Kingdom of the Netherlands

TRAIDE

Investment Opportunities in the Ethiopian Energy Sector

TRAIDE Ethiopia

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TRAIDE

Management summary

With 115 million people, Ethiopia is the second most populous nation in Africa. Ethiopia's economy has been one of the fastest growing in the region over the past 15 years, with an average annual growth rate of 9.5%.[1] As such, Ethiopia requires sustainable, reliable, and affordable energy production to power the needs of the population, businesses, and industries. Energy, therefore, has become a strategic priority, and the country aspires to reach 100% electrification in 2030 through a blend of on- and off-grid energy solutions.

OPPORTUNITIES IN ENERGY SECTOR IN ETHIOPIA

SOLAR

- Supply, installation, and maintenance of home energy systems
- Development of pay-as-you-go (PAYGO) systems
- Supply, installation, and maintenance of off-grid solar systems, especially for businesses and other productive users
- Construction and maintenance of solar mini-grids
- Mega projects and power purchase agreements (PPAs), e.g. Wolenchiti, Weranso, Gaad and Dechato (re-tender)
- Consultancy, particularly training and feasibility studies

WIND

- Maintenance of existing wind farms
- Mega projects and PPAs, e.g. Ayisha, Ayisha I, Debre Birhan and Assela I and II

GEOTHERMAL

- Mega projects and PPAs, e.g. Shashemene, Alolabad, Dugnafang, Boko, Bofan and Fentale

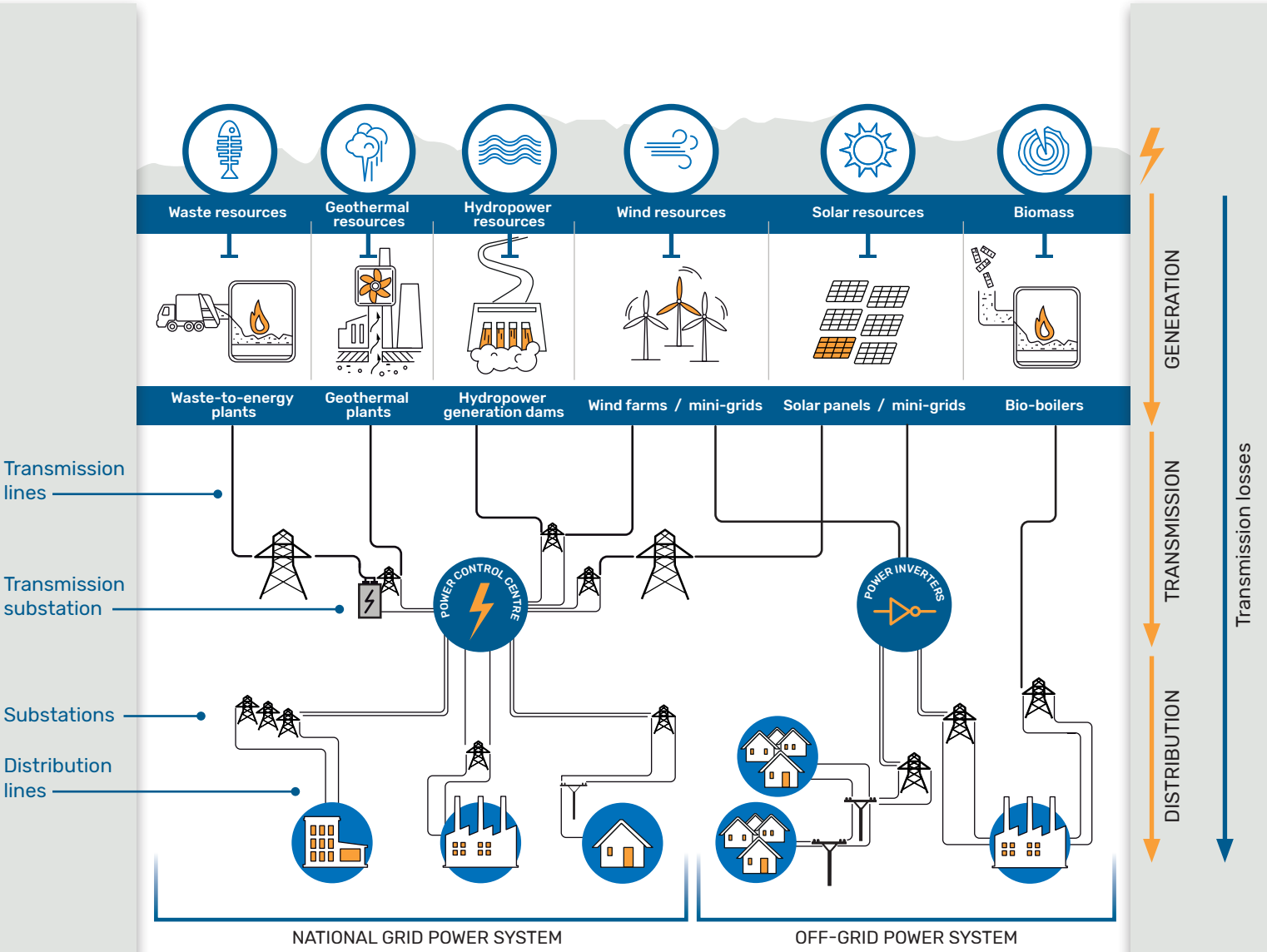
HYDROPOWER

- Off-grid irrigation systems
- Introduction of green hydrogen technologies at hydro sites with over-production
- Mega projects and PPAs, e.g. Chemoga Yeda I and II, Halele Werabesa, Genale Dawa V, Genale Dawa VI and Dabus

WASTE TO ENERGY

- Consultancy, particularly training and feasibility studies
- Introduction and promotion of waste-to-energy systems
- Supply, installation and maintenance of bio-fuel systems

Figure 1. ETHIOPIAN ENERGY SECTOR DIAGRAM



CHALLENGES

Unexploited renewable energy source	Power interruptions and transmission losses	Unreliable, fluctuating, and low-quality power supply	Low-quality equipment	Low technical skills and lack of expertise
Delayed project implementation	Financing and associated modalities	Overall low electrification rates	Low consumer purchasing power	

1. General overview: Status quo

1.1 THE ETHIOPIAN CONTEXT

With 115 million inhabitants, Ethiopia is the second most populous country in Africa, after Nigeria. Ethiopia has an average annual population growth of 2.7% and is expected to surpass 200 million by the end of 2049.[2] Around 80% of the Ethiopian population lives in rural areas, and while overall poverty rates dropped by 20% between 2011 and 2016, rates in rural areas increased over the same time. The average per capita income is US$850 per year, with averages for Addis Ababa (US$1,517) and other urban areas (US$1,421) substantially higher.[3] The low average income, combined with a vast and challenging topography, creates a challenge for the quick expansion of energy access rates, as the typical installation of on-grid and off-grid connections currently cost around US$350 and US$1,500, respectively (taking both solar home systems and mini-grids into account).[4]

Ethiopia's Gross Domestic Product (GDP) has experienced an average annual growth rate of 9.5% over the past 15 years, making it one of the fastest growing economies in Africa.[5] In recent years, the Government of Ethiopia (GoE) has invested extensively in the expansion of energy infrastructure, such as hydropower plants, for both national consumption and as an export product. An increase in access rates, both quantitative and qualitative, can support both households and productive users, such as industries and small businesses, and thus improve the business climate.

