network and with high concentrations of households with high consumer power. Further graphic depictions of zones and their different levels of consumer power can be found in Annex A.

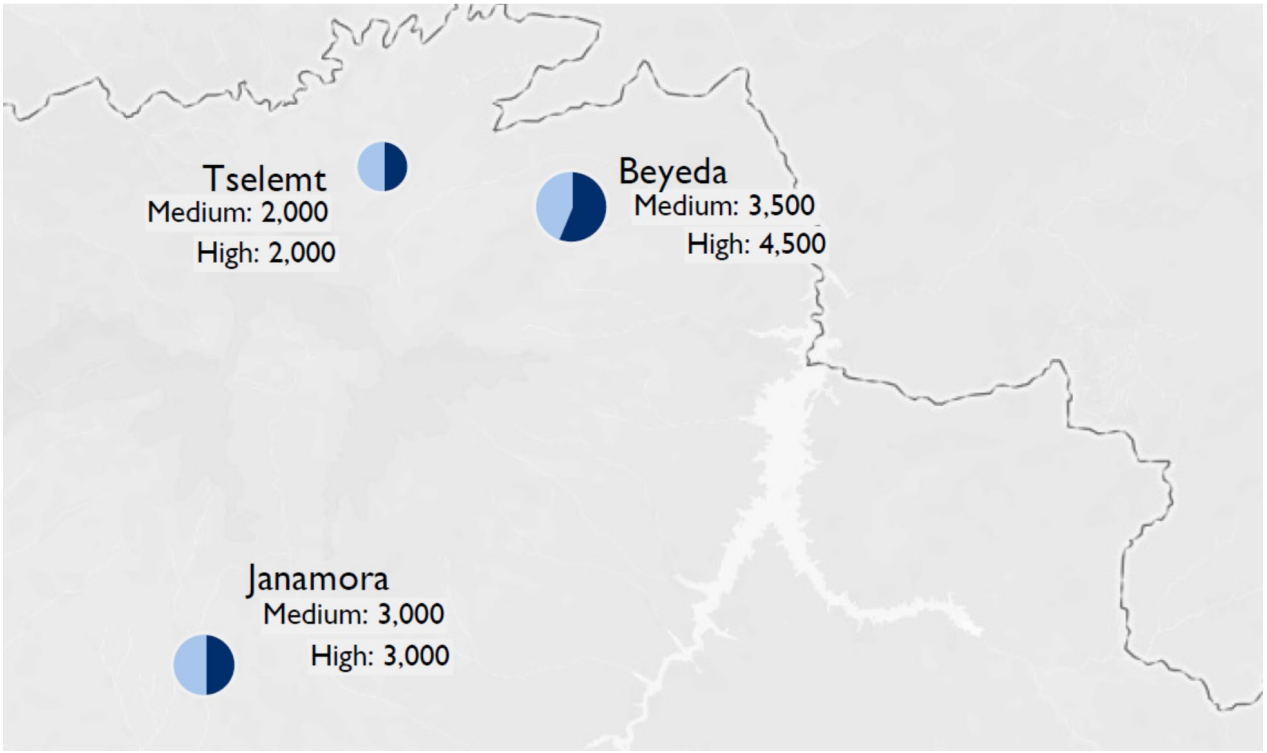
FIGURE 6. NUMBER OF HIGH AND MEDIUM CONSUMER POWER HOUSEHOLDS IN AMHARA WOREDAS



Source: Power Africa Geospatial Analysis 2019

The woredas of Beyeda, Janamora, and Tselemt, located in northern Amhara, are a few areas that have high concentrations of households beyond 10 km from the medium voltage line (Figure 7). These woredas contain promising communities for mini-grid development.

FIGURE 7. NUMBER OF HIGH AND MEDIUM CONSUMER POWER HOUSEHOLDS IN AMHARA WOREDAS



Source: Power Africa Geospatial Analysis 2019

3.5.2 MINI-GRID GAPS AND BARRIERS

Table 42 outlines various gaps and barriers that inhibit market growth for the mini-grid sector in Ethiopia as well as potential solutions to overcome these challenges.

TABLE 42. GAPS AND BARRIERS ANALYSIS FOR MINI GRIDS

GAPS/BARRIER	REASON	POTENTIAL SOLUTIONS
Policy and Regulations	Ethiopia has taken good steps toward engaging private sector mini-grid companies to boost the pace of electrification in off-grid areas, such as adoption of the Energy Regulations by the Council of Ministers. Two important documents have been developed as a follow-up of the Energy Regulations but have yet to be adopted: The Directive for Off-grid and Tariff Methodology Guidelines. Site allocation: Both competitive bidding and unsolicited application are allowed, though there is no provision for a provisional authorization to ease feasibility studies and project development. Licensing process is clear but still cumbersome, and clarity is needed on service exclusivity within the allocated area for systems below 50 kW.	Finalize and adopt both the Directive for Off-grid and Tariff Methodology Guidelines. Implement a more light-handed licensing. Develop a process for systems below 50 kW. Mini-grid regulations should provide an opportunity for a time-limited provisional license. Encourage the GOE to clarify the source of funding to incentivize mini-grid companies to invest.

GAPS/BARRIER	REASON	POTENTIAL SOLUTIONS
	Tariff guidelines have a provision for subsidies but there is no clear source of funding; GOE has to work with development partners to design a facility that is transparent and provides incentives to EEU and private mini-grids developers on an equitable and sustainable manner, particularly when encouraging the application of the national average electricity tariff.	
Duties and taxes	Exemptions are not well defined for solar products.	Encourage: Updated tax regulations to include solar product and component exemptions. Clarity on items eligible for taxes and duty exemption. Clarity on the level of exemption to be granted per item type.
Capacity building	The development of skills to support the off-grid sector remains a crucial challenge in local communities.	Encourage companies installing the renewable energy systems, NGOs, academia, and local associations to play a crucial role in this area.
Lack of forex	The country's negative trade balance jeopardizes the availability of forex funding to import solar systems into the country.	Work on creative ways to bring in directed forex for solar companies and link the private sector with local programs that enable the supply of forex loans.
Closed trade system	The country does not allow foreign companies to be involved in distribution of solar systems, making it difficult to support international vertically integrated companies to come into the Ethiopian market.	Support companies to set up their business in a more creative way to ensure international supply.

Note: Information provided by the Power Africa technical advisory team

3.5.3 MINI-GRID POLICIES AND REGULATIONS

Table 43 details policies and regulations that pertain to the mini-grid sector.

TABLE 43. MINI GRID POLICIES AND REGULATIONS

POLICY, PLANS AND REGULATIONS	DESCRIPTION
NEP 2.0[75]	Aims for 100% electrification through on- and off-grid solutions by 2025. 35% electrification from stand-alone solar and mini-grid solutions.
National Energy Policy[76]	National Energy Policy, 2013

[75] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report."
[76] National Energy Policy, "Ethiopian National Energy Policy."