The impact of the COVID-19 pandemic and conflict in the country are not (yet) visible in current statistics. Considering recent developments, delays in the execution of energy generation projects are expected and might expose the vulnerability of on-grid power connections due to infrastructure damage and delays due to forex unavailability. These developments show that there are opportunities within the off-grid renewable energy sector for households and even more for businesses and productive users.

1.2 CURRENT ENERGY PRODUCTION AND INSTALLED CAPACITY

Currently, Ethiopia has an on-grid installed capacity of 4,500 MW, generated from hydro, wind and waste-to-energy sources. This installed capacity is only a fraction of the 60,000 MW that Ethiopia can potentially generate.[6]

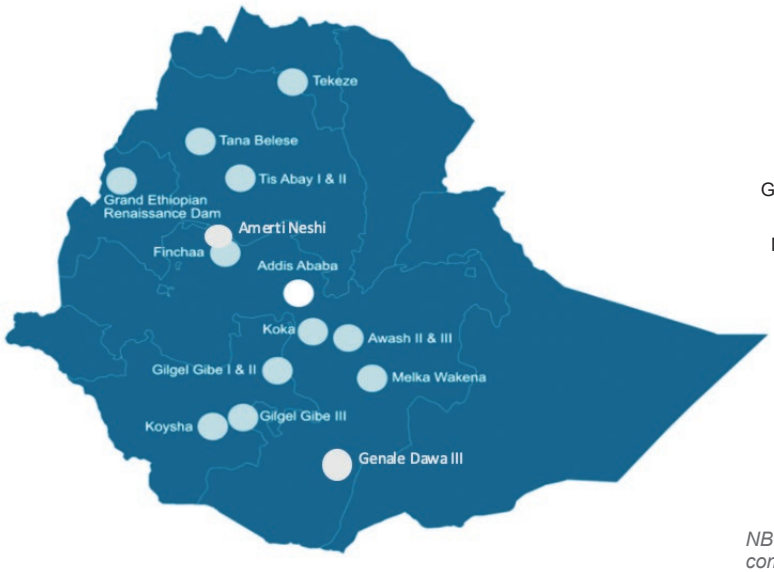
Figure 2. ENERGY MIX

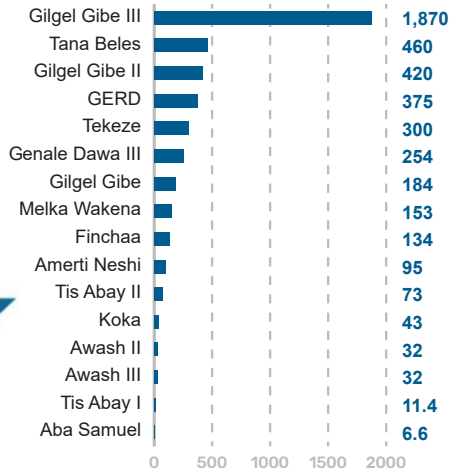
According to government data, access to electricity in Ethiopia is 48%, with 11% of the population having access through off-grid solutions.[7] Approximately 60% of households with access to electricity are connected via a grid line.

It is unknown how much energy is generated through off-grid solutions, although currently 2.2 million households receive electricity via these solutions.

Regarding power generation, Ethiopian Electric Power (EEP) currently administers 15 hydro and three wind (two in Oromia and one in Tigray) plants, and one waste-to-energy (WtE) plant.

Map 1. POWER PLANT AND INSTALLED CAPACITY (IN MW)





NB. Aba Samuel is currently not operational due to compensation issues.

1.3 TRANSMISSION AND DISTRIBUTION

According to EEP, Ethiopia currently has 225 substations to which generated power is transported and from which electricity is further distributed to consumers. The transmission lines, distribution lines and substations are unreliable and often lead to low-quality energy provision to consumers. During peak hours or during the rainy seasons, many transmission lines and substations are overloaded or damaged, which leads to outages and losses of power in the transmission from substations to consumers. Almost 60% of households in Ethiopia connected to the grid face between four and 14 disruptions a week.[8] These disruptions vary from multiple hours to multiple days. In addition, power fluctuations are common in Ethiopia, which can cause electric shocks or lead to the malfunctioning of appliances at home.

The latest projections made on technical losses in Ethiopia are estimated at 18%. Apart from unreliable transmission and distribution lines, there is also a lack of technical capacity to expand on-grid connectivity throughout the country, particularly in first- and second-tier cities.

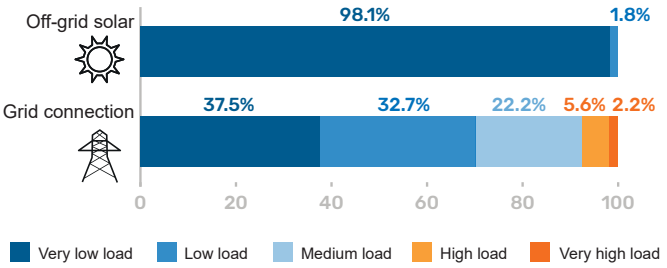
Ethiopia has taken the first step to decreasing the high percentage of losses by building a new Load Dispatch Center (LDC). This aims to not only reduce technical losses but improve the control and management of power plants and substations, and enhance the integration of new renewable energy power plants into the transmission system.[9]

1.4 ENERGY CONSUMPTION AND USAGE

Households

On average, the energy consumption of households connected to an on-grid or off-grid source in Ethiopia is high compared to its neighbouring countries. With a usage of 120 kWh per month,[10] overall electricity consumption is higher than usage in other countries in the region, such as Rwanda (20.8 kWh)[11] and Kenya (<50 kWh).[12] As in many other African countries, the difference between usage in urban and rural areas is significant.[13] In 2018, urban households typically consumed almost 150 kWh per month, while rural households used 45 kWh per month. Urban households spend on average 1.9% (US$3.30) of their monthly expenses on electricity, while rural households spend 5.2% or US$1.10, which is likely to increase due to recent inflation figures.

Figure 3. DISTRIBUTION OF APPLIANCE OWNERSHIP FOR HOUSEHOLDS WITH OFF-GRID AND ON-GRID ELECTRICITY SUPPLY[14]



Although the average usage by households is relatively high, most of them use low-load appliances, which means that households do not take full advantage of the service performance of the electricity supply they receive.[15] Most appliances used by grid-connected households do not have a load higher than 800 W in urban areas (refrigerators, freezers, air coolers), and 200 W in rural areas (televisions, fans). Among off-grid-connected households using, for example, a solar home system, very-low-load appliances are mostly used (e.g. lighting, phone charger, radio).

Businesses and other productive users

Internal mapping conducted by (rural) businesses and productive users in the agriculture, health and education sectors reveals that most are connected to the grid but use diesel-fuelled generators to support the energy supply when there are power cuts or power fluctuations occur. Power cuts and disruptions lead to a range of challenges:

- Black-outs and power surges reduce the lifespan of machinery and lead to increased replacement costs. This – combined with unforeseen breakdowns – increases costs and operational risks.
- Power fluctuations are an important reason for businesses to use generators, to make sure machinery can keep running continuously. To adjust to power fluctuations, companies require transformers, but this equipment is scarcely found in the country and the government is not allowing investors to import them on a duty-free basis.
- Overall, the availability, quality and reliability of electricity supply is low. These challenges are aggravated for productive users in rural areas, especially in the agriculture sector.
- Operations halt until supply returns or a generator takes over. It takes about 30 seconds for a generator to start. This has mid- to long-term financial consequences when disruptions occur frequently, while some products and machines cannot handle these interruptions.

Box 1. BUSINESS EXPERIENCE OF ADDITIONAL ENERGY COSTS

Using back-up diesel generators increases operational costs and increases companies' carbon footprints. Moreover, transportation and unreliable supplies can disrupt operations and harm productivity.

A practical example from a flower cuttings company shows that the company spends an additional US$25,000 per annum on fuel to run generators during power disruptions. Expenses are likely to increase due to rising fuel costs. It also makes the company vulnerable to risks relating to unreliable fuel supplies.

1.5 ENERGY EXPORTS

Annually, Ethiopia exports electricity from the national grid to Djibouti (75 MW) and Sudan (300 MW). Ethiopia plans to increase power exports to different countries from the national grid as a result of the increased capacity produced by the Grand Ethiopian Renaissance Dam (GERD). Export capacity to Djibouti is planned to increase to 400 MW per annum. Ethiopia is also set to start energy export to Kenya in 2022. The agreement was signed in July 2022, which indicated that Ethiopia would export 200MW of energy in the initial period of operation.[16] Furthermore, recently, the GoE signed an MoU for implementing the interconnection project with a transfer capacity of 100 MW to South Sudan in the first phase, with plans to increase this to 400 MW in the second phase. According to EEP, other countries are in line to import energy from Ethiopia, namely Somalia, Rwanda, Tanzania, and Burundi.

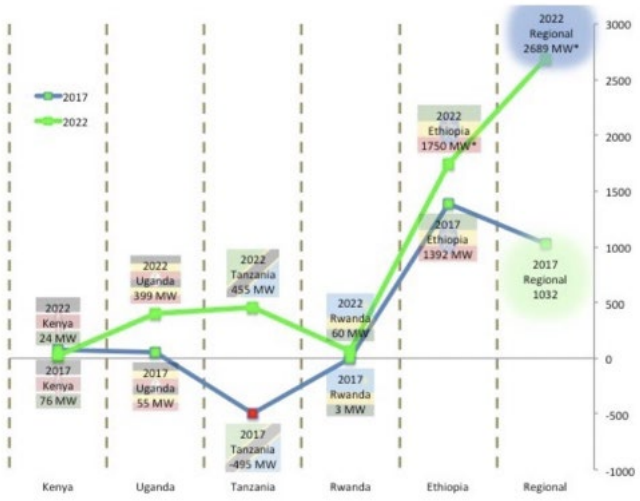
As outlined in the country's National Electrification Program (NEP), Ethiopia aspires to become the regional electricity hub by exporting electricity to countries in the Horn of Africa and across East Africa. By 2030, Ethiopia aims to export a total of over 5,000 MW of electricity to Djibouti, Sudan, Egypt, Kenya and Tanzania. The associated export revenues could significantly contribute to the country's forex reserves.[17] Ethiopian-produced electricity is relatively cheap and Ethiopia could therefore have a comparative advantage.

Some of these target countries produce a surplus of energy and are also planning to export electricity to neighbouring countries, which raises the question of where and how all the surplus electricity is going to be used. In 2017, Tanzania was the only country in East Africa with an undersupply of electricity, while Ethiopia, Kenya and Uganda all had a surplus.[18] The projected surplus in the region will more than double in 2022 and therefore makes the electricity export market overcrowded.

Table 1. A COMPARISON OF ELECTRICITY TARIFFS IN EAST AFRICA[19]

Country	Households (per kwh in US$)	Businesses (per kwh in US$)
Ethiopia	0.005	0.06
Kenya	0.213	0.174
Tanzania	0.099	0.102
Egypt	0.045	0.063
Djibouti	–	–
Sudan	0.002	0.019

Figure 4. SUPPLY AND DEMAND EVOLUTION ACROSS EAST AFRICA, 2017 AND 2022[20]



*Includes projected exports outside the region

2. Development plans and relevant actors

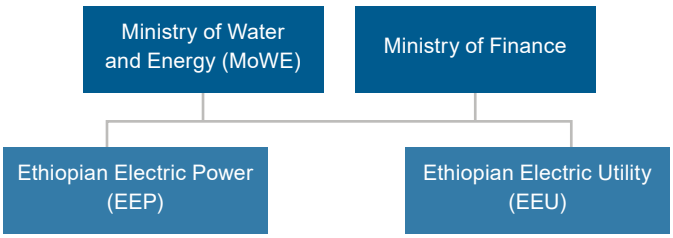
2.1 OVERVIEW OF STAKEHOLDERS

Stakeholders in the Ethiopian energy sector can broadly be divided into six categories: (1) national government, (2) regional energy bureaus (REBs), (3) private sector, (4) development partners, (5) associations, and (6) beneficiaries (consumers).