POLICY, PLANS AND REGULATIONS	DESCRIPTION
Electricity regulations	Council of Ministers Regulation No. 308/2014: establishes EEA.[77] Electricity Operations Regulation No. 49/1999: sets standards for licensing, standards, and tariffs.[78] Energy Proclamation 810/2013: establishes Energy Efficiency and Conservation Fund; establishes powers of EEA; establishes requirements and competencies for electricity generation, transmission, and distribution.[79] National Electricity Transmission and Distribution Grid Code, 2016[80] PPP Proclamation No. 1076/2018: MOWIE is on the PPP Board.[81] Licensing related to mini-grids is under development by the EEA, but currently all off-grid energy companies have to go through the EEA licensing process, which can be a long and bureaucratic process (wait times may be 6 months to 1 year).
Tax and import regulations	The Ministry of Finance and Economic Development had an MOU in 2010 that allowed Lighting Africa-certified products to be imported duty-free. This continues to apply, however, it is not uniformly implemented and lacks clarity . No official regulation exists; the MOU applies to all solar products but is applied inconsistently to components that are imported as parts of SHS.
Financial regulations	A National Financial Inclusion Strategy was launched in April 2017.
Quality control standards/ regulations	CES 140:2015 Off-grid solar PV lighting kits—requirements. ECAE is responsible for ensuring adherence and testing for any standards developed by the Ethiopia Standards Agency. ECAE has a solar laboratory at its site that allows for the testing of a range of solar products; it can take 4–7 days for testing. Testing of shipments containing solar products is done by ECAE at the behest of the Ministry of Trade. This process has been undergoing revisions and is not yet well-defined.
Mobile payment regulations	Mobile and Agent Banking Regulations were published in 2012, outlining a financial institution-led policy. Technology service providers must partner with a financial institution to provide e-wallet services. Final draft of the Electronic Fund Transfer Directive by the NBE was circulated in 2017 and adopted. eCommerce law allowing for e-signatures and electronic receipts is yet to be passed.
Environmental regulations	Investment Proclamation 769/2012: establishes the responsibility of the investor to follow all Ethiopian environmental protection laws and the responsibility of Ethiopian Investment Board to approve all environmental impact assessment studies.
E-waste Regulations	None exist.

[76] Council of Ministers, "Regulation No. 308-2014."
[77] Council of Ministers, "Regulation No. 49-1999."
[78] Council of Ministers, "Energy Proclamation No. 810/2013."
[79] Ethiopian Energy Authority, "Ethiopia National Electricity Transmission Grid Code."
[80] "Public Private Partnership Proclamation No. 1076/2018."
[81] ODI, "Accelerating Access to Electricity in Africa with Off-Grid Solar."
[82] National Bank of Ethiopia, "Ethiopian National Financial Inclusion Strategy."
[83] CLASP, "Https."
[84] Ethiopia Conformity Assessment Enterprise, "HOME - ECAE."
[85] National Bank of Ethiopia, "Regulation of Mobile and Agent Banking Services."
[86] Federal Democratic Republic of Ethiopia, "Investment Proclamation No. 769-2012," 769–2012.

3.6 PRODUCTIVE USE

Priority Agriculture Areas for Off-Grid Interventions

The agricultural sector remains dominant in the Ethiopian economy and is an important source of economic growth. Although there is an ongoing structural transformation in the Ethiopian economy—predominantly from agriculture, services and manufacturing— agriculture still comprises about 40 percent of total GDP and continues to dominate employment, with 78 percent of the population employed in agricultural activities.[88]

According to NEP 2.0, the World Bank is supporting an approach under the Agriculture Growth Program II project, which supports the identification of high-potential cluster areas based on the following criteria:

- Access to markets (cities of 50,000 population or over in less than five hours
- Natural resource endowment (factors to consider are good rainfall distribution with annual average of 700 mm or over)
- Suitable rainfall and soil for crop and fodder production
- Potential for development of small-scale irrigation facilities
- Institutional plurality of service providers, including good basis and growth of viable cooperatives and farmer groups, and existing partnership engagements with the private sector
- Willingness and commitment to participate (supportive environment, performance of programs supported by other donors)
- Woreda clustering as a criterion for selection to develop synergies for growth.[89]

3.6.1 PUE COMMERCIAL OVERVIEW

Table 44 provides details on three of the most active off-grid companies that offer PUE solutions.

TABLE 44. COMPANY SNAPSHOTS FOR PRODUCTIVE USE

COMPANY LOGO	YEARS OF OPERATIONS	REGIONS OF OPERATION	TYPES OF PRODUCTIVE USE APPLIANCES SOLD	EXPANSION PLANS
Lydetco	18	Amhara, Tigray, Oromia, SNNP	Solar pumps	More involvement in solar pumps and cold chains
SOLAR DEVELOPMENT	10	Amhara, Tigray, Oromia, SNNP	Solar pumps	More involvement in solar pumps and cold chains
Acme Engineering	15	Amhara, Tigray, Oromia, SNNP	Solar pumps	More involvement in solar pumps

Note: Information provided by the Power Africa technical advisory team

[88] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report."
[89] National Electrification Program 2.0.

The Ethiopian government is taking a cluster approach to enhance agricultural transformation. This initiative is called the Agricultural Commercialization Clusters (ACC). The ACC Initiative contains clearly defined geographic clusters specializing in priority commodities across the four major agricultural regions of the country: Amhara, Oromia, SNNP, and Tigray. These ACC clusters are intended to act as Centers of Excellence, where regions will be supported to maximize production and productivity while integrating commercialization activities. These clusters therefore are meant to serve as models for learning as Ethiopia intensifies the ACC approach and scales up best practices across the country. In parallel, many regions have begun to replicate the model across other geographies and commodities.[90]

A rigorous, three-step process was undertaken to identify and prioritize the clusters: (i) identification of primary and priority commodities where Ethiopia has a comparative advantage, (ii) identification of appropriate woreda groupings for these commodities that could be "clustered," and (iii) final woreda selections based on additional market factors. To collect data necessary both for planning and monitoring achievements in the ACCs, a comprehensive baseline study was commissioned by the International Food Policy Research Institute. Nine priority crop commodity value chains have been identified for focus by the ACC Initiative in the last two years of GTP II: wheat, maize, sesame, malt barley, and horticulture crops—tomato, onion, banana, mango, and avocado. This prioritization of crops has been laid out on a map and shared with relevant stakeholders interested in working on agricultural value chains.

This information is particularly important for the energy sector because it points out where water intensive crops are produced throughout the country impacting business strategies of water pump importers. If this area prioritization can be coupled up with other available information such as shallow ground and surface water availability as well as soil type analysis in each area, it would steer the marketing strategies of productive use appliance producers/assemblers/importers in the right way. It should be noted that all of this information is available from government partners working in the agriculture and water sectors.

3.6.2 PRODUCTIVE USE APPLICATIONS FOR HOUSEHOLDS THAT ARE DEPENDENT ON NON-GRID LIGHTING SOURCES

Half of Ethiopians in households dependent on non-grid lighting sources work in agriculture, and 85 percent of them hold agricultural land. Among these farming households, the major crop grown is maize, which is grown by 65 percent of households, while 45 percent grow teff, 40 percent grow sorghum, 35 percent grow wheat, and 30 percent grow coffee.[91]

Households that grow agricultural products that require some amount of processing, such as milling teff and wheat or drying coffee beans, could see increased productivity with solar systems that provide electricity for mills.

Irrigated agriculture is uncommon in Ethiopia. Only about 10 percent of farming households dependent on non-grid lighting sources practice irrigated agriculture, compared to about 15 percent of farming households that get electricity from the national grid. Of all households dependent on non-grid lighting sources that practice irrigation, half use river and stream diversions, while 25 percent of these households irrigate using pressure, or hand pumps, and only 13 percent use motorized pumps. Farming households that do not irrigate, as well as those farming households that irrigate using things other than motorized pumps, offer significant markets for solar irrigation schemes.