1. At the national level, the public sector consists of five entities that have their own responsibilities:

    a. **Ministry of Water and Energy (MoWE):** is responsible for policy issues.
    b. **Ethiopia Energy Authority (EEA):** has licensing and regulatory oversight, including for private sector entry, and across the whole power sector value chain of generation, transmission, distribution, and sales. EEA is also responsible for establishing standards and regulations required for the implementation of on- and off-grid programmes, including social, safety and environmental safeguards, as well as their compliance. EEA is now under the Ministry of Mines.
    c. **Ethiopian Electric Utility (EEU):** is responsible and accountable for network planning, and the design and implementation of the grid component. In addition, EEU is responsible for service delivery in commercially attractive areas, operating a share of the mini-grids in Ethiopia.
    d. **Ethiopian Electric Power (EEP):** is responsible for the upstream functions of generation and transmission.
    e. **Ministry of Finance:** is responsible for the day-to-day business of EEP and EEU.

Figure 5. ETHIOPIAN ENERGY SECTOR HIERARCHY



2. At the regional level, the **REBs** support the implementation of energy plans and projects in their states but cannot influence energy policies and regulations. REBs promote off-grid services, mainly in the deep rural areas. They are of importance to private sector companies seeking to sell off-grid systems on credit to households using microfinance institutions' (MFIs) consumer loans.

3. The **private sector** is, and will be, mainly involved in the roll-out of the off-grid programme focused on solar home systems (SHSs) and mini-grids in both commercially attractive areas and deep rural areas.

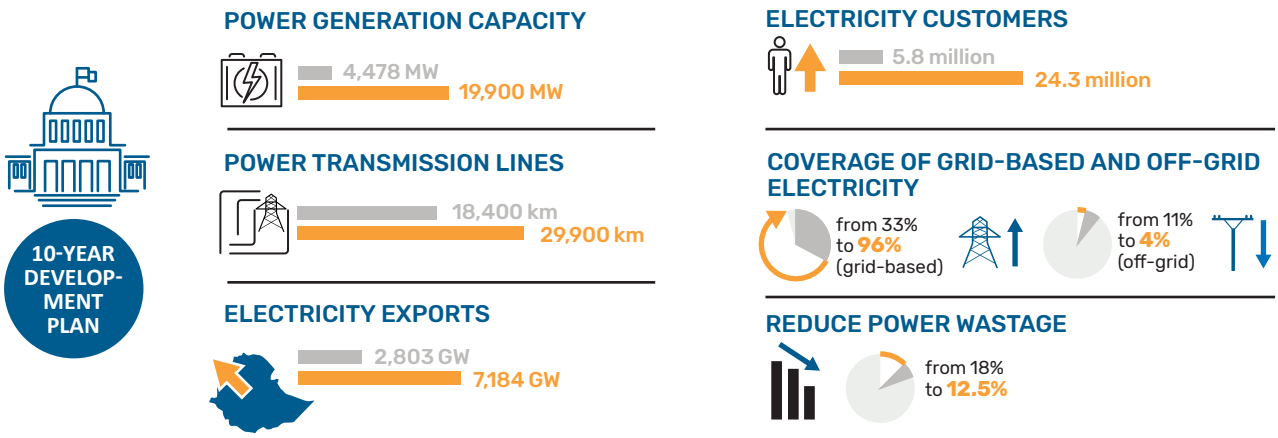
4. **Development partners** are responsible for a part of the finance needed to support both the public and private sector in developing the energy sector.

2.2 DEVELOPMENT PLANS

Ethiopia's national power generation capacity has increased significantly over the past three decades, from 380 MW in 1991 to 4,478 MW in 2021.[21] More large-scale energy projects are developing, including the Grand Ethiopian Renaissance Dam (GERD). All future projects will support Ethiopia in providing domestic access to electricity and will contribute to the country's ambitions to become East Africa's electricity hub. As the majority of these projects will generate energy from renewable sources, Ethiopia is also on its way to becoming a green economy front-runner.

The **10-year perspective plan** prioritises access to clean and high-quality energy technologies. It aims to increase the capacity to generate power through infrastructural improvement and minimise power losses. More specifically, the 10-year targets are to raise power generation capacity to 19,900 MW, increase power transmission lines from 18,400 km to 29,900 km, increase electricity exports from 2,803 GW to 7,184 GW, increase electricity customers from 5.8 million to 24.3 million, increase the coverage of grid-based electricity from 33% to 96% (and that of off-grid from 11% to 4%), and to reduce power wastage from 18% to 12.5%.[22] The targets, set for 2030, are highly unlikely to be achieved given the major focus on on-grid expansions.

Figure 6. THE 10-YEAR PERSPECTIVE PLAN OF THE GOVERNMENT



The **National Electrification Program** is a nationally developed plan of action launched by the Government in 2017 to achieve nationwide access to electricity. Since the 2019 update, the Ministry of Water and Energy (MoWE) aspires to reach universal access by 2025, with Ethiopians connected to the national grid, and with additional off-grid solutions.[23] After 2025, MoWE aims to increase the proportion connected to the grid and decrease the proportion connected to off-grid solutions. Moreover, it aims to connect all schools, hospitals and health centres to the grid by 2025.

These targets imply that the current 6.9 million households connected to the national grid will increase to 15 million by 2025; and the 2.3 million households connected to off-grid installations will rise to 8.1 million households (annual population growth incorporated). While the GoE has taken the impact of population growth into account, a significant population increase will require substantial efforts on the part of the GoE and aligned stakeholders to achieve these targets. The aspirations of the GoE regarding the unmet energy demands of the country, which is expected to grow further, is indicative of investment opportunities for the private sector.

Box 2. ENERGY SECTOR DEVELOPMENT PLAN FOR HOUSEHOLDS, DESCRIBED IN THE NEP

The Government of Ethiopia (GoE) is currently implementing the second phase of its Growth and Transformation Plan II (GTP II), which focuses on becoming a lower-middle-income and carbon-neutral country by 2025. In line with the poverty reduction strategy, MoWE has set ambitious targets in the National Electrification Program (NEP) 2.0 for 2019–2025, focusing on the development of the on- and off-grid subsectors on the one hand, and on institutional mechanisms and investment requirements on the other. While on-grid access is aimed to be increased by 8.1 million households, MoWE's on-grid programme also includes a component for social institutions (schools, clinics) and productive users (industrial parks, small and medium-sized enterprises, and agribusinesses). Different from the on-grid target group, off-grid is primarily destined for households and broader communities, connected via either a solar home system (SHS) or a mini-grid. MoWE also distinguishes three types of off-grid-assigned households:

1. Short-term pre-electrification households, consisting of approximately 3.3 million households. They are planned to be connected to the national grid, but as the roll-out of the grid will take a relatively long time, they can be offered a temporary off-grid solution.
2. Mid-term pre-electrification households, residing between 2.5 km and 25 km from the existing grid and consisting of approximately 5 million households. These households are expected to be connected to the grid between 2025 and 2030.
3. The long-term deep rural households, consisting of approximately 0.9 million households. These households are located more than 25 km from the existing grid and are not expected to be connected to the national grid until 2030 at the earliest.