[90] ATA, "Agricultural Commercialization Clusters (ACC)."

[91] Farming households are defined as households that reported growing any crops.

Roughly a quarter of households dependent on non-grid lighting sources operate a non-farm enterprise, compared to 46 percent of households that get electricity from the national grid. This suggests significant potential for productive use. This is true across different types of households dependent on non-grid lighting sources.

In households with modest consumer power, one in four operate a non-farm enterprise and more than one-third of medium and high consumer power households operate non-farm enterprises.[92]

There are several government and development partners working on productive use: ATA's solar irrigation pilot project will install 160 solar pumps in the Amhara, Oromia, SNNP, and Tigray regions; the USAID Lowland Water, Sanitation, and Hygiene (WASH) project is working on developing pump standards with the Ethiopian government; and a mini-grid pilot led by the EEU will integrate productive use pilots.

3.6.3 PRODUCTIVE USES OF ENERGY

Solar Irrigation Pumps

Solar irrigation improves production, productivity, and income over rainfed agriculture. Some of the suppliers involved in solar pumps in Ethiopia include Davis and Shirtfiff, Lorentz, Grundfos, Futurepump, and Pedrollo among others.

Solar Cooling Systems

There are solar cooling system products being sold and supplied by several companies in Ethiopia; however, the cooling value chain is limited to short distances. Local value chains with households and businesses rely more on local green markets, fresh food, and purchasing for daily needs.

Potential Market

There is a potential market for productive use of energy (PUE) products in Ethiopia. Solar pumps and cooling systems are among the products with the most potential. The poultry value chain also holds a lot of promise—Ethiopia's rapidly growing population needs nutrient-rich food, and eggs and chickens provide significant dietary protein. Energy is needed to incubate eggs, lighting and heating are needed to house broiler chickens, grinders are needed for the chicken feed, refrigeration is necessary for some chicken vaccinations, and electricity is needed for larger processing and cooling and freezing for already processed meat. Other opportunities for processing include hulling and cleaning seeds, and processing oils such as sesame seed oil and flaxseed oil—both are in high demand globally.

3.6.4 PUE GAPS AND BARRIERS

Table 45 outlines various gas and barriers that inhibit market growth for the pico-solar sector in Ethiopia as well as potential solutions to overcome these challenges.

[92] Households grouped by consumer power only include households dependent on non-grid lighting sources.

TABLE 45. GAPS AND BARRIERS ANALYSIS FOR PRODUCTIVE USE		
GAPS/BARRIER	**REASON**	**SOLUTIONS**
Policy and regulations	Inadequate policy and regulations to support renewable energy technologies.	Finalize renewable energy policy and support the development of standards set for productive use appliances.
Duties and taxes (issues related to regulation implementation)	Even though solar products have been exempted from taxation, it is still difficult for the customs officers to identify these products to allow for the exemptions on importation.	Build capacity of customs officers to understand tax regulations on solar products, support the certification of solar pumps, and create awareness in the sector on product tax issue implementation.
Capacity building	The development of skills to support the off-grid sector remains a crucial challenge in local communities.	Encourage companies installing the renewable energy systems, NGOs, academia, and local associations play a crucial role in this area.
Lack of forex	The country's negative trade balance makes forex funding to import solar systems into the country unavailable.	Work on creative ways to bring in directed forex for solar companies and link the private sector with local programs that enable the supply of forex loans.
Closed trade system	The country does not allow foreign companies to be involved in the distribution of solar systems, making it difficult to support international vertically integrated companies to come into the Ethiopian market.	Support companies to set up their business in a more creative way to ensure international supply.
Financing	Inadequate financing mechanisms to smallholder farmers due to the high-risk nature of some of the PUE products, such as solar pumps.	Sensitize MFIs and financial institutions to understand PUE products and reduce the perceived high risk associated with the products.

Note: Information provided by the Power Africa technical advisory team

3.7 PUE POLICIES AND REGULATIONS OVERVIEW

Table 46 details policies, plans, and regulations that pertain to the PUE sector.

TABLE 46. PUE POLICIES AND REGULATIONS OVERVIEW	
POLICY, PLANS AND REGULATIONS	**DESCRIPTION**
NEP 2.0[93]	Aims for 100% electrification through on- and off-grid solutions by 2025. Rapid assessment of productive uses location and electricity needs to inform the design of mini-grid sites for the piloting of the mini-grid program.
National Energy Policy[94]	National Energy Policy 2013 includes demand-side policy objectives and instruments for industry and agriculture among other service sector institutions.

[93] National Electrification Program 2.0, "Ethiopia National Electrification Program 2.0 Report."

[94] National Energy Policy, "Ethiopian National Energy Policy."

TABLE 46. PUE POLICIES AND REGULATIONS OVERVIEW (CONTINUED)	
POLICY, PLANS AND REGULATIONS	**DESCRIPTION**
Electricity regulations	Council of Ministers Regulation No. 308/2014: establishes EEA. Electricity Operations Regulation No. 49/1999: sets standards for licensing, standards, and tariffs. Energy Proclamation 810/2013: establishes Energy Efficiency and Conservation Fund; establishes powers of EEA; establishes requirements and competencies for electricity generation, transmission, and distribution. National Electricity Transmission and Distribution Grid Code, 2016. PPP Proclamation No. 1076/2018: MOWIE is on the PPP Board.
Tax and import regulations	The Ministry of Finance and Economic Development had an MOU in 2010 that allowed Lighting Africa-certified products to be imported duty-free. This continues to apply; however, it is not uniformly implemented and lacks clarity. No official regulation exists; the MOU applies to all solar products but is inconsistently applied to components that are imported.
Financial regulations	A National Financial Inclusion Strategy was launched in April 2017.
Mobile payment regulations	Mobile and Agent Banking Regulations were published in 2012, outlining a financial institution-led policy. Technology service providers must partner with a financial institution to provide e-wallet services. Final draft of Electronic Fund Transfer Directive by the NBE circulated in 2017 and adopted. eCommerce law allowing for e-signatures and electronic receipts is yet to be passed.
Environmental regulations	Investment Proclamation 769/2012: establishes the responsibility of investors to follow all Ethiopian environmental protection laws and the responsibility of the Ethiopian Investment Board to approve all environmental impact assessment studies.
E-waste Regulations	None exist.

Note: Information provided by the Power Africa technical advisory team

3.8 PUE FINANCING OVERVIEW

According to the ATA Rural Financial Services Strategy, there is an unserved part of the population named the "missing middle" that is not able to access loans from many of the financial institutions outlined in Section 3.3. This presents an opportunity for an intervention in the market. As the formal financial sector has been unable to serve the needs of small and medium enterprises and the rural population, specific financing for non-commercial PUE products would help rural populations.

As the above analysis shows, the Ethiopian finance sector consists of a group named the "missing middle" that has low access to any kind of financing. These institutions or sizes of loans are too small for commercial banks and too big for MFIs and SACCOs to lend to. They are usually higher finance demanders with mid-term repayment periods. Productive use appliance customers could be grouped into this category depending on the loan size they require. Even though this requires an in-depth analysis, this could indicate that the Ethiopian finance sector might find it difficult to finance borrowers for productive use in off-grid areas.

4 GENDER MAINSTREAMING

The National Energy Policy 2013 considers women's energy-related needs and participation in the energy sector.[95] The policy recognizes the link between gender and energy and contains a separate section to address gender issues. The objective is to ensure that women participate in, and benefit from, energy sector programs and projects. Women are explicitly recognized as participants in energy planning as well as beneficiaries. A number of measures are outlined in the policy such as enhancing women's access to modern energy services, improving women's participation in energy programs, facilitating women's participation in relevant decision-making, introducing modern energy appliances in households, collecting gender-disaggregated information, facilitating credit for women, and raising awareness of energy efficient technologies.

All government ministries in Ethiopia are required to mainstream gender according to the National Gender Mainstreaming Guidelines.[96] The Ministry of Women, Children, and Youth Affairs supports all ministries in this respect. There is also a gender focal point in MOWIE.

The GOE has outlined several measures for gender equality in the 2019 National Electrification Program 2.0, which were informed by the World Bank's gender analysis of the energy sector in Ethiopia (NEP 2.0).

The DBE has mapped barriers and opportunities for women entrepreneurs with respect to access to finance. Based on the mapping, it has taken specific actions to ensure that women entrepreneurs are able to access, and benefit from, the $45 million Market Development for Renewable and Energy Efficient Product Credit Line.

The DBE has collaborated with the World Bank, the IFC, and the Ethiopia Climate Innovation Center to inform women's business associations and women entrepreneurs, such as the Ethiopian Chamber of Commerce, Alliance of Women Enterprise Program, and the Association of Women in Business, about the opportunities available in the off-grid sector. Technical assistance, provided to MFIs, including training, engaged in consumer finance aspects of off-grid energy under the DBE credit line. This technical assistance specifically considered reaching more women in the off-grid sector by using financing solutions. For example, a possible solution considered under the NEP 2.0 is using a "priority window" for women entrepreneurs to reduce loan processing times and requirements.

The NEP 2.0 indicates that specific measures will be taken to promote opportunities for women's employment in the off-grid sector. These include working with local vocational training institutions to train women solar technicians and electrical engineers, and capacity building for women entrepreneurs as well as small and medium enterprises to participate in the value chain, including as last-mile retailers.

Women are also given explicit consideration under the NEP 2.0 in demand creation, marketing, and affordability, recognizing that current financial products and business models have had a limited reach in promoting the uptake of off-grid energy products by women. The communication and education campaign envisioned under the NEP 2.0 will target women, including through savings groups, to promote new customers for household and productive use.

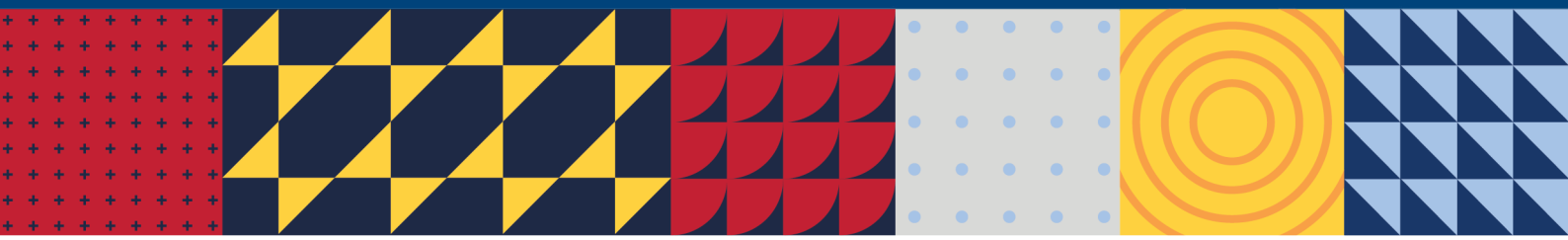
[95] National Energy Policy.

[96] Ministry of Women's Affairs, "National Gender Mainstreaming Guidelines."

GENDER MAINSTREAMING EXAMPLE

Solar Development PLC is implementing a project with CARE Ethiopia to distribute solar lanterns in rural areas. The program employs women in need of alternative economic sources. The objective of this project is to empower women though economic empowerment. CARE organized four powerful suppliers in Ethiopia that do wholesale and retail of -fast moving consumer goods and solar products so women in rural Ethiopia can distribute the products to people in the areas they live and can benefit from the profits. This project has been designed in a way that promotes sustainability by making sure no direct financing goes to the women. It supports women by linking them with suppliers, building their business skills though training, and providing follow up support when needed. This project currently addresses two regions with solar products and has recruited more than 300 women agents with plans to expand to 500 agents. Solar Development, one of the suppliers for these women, focuses on providing consistent supplies of solar lanterns and product training. This project mainly focuses on women in households headed by men and aims to reach beyond its original objectives. The impact of empowering women in these households reaches beyond these women and changes the lives of their entire family and community. According to Solar Development, these women have proven to be reliable distribution partners in some areas of Ethiopia. This project also helps Solar Development to cultivate a better reputation with regional governments, as their focus has been social impacts in their regions.

Source:[97]



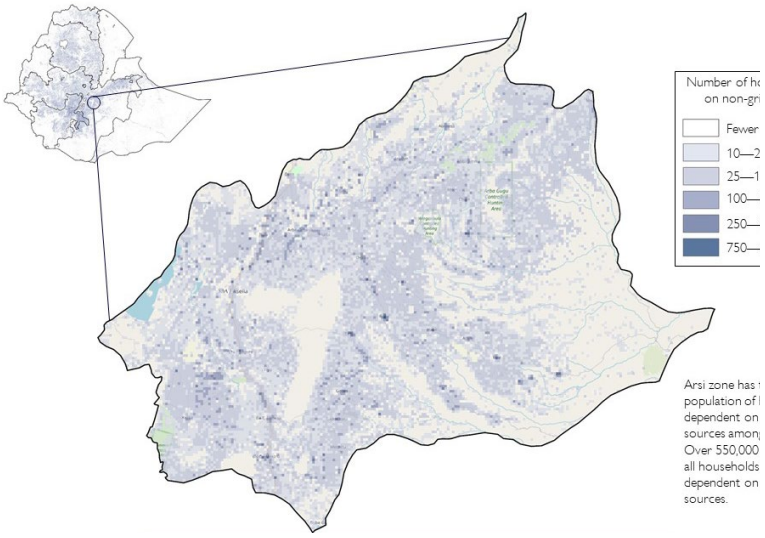
[97] Little Sun, "Light and Livelihood for Women in Ethiopia with Little Sun and Solar Development."