2.3 ROLE OF THE PRIVATE SECTOR

Ethiopia is very ambitious about its target of 100% access to electricity by 2025. This signifies that there are many opportunities for new investors coming to Ethiopia. These investment and trade opportunities for the private sector seem to exist in both the off- and on-grid sector. The GoE has numerous plans for the expansion of the national grid network, and many projects have already been planned with independent power producers (IPPs). However, in many rural areas it is too expensive to establish on-grid connections. Hence, this presents opportunities for innovative solutions for the off-grid sector. The GoE sees a big role for the private sector, in particular to support households and social institutions that currently have no access to electricity by providing off-grid solutions. Similarly, support from the private sector in grid-connected areas is also significant, as many businesses currently rely on expensive diesel generators. Businesses can develop technologies and business models suited to these challenging target groups in the energy sector.

Investment incentives

Unless a specific investment activity is indicated, it is difficult to decide on the applicable investment incentives for any sector. Therefore, we indicate some of the pertinent investment incentives according to the regulations that are currently prevalent.

Once an investor has obtained an investment licence, details of the investment incentives can be obtained from the Ethiopian Investment Commission (EIC). The following are applicable incentives:

- Corporate income tax exemption.
- Duty-free importation of capital goods and construction materials necessary for the establishment of a new enterprise or the expansion or upgrading of an existing enterprise.
- Duty-free importation of spare parts the value of which is not greater than 15% of the total value of the capital goods within five years from the date of commissioning of the project. 'Capital goods' in Regulation No. 517/2022 includes equipment and other similar tangible goods used to produce goods or render services for consideration.
- Duty-free importation of some vehicles.

A new legal document to refer to regarding investment incentives in Ethiopia is the Council of Ministers' Investment Incentive Regulation No. 517/2022.[24]

N.B. These incentives are for investments limited to a specific period (depending on the investment activity), and strictly dependent on the approval of the Ministry of Finance. Investors may approach the Ethiopian Investment Commission to receive information on what incentives they are entitled to. Their applications will then be sent to the Ministry of Finance for a final decision.

Figure 7. TOP ENERGY GENERATION-RELATED IMPORTS (2020), IN US$'000[25]

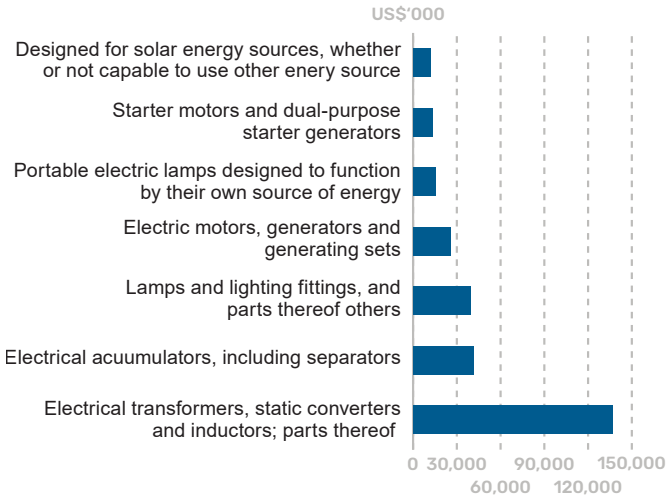
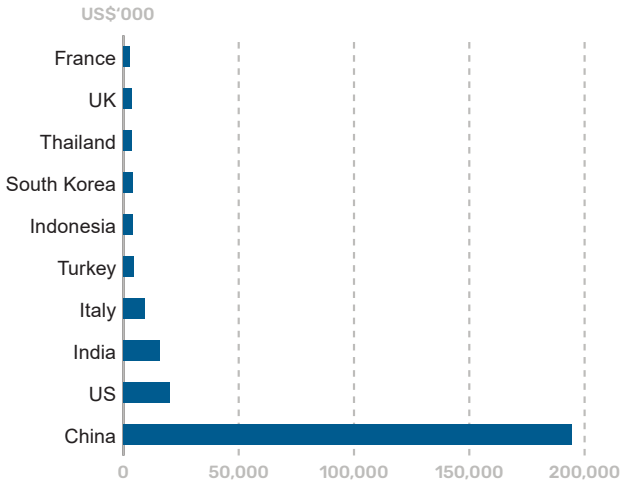


Figure 8. TOP ENERGY-RELATED GOODS EXPORTERS TO ETHIOPIA (2020), IN US$'000[26]



3. Business opportunities in subsectors

Ethiopia's current installed capacity (4,500 MW) is only a fraction of the 60,000 MW that Ethiopia can potentially generate. In the renewable energy sector, the largest amount of this, 45,000 MW, is calculated to come from hydropower. Therefore, the 4,000 MW of installed hydropower capacity is less than 10% of Ethiopia's potential hydropower generation. Besides hydro, there is great potential for power generation based on solar, wind, geothermal, waste-to-energy, and hydrogen resources.

There are many grid expansion projects in the pipeline, including the GERD mega project, which should generate an extra 6,000 MW from hydropower when completed as expected in 2023.[27]

The GoE plans to achieve 100% electrification by 2025. It is unlikely that the target will be achieved according to this schedule. Besides that, the changing targets in the medium and long term might deter off-grid investment. Despite these ambiguous long-term targets, the overall ambition to become the power hub of East Africa will lead to many financial opportunities for new investors. The GoE is inviting private players and investors to the energy sector. New projects are regularly announced through national newspapers, websites of respective government bodies, or donor agencies. Moreover, existing businesses and industries are eager to benefit from reliable and renewable energy solutions.

3.1 SOLAR

Based on the solar radiation of Ethiopia, the potential to use it for power generation is high. EEP estimates the country's solar power generation capacity to be 5 to 6 kWh/m² per day.

Slight seasonal variations occur, with the highest values in February and March (6.5 kWh/m² per day) and the lowest in July (4.5 kWh/m² per day). The solar resource is relatively low in the most northern, central and western highlands of the country, while the Rift Valley regions and the eastern lowlands of the country receive higher annual average irradiance (above 6 kWh/m² per day).