ANNEX A GEOSPATIAL ANALYSIS FIGURES

FIGURE A-1: NUMBER OF HOUSEHOLDS DEPENDENT ON NON-GRID LIGHTING PER KM^2 IN ARSI ZONE[98]

Number of households dependent on non-grid lighting sources

- Fewer than 10
- 10 - 25
- 25 - 100
- 100 - 250
- 250 - 750
- 750 - 850



Source: Power Africa Geospatial Analysis 2019

Arsi Zone Characteristics	
Total households	800,000
Modest consumption power households	330,000
Medium comsumption power households	125,000
High consumption power households	75,000
Non-grid lighting households within 10 km of power lines	525,000

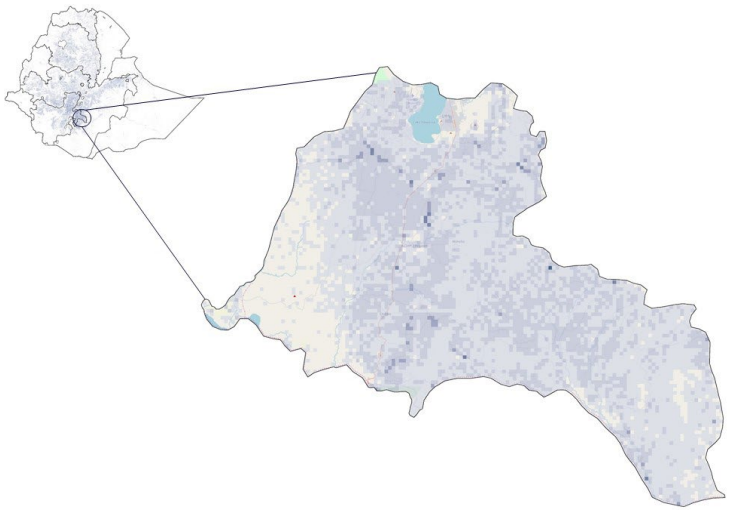
Arsi zone has the third largest population of households dependent on non-grid lighting sources among Ethiopian zone, Over 550,000 families, or 70% of all households in Arsi zone, are dependent on non-grid lighting sources.

[98] Areas with fewer than 10 households are excluded. Households grouped by consumer power only include households dependent on non-grid lighting. Source: Power Africa Geospatial Analysis 2019.

FIGURE A-2: NUMBER OF LOW CONSUMER POWER HOUSEHOLDS PER KM^2 IN SIDAMA ZONE[99]

Number of modest consumption households

- Fewer than 10
- 10 - 25
- 25 - 100
- 100 - 250
- 250 - 750
- 750 - 850



Source: Power Africa Geospatial Analysis 2019

Sidama Zone Characteristics	
Total households	1,000,000
Modest consumption power households	370,000
Medium comsumption power households	120,000
High consumption power households	70,000
Non-grid lighting households within 10 km of power lines	575,000

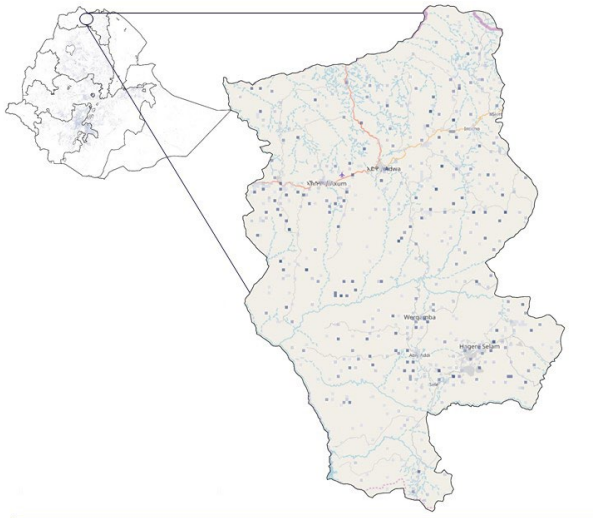
Sidama zone has the second largest population of households dependendent on non-grid lighting sources among Ethiopian zones, and the largest population of low consumption power households. Nearly 600,000 families or about 60% of all households in Sidama zone, are dependent on non-grid lighting sources.

[99] Areas with fewer than 10 households are excluded. Households grouped by consumer power only include households dependent on non-grid lighting. Source: Power Africa Geospatial Analysis 2019.

FIGURE A-3: NUMBER OF MEDIUM CONSUMER POWER HOUSEHOLDS PER KM^2 IN MEHAKELEGNAW ZONE[100]

Number of medium consumption households

- Fewer than 10
- 10 - 25
- 25 - 50
- 50 - 75
- 75 - 150
- 150 - 200



Source: Power Africa Geospatial Analysis 2019

Mehakelegnaw Zone Characteristics	
Total households	350,000
Modest consumption power households	120,000
Medium comsumption power households	50,000
High consumption power households	30,000
Non-grid lighting households within 10 km of power lines	220,000

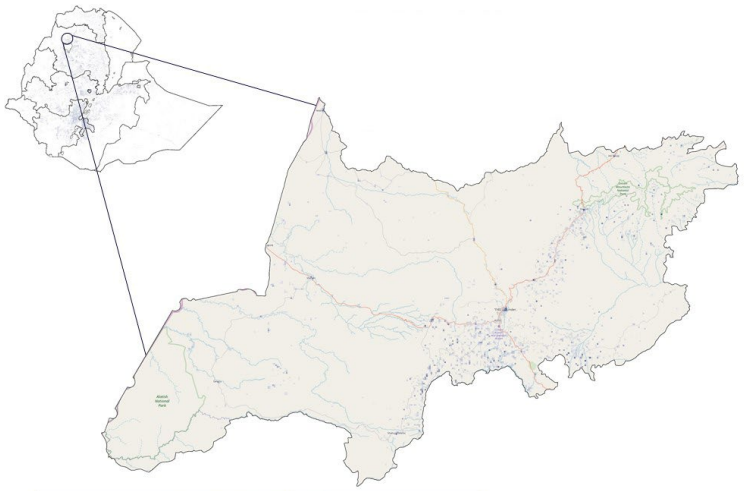
Mehakelegnaw zone has the largest population of households dependent on non-grid lighting sources in Tigray. About 65% of all households in Mehakelegnaw zone are dependent on non-grid lighting sources. Medium consumption power households are mostly concentrated in Adwa, Axum, and Hagere Selam, but there are also smaller communities to the west of Axum and south of Inticho with high concentrations of these target households as well.

[100] Areas with fewer than 10 households are excluded. Households grouped by consumer power only include households dependent on non-grid lighting. Source: Power Africa Geospatial Analysis 2019.

FIGURE A-4: NUMBER OF HIGH CONSUMER POWER HOUSEHOLDS PER KM^2 IN NORTH GONDAR ZONE[101]

Number of high consumption households

- Fewer than 10
- 10 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 175



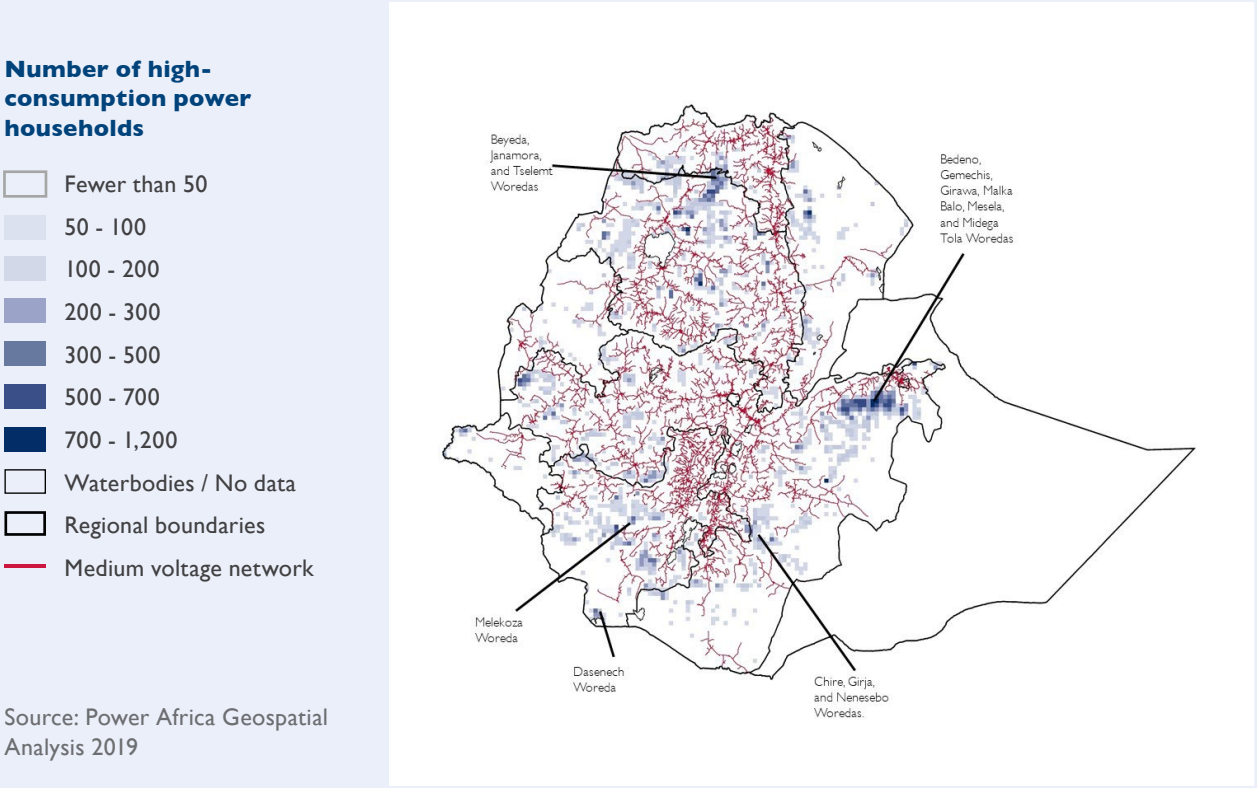
Source: Power Africa Geospatial Analysis 2019

Semen Gondar Zone Characteristics	
Total households	840,000
Modest consumption power households	330,000
Medium comsumption power households	115,000
High consumption power households	95,000
Non-grid lighting households within 10 km of power lines	400,000

Semen Gondar zone has the largest population of households dependent on non-grid lighting sources, and the most high-consumption target households. These households are concentrated in cities like Gondar, Debark, and Adi Arkay. Over 600,000 families, or 75% of all households in North Gondar are dependent on non-grid lighting sources.

[101] Areas with fewer than 10 households are excluded. Households grouped by consumer power only include households dependent on non-grid lighting. Source: Power Africa Geospatial Analysis 2019.

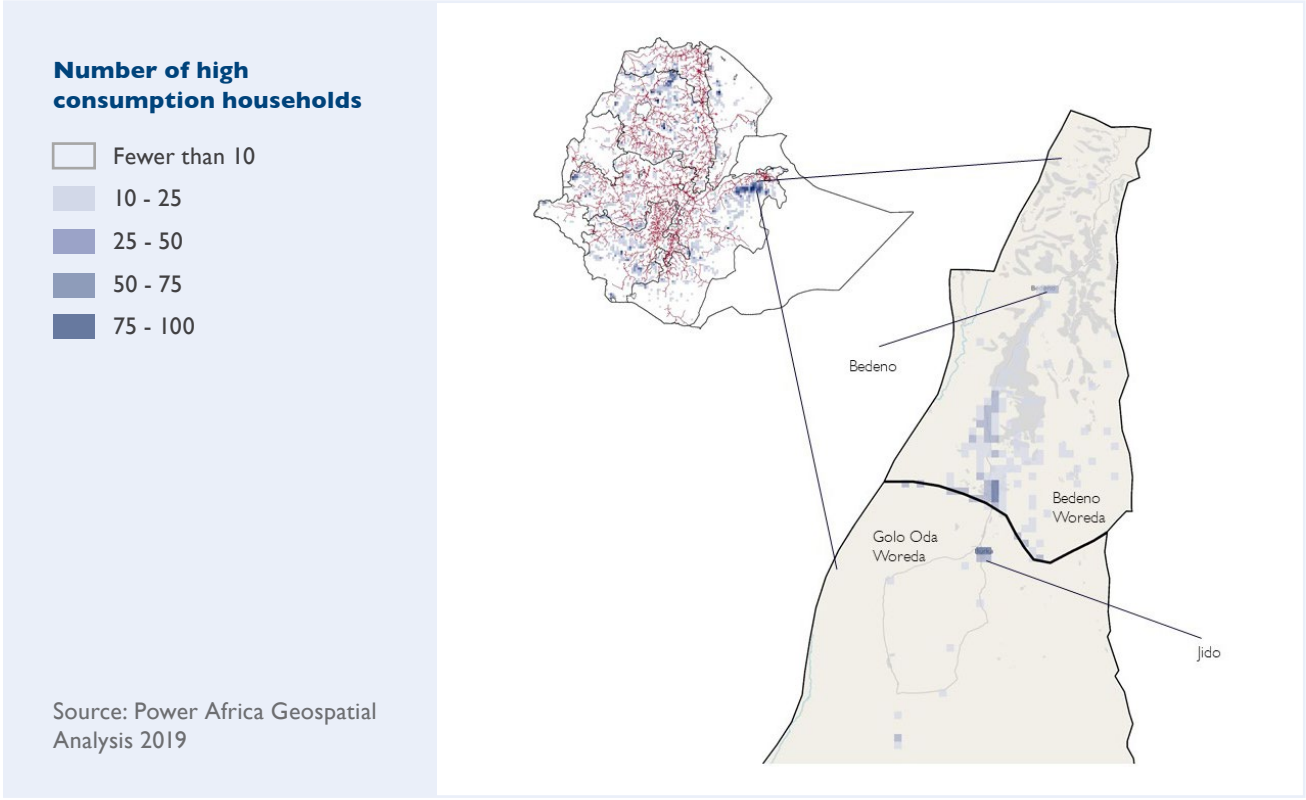
FIGURE A-5: NUMBER OF HIGH CONSUMER POWER HOUSEHOLDS PER 10 KM^2 THAT ARE FURTHER THAN 10 KM FROM THE MEDIUM VOLTAGE NETWORK[102]



Mini-grids would be particularly useful in woredas that are far from the medium voltage network, and that have high concentrations of households with high consumption power. These are just a few examples of possible areas to develop mini-grids

[102] Map shows the number of households dependent on non-grid lighting sources with high consumer power per 10 km^2. Areas with fewer than 50 of these households per square kilometer are shown in gray; water bodies are shown in white. Source: Power Africa Geospatial Analysis 2019.