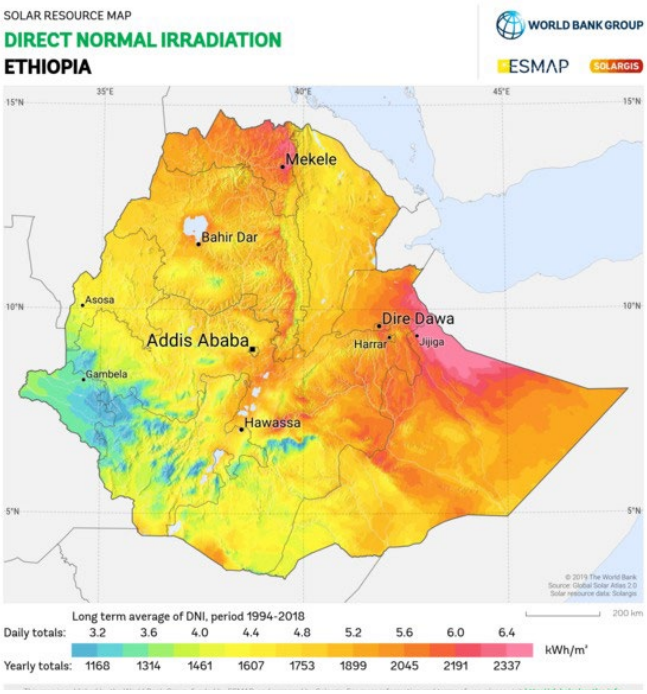
For household solar systems, there are subsidy programmes and financial instruments available, mainly from the World Bank and the African Development Bank (AfDB) (see Table 2).

Table 2. DEVELOPMENT PARTNER ACTIVITIES IN THE OFF-GRID SUBSECTOR IN ETHIOPIA AND AVAILABLE FINANCIAL INSTRUMENTS

Organisation	Fund	Budget	Timeline
IBRD (World Bank)	Access to Distributed Electricity and Lighting in Ethiopia (ADELE) Project	US$500 million	2021–2027
AfDB	Scaling up for Renewable Energy Program (SREP)	US$50 million	2012–current

** The African Development Bank (AfDB) funds renewable energy projects for ticket size ranging from US$1 million to US$5 million.*

Map 2. DIRECT NORMAL SOLAR IRRADIATION IN KWH/M² BETWEEN 1994 AND 2018[28]



Solar home systems

Most Ethiopians with an off-grid connection do not have a solar lighting system (SLS) or solar home system (SHS), but rely on more basic solar lanterns: 94% of Ethiopian households (approximately 72,000 households) with an off-grid connection use lanterns.[29] There are different types of SLSs and SHSs, ranging from those that can power two or more light bulbs and which have a phone charge capability, to those that can power two or more light bulbs and appliances such as a television. More advanced SHSs can power an iron, microwave or refrigerator.[30] However, because of limited purchasing power, many SHSs are not affordable for most households in Ethiopia. In this regard, projects related to easier access to finance and monetisation of collateral could unlock consumer potential by making finance available.

In 2018, there were eight solar companies in Ethiopia selling the so-called 'pico solar systems' (solar lanterns, SLSs and SHSs): Lydetco, Solar Development, Vera International Business PLC, Acme Engineering & Trading, Green Scene, Sun Transfer Tech PLC, HelloSolar and Fosera.

OPPORTUNITIES

Companies can supply and maintain SHSs in partnership with local distribution companies. Overall, the sector is challenged by low technical skills and lack of expertise. This presents an opportunity for companies introducing and improving technical skills.

Pay-as-you-go (PAYGO)

The business opportunities and market potential for PAYGO systems are huge in Ethiopia. The energy access report based on the Multi-Tier Framework reveals that 56% of households are still in Tier 0 but report a high willingness to pay for Tier 1+ quality on credit.

Most SHSs and portable lantern products are sold on a cash basis, with a small fraction sold using the PAYGO model. When PAYGO is used, this is mainly for the payment of SLSs and SHSs, as these systems require higher upfront costs that are beyond the financial means of most households. PAYGO systems are not widely used yet due to several issues:

- Limited access to finance by households, particularly about the need for hard currency, equity, debt, but also the lack of credit lines to cover the gap between asset financing and end-user receivables for PAYGO systems.
- Poor policy and regulatory environment, particularly regarding the possibility of foreign investors investing in distribution, and the difficulty of repatriating their returns.
- Weak stakeholder engagement and skills to compensate low mobile money penetration rates, and weak GSM coverage through agent-based networks.

OPPORTUNITIES

Several business opportunities are foreseen for pay-as-you-go (PAYGO) systems for the off-grid solar market:

- Developing PAYGO platforms and microfinance information systems, or engaging in the scale-up of existing PAYGO initiatives.
- Capacity building and provision of technical assistance for the energy and finance sectors, specifically on the use of PAYGO platforms: mobile money integration, data analytics and data-based management.
- The development of investment vehicles that are tailored to the Ethiopian context. Barriers related to accessing hard currency can be mitigated by, for example, combining remittances with other guarantee funds. International PAYGO investors can also apply for subsidy programmes for non-commercially viable areas.

Solar systems for businesses and industries

For businesses operating in Ethiopia, the challenges are two-fold. On the one hand, there is a demand for sufficient electricity supply. On the other hand, energy is needed in value chain development, especially in the agriculture sector. Because of the high frequency of outages, even in special economic zones, businesses install diesel generators as a back-up for the outages. However, generators cannot prevent machinery from shutting down completely, and it takes time before the generator starts running. These outages, therefore, are costly since operations stop for some time. They are also costly given that outages can cause lasting damage to machinery, which may need to be replaced. Generators rely on the delivery of their fuel – diesel – which is imported and must be transported to the facility. In addition to the fact that diesel is an environmentally unfriendly source, it also makes businesses dependent on the punctual arrival of diesel. This indicates that the expenses of a company are likely to increase due to rising fuel costs. Moreover, it makes the company vulnerable to risks related to unreliable fuel supply.

Solar photovoltaic technology has been found to be advantageous in productive industries, such as in the agriculture.[31] For tasks like water pumping for (drip) irrigation and cattle drinking, aeration for aquacultures, refrigeration of agricultural products, electric fencing, poultry lighting and pest control solar PVs can be utilised. Therefore, the use of off-grid solar photovoltaic cells becomes more pertinent, depending on the financial capability of the company.

OPPORTUNITIES

Businesses and industries need reliable electricity supplies. Current off-grid energy systems (i.e. diesel generators) are expensive and environmentally unfriendly. This presents a business opportunity for any company that provides reliable off-grid solar solutions.