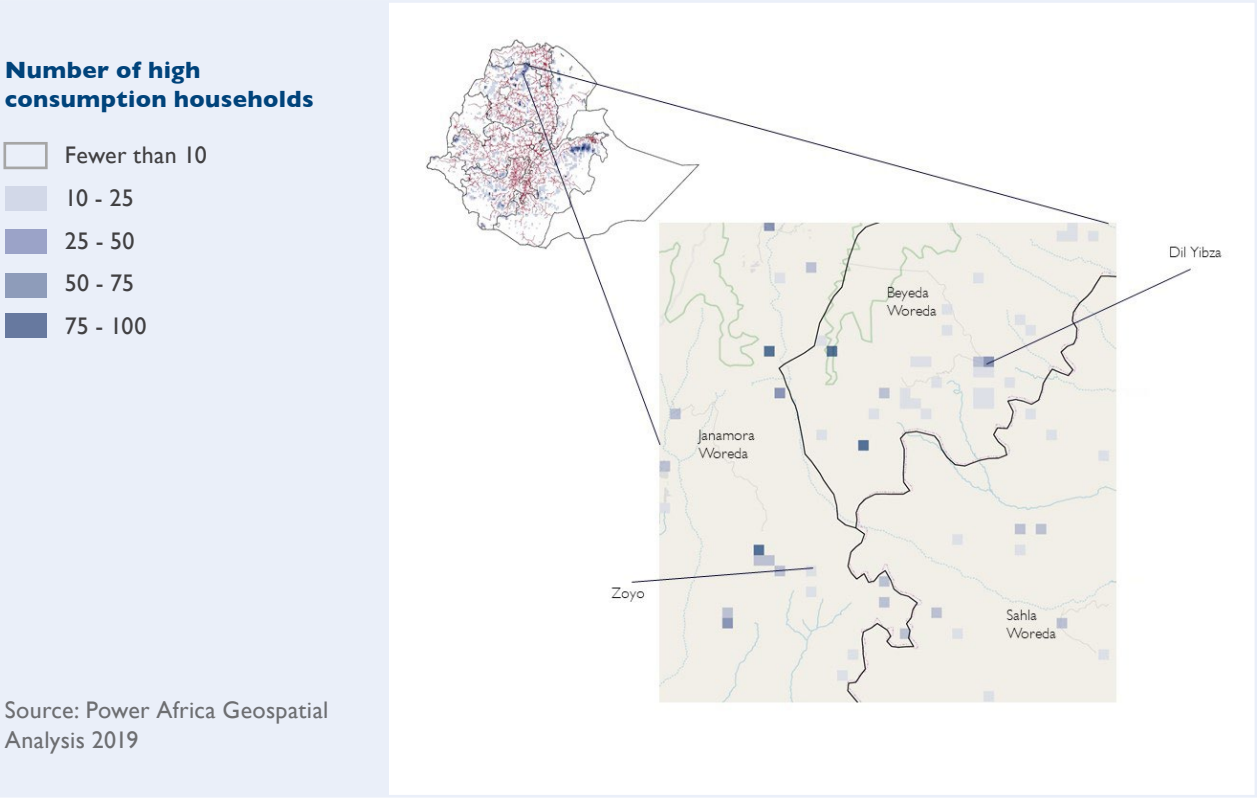
FIGURE A-6: POTENTIAL COMMUNITIES FOR MINI-GRID DEVELOPMENT—NUMBER OF HIGH CONSUMER POWER HOUSEHOLDS THAT ARE BEYOND 10 KM FROM THE MEDIUM VOLTAGE NETWORK[103]



Communities in Bendeno and Golo Oda woredas offer some attractive locations for mini-grid development.In particular towns like Bedeno and jido have high concentrations of households with high consumption power.

[103] Inset shows the number of households dependent on non-grid lighting sources with high consumer power per 10 km^2. Main map shows the number of these households per 1 km^2. Areas with fewer than 10 of these households per square kilometer are not presented on the main map. Source: Power Africa Geospatial Analysis 2019.

FIGURE A-7: POTENTIAL COMMUNITIES FOR MINI-GRID DEVELOPMENT—NUMBER OF HIGH CONSUMER POWER HOUSEHOLDS THAT ARE BEYOND 10 KM FROM THE MEDIUM VOLTAGE NETWORK[104]



Communities like Dil Yibza and those near Zoyo are potential markets for mini-grids. These communities are beyond 10 kilometers from the medium voltage network, and have high concentrations of high consumption power households.

[104] Inset shows the number of households dependent on non-grid lighting sources with high consumer power per 10 km^2. Main map shows the number of these households per 1 km^2. Areas with fewer than 10 of these households per square kilometer are not presented on the main map. Source: Power Africa Geospatial Analysis 2019.

ANNEX B METHODOLOGY FOR GEOSPATIAL ANALYSIS

The Fraym database used in the geospatial analysis combines satellite imagery and existing household surveys that are harmonized and re-weighted based on population data from third-party sources like multilateral and bilateral development actors, ensuring that indicators are comparable across countries and over time.

For this study, indicators at the individual and household levels were sourced from the third wave of the Ethiopia Socioeconomic Survey, implemented by the Ethiopian Central Statistics Agency and the World Bank Living Standards Measurement Study-Integrated Survey of Agriculture project (LSMS), as well as the 2016 Ethiopia Demographic and Health Survey (DHS).[105] These surveys are designed to be nationally representative and use a stratified two-stage sample design. The LSMS data were enumerated between January and May 2016, with a total sample size of 4,954 households. The DHS data were enumerated between January 2016 and July 2016, with a total sample size of 16,650 households.

After data collection, post-hoc sampling weights were created to account for any oversampling and ensure survey representativeness. The weights and resulting population proportions were triangulated with independent, third-party sources, such as the UN Population Division and the World Bank's World Development Indicators.

Additionally, granular population distribution data comes from LandScan,[106] a product of the US Government's Oak Ridge National Laboratory. High resolution mapping of the medium voltage transmission network was provided by NRECA International.

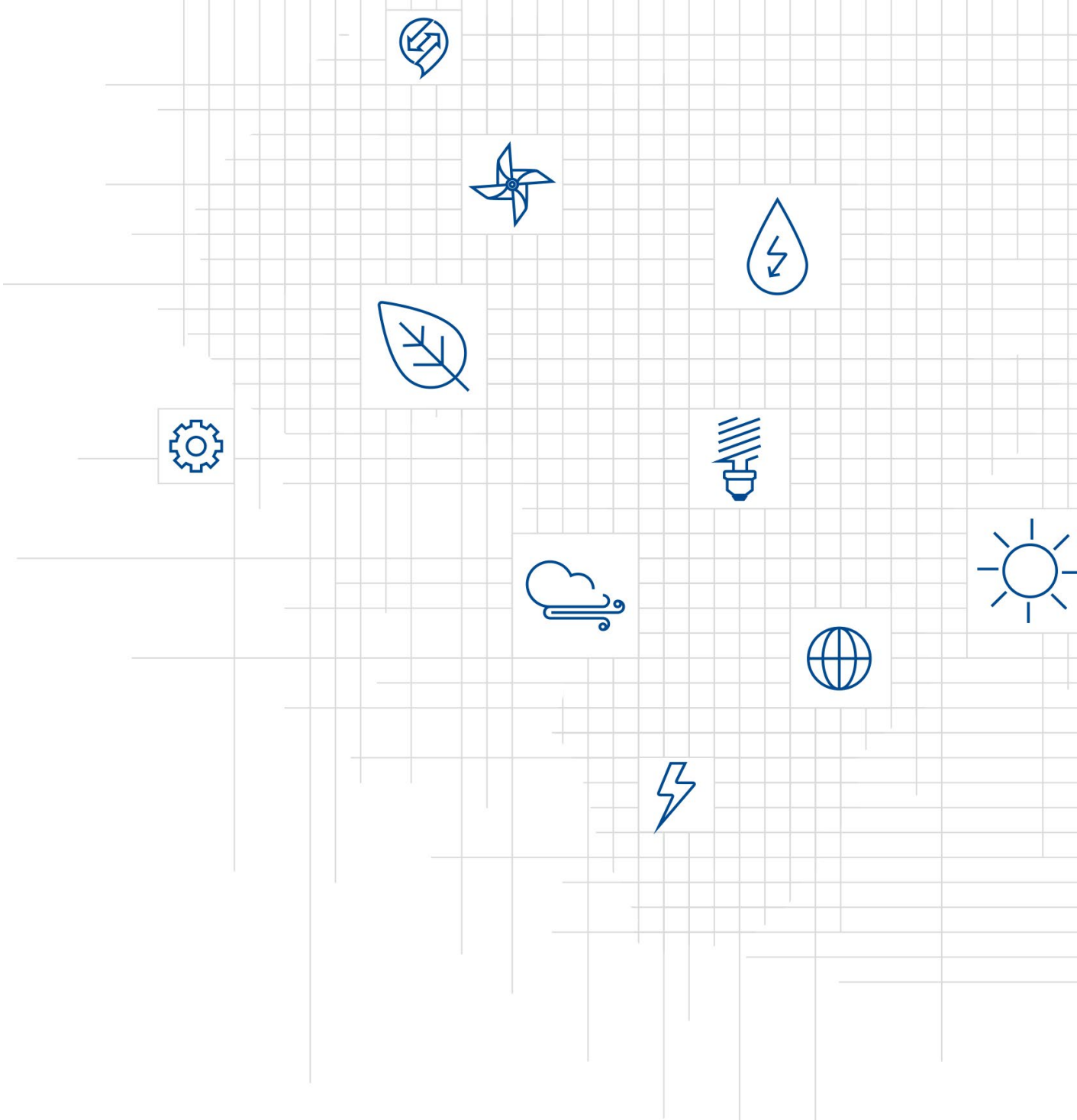
SPATIAL PREDICTION

To create spatial layers of households dependent on non-grid lighting sources, machine learning was used to combine survey coverage data at the cluster level with satellite imagery to identify spatial relationships and predict patterns at a hyper-local scale. In particular, the analysis relied on a survey question that refers to materials and equipment that work and asks, "Does your household have electricity?"

Forty spatial co-variates (satellite images) were used for this process. These covariates were selected because of their availability across time and space, and their high predictive power. A combination of raw and modeled satellite data layers were used and were provided by respected organizations including LandScan, USGS, European Space Agency, the Socioeconomic and Applications Center, and the Center for International Earth Science Information Network.

Although this particular process for creating spatial layers is proprietary, related approaches are detailed in the academic literature, including:

- Gething, Peter, Andy Tatem, Tom Bird, and Clara R. Burgert-Brucker. 2015. Creating Spatial Interpolation Surfaces with DHS Data DHS Spatial Analysis Reports No. 11. Rockville, Maryland, USA: ICF International. – available at: http://dhsprogram.com/publications/publication-SAR11-Spatial-Analysis-Reports.cfm#sthash.U4CPy69y.dpuf;
- Engstrom, Ryan; Hersh, Jonathan Samuel; Newhouse, David Locke. 2017. Poverty from space: using high-resolution satellite imagery for estimating economic well-being. World Bank Policy Research working paper; no. WPS 8284 – available at: http://documents.worldbank.org/curated/en/610771513691888412/Poverty-from-space-using-high-resolution-satellite-imageryfor-estimating-economic-well-being



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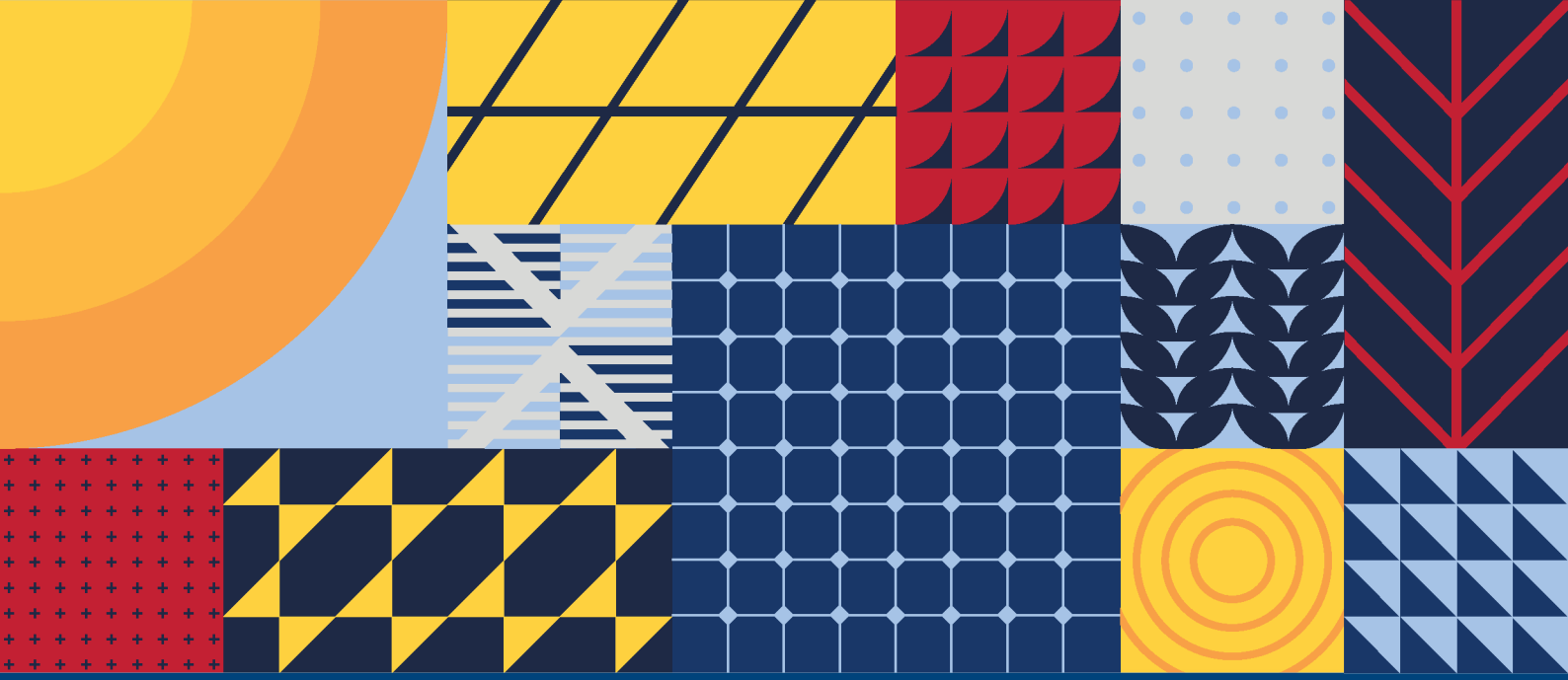

Power Africa aims to achieve 30,000 megawatts of new generated power, create 60 million new connections, and reach 300 million Africans by 2030.