Solar mini-grids

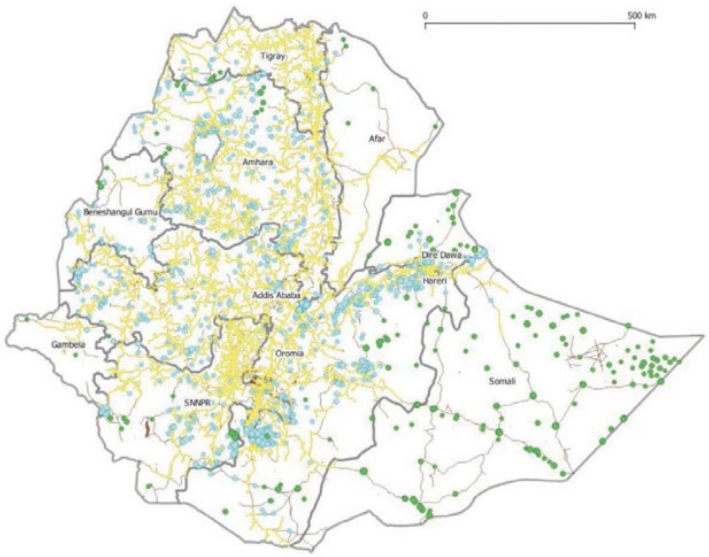
According to MoWE, there are three types of mini-grids suitable for Ethiopia, with solar mini-grids offering the highest potential. Power Africa has calculated that approximately 15% of the off-grid population could be cost-effectively reached by mini-grids, systems typically in the range of 10 kW to 100 kW.[32]

According to MoWE, grid electricity is the optimal and cheapest approach to increasing electrification rates. Although MoWE is expanding the grid and connecting households and businesses, the GoE will be serving others with off-grid technologies, including mini-grids. MoWE has devised and approved a special directive on mini-grids. Among the issues addressed by this directive is how companies can obtain mini-grid development licences, tariffs, and environmental protection issues.[33]

Looking at Map 3, we can see that there are many opportunities for the development of mini-grid sites. Most potential is available at sites more than 10 km from the current grid. 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. These areas already have large concentrations of households with high discretionary spending, which increases their ability and willingness to pay for a mini-grid connection.

Currently, there are only two companies operating in the mini-grid space in Ethiopia, with a total of two sites operating, and four more under construction. This shows that the market is still virgin, with few players in the market.

Map 3. NATIONWIDE PRELIMINARY POTENTIAL FOR PRE-ELECTRIFICATION MINI-GRID DEVELOPMENT (LIGHT BLUE)[34]



OPPORTUNITIES

The construction and maintenance of mini-grids is an attractive business opportunity given the geographic dispersion, grid unreliability, and the local willingness to pay. Specifically, we foresee opportunities for suitability mapping, businesses development, construction, and maintenance of solar mini-grid sites. Remote and geographically challenged locations, in particular, are less likely to face future on-grid competition.

Mega projects

As part of the overall initiative to become the power hub of East Africa, the GoE is inviting private players and investors to invest in the on-grid power generation sector (as IPPs). These IPPs are expected to bring in commercial capital and sustainable financing structures, supplement technical skills, and improve the implementation speed of the energy sector.

A scheme was introduced by the Ministry of Finance in 2018, cognisant of the private sector's involvement to drive the country's economic growth. The Ministry of Finance's Public-Private Partnership (PPP) Directorate then approved, among others, solar projects to be procured through this scheme, which presents opportunities for foreign investors.

The first two projects that came close to a financial close through the PPP initiative were Gaad and Dechato, where a Saudi Arabian company, ACWA, won the tender. Due to regulatory framework issues, however, the deal did not go through as they could not reach financial closure, and the projects are to be re-tendered.

An important note to make with regard to grid project development in Ethiopia in general is that signing energy agreements with the GoE always goes hand in hand with regulatory frameworks that cause processes to be lengthy, bureaucratic, and increase the risk of misuse of power. The political situation also plays a significant role in creating a shift in focus for the GoE and can harm project development and execution. A more positive note is that the GoE recently announced that IPPs can soon generate revenues and profit in US$, instead of in Ethiopian Birr and later repatriation, which is expected to give a boost to grid project developments.[35] Solar mega projects that are in pipeline have an approximate cost of between US$150 million and US$160 million and are to be constructed in different parts of the country.[36]

OPPORTUNITIES

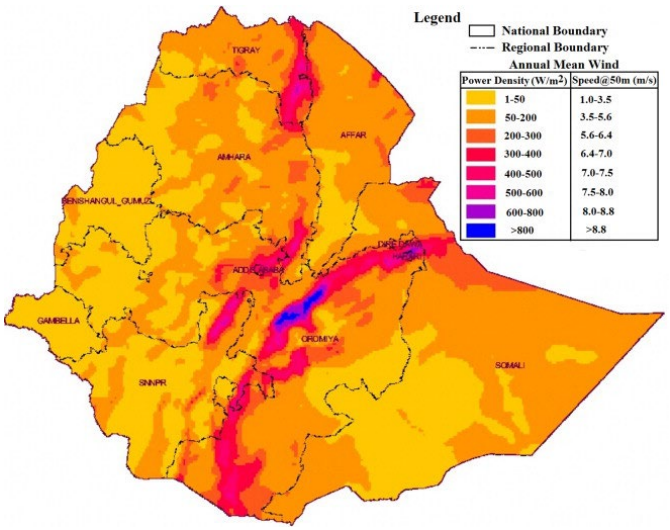
EEP and the Ministry of Finance are calling for companies to join a PPP. Current larger tenders for solar production (±700 MW) are Wolenchiti (150 MW), Weranso (150 MW), Gaad (125 MW) and Dechato (125 MW). This also presents opportunities for engineering, procurement and construction companies providing maintenance solutions, or companies specialising in providing knowledge/technical assistance.[37]

3.2 WIND

Ethiopia's wind speed is relatively low. However, there are north-eastern regions and areas located around the main East African Rift Valley that have wind speeds that the country can capitalise on. EEP indicates that the country has 10,000 MW of power generation potential from wind energy. Therefore, capitalising on the wind resource is the most efficient, clean and ecologically acceptable solution for the country and would enable the grid system to achieve more stable and reliable energy generation.[38]

There are currently two wind farms in Ethiopia: Ashegoda, in the north of Ethiopia and Adama I, located south of Addis Ababa. The government plans to construct a few more wind farms to contribute to the national grid, as current wind energy generation remains marginal. The national grid system is largely based on hydropower reservoirs, which are significantly affecting the power supply reliability during extended droughts and when reservoir waters are depleted. Therefore, with the aim of providing sufficient and reliable electric power supply to citizens, the GoE is undertaking various initiatives to develop electric power generation facilities in different modalities, including wind power. For the development of wind power facilities, it is essential to undertake energy assessments at pre-identified potential areas.

Map 4. ANNUAL MEAN WIND POWER DENSITY AT 50 M HEIGHT WITHOUT EXCLUDING PROTECTED AREAS[39]



OPPORTUNITIES

The GoE identified several locations with higher-than-average wind resources and readily available land. Initial identified locations are Ayisha I (300 MW), Debre Birhan (126 MW), Ayisha (150 MW), Assela I and II. PPPs are foreseen to exploit these untapped wind resources. Dutch companies with a competitive advantage can become strategic partners and engage through engineering, procurement and construction (EPC) and PPP modalities. Propositions could include financing, design, procurement, construction, commissioning, operation, and maintenance.

3.3 GEOTHERMAL

Besides solar, water and wind, the potential for geothermal energy generation in Ethiopia is high.

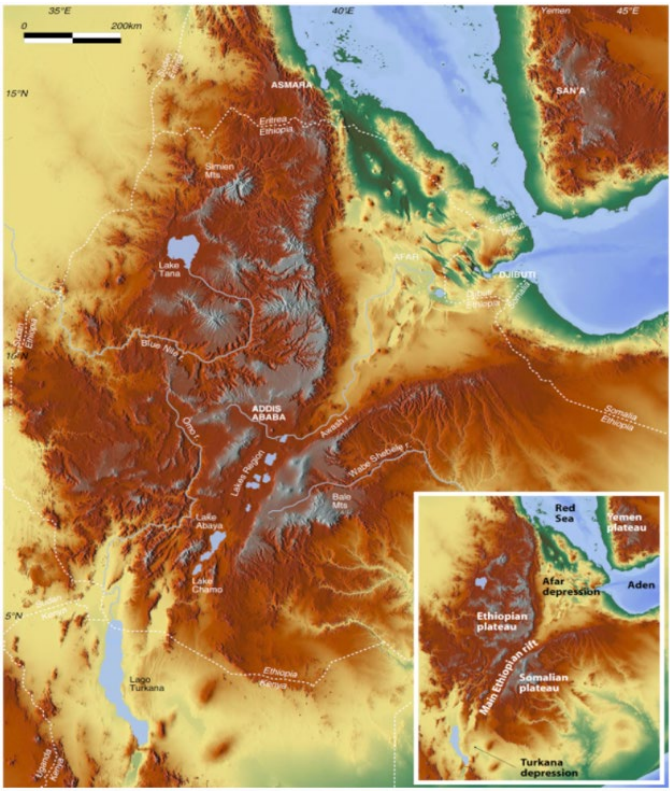
According to EEP, the estimated power that could potentially be generated from geothermal sources is 10,000 MW. Several sites appropriate for geothermal power generation are being explored, with the expectation that supply to the grid will begin in the near future. These potential areas are situated within the Ethiopian Rift Valley, which runs in a north-easterly direction along the entire length of Ethiopia. Erta Ale, Alayta and Manda Harraro active volcanic ranges are indicative of the existing heat resources.[40]

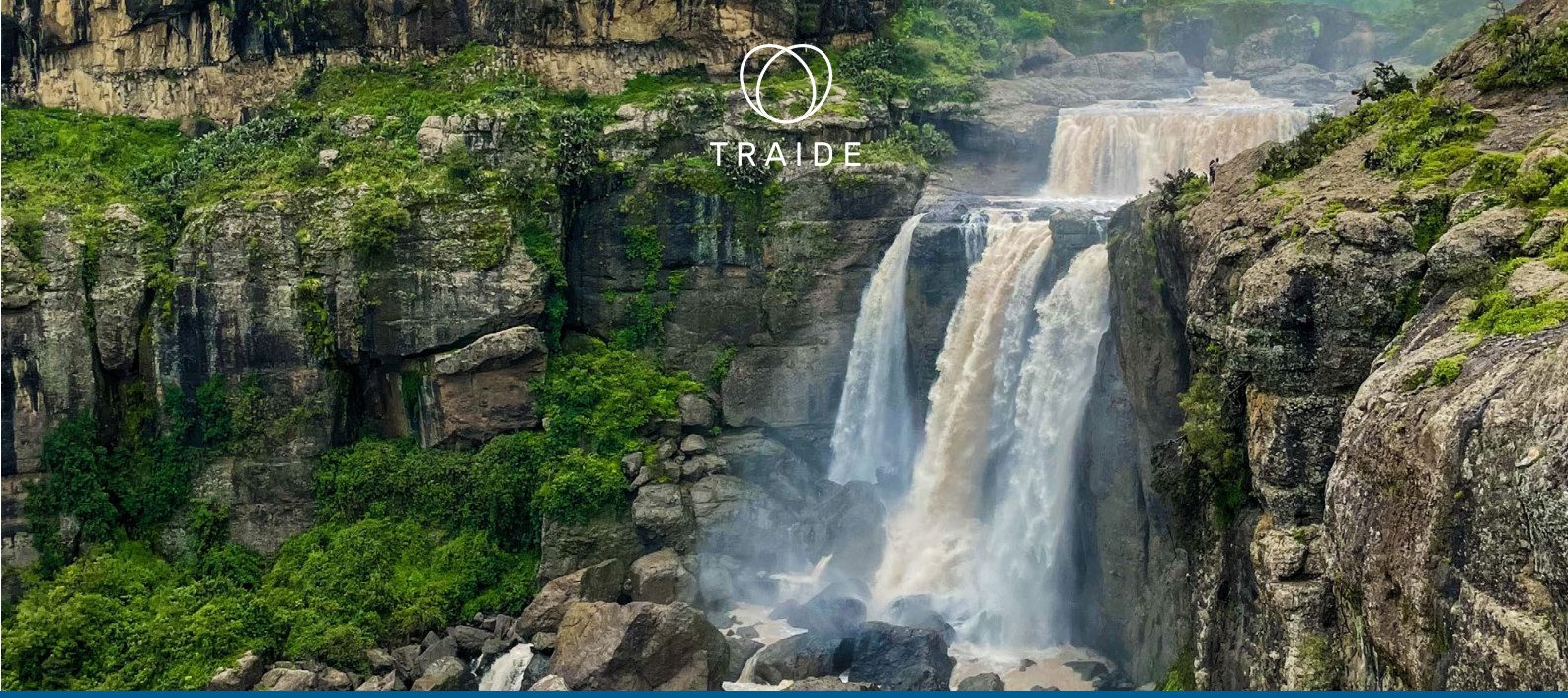
According to the National Electrification Program, less than 1% of potential geothermal resources have been exploited so far.[41] And interview held with EEP indicates that Geothermal projects that are currently in progress include Aluto, Tulu Moye and Corbetti, with the support of Japan International Cooperation Agency (JICA) and the World Bank.

OPPORTUNITIES

EEP aspires to engage in more geothermal power generation. Notable projects include Shashemene (150 MW), Alolabad (100 MW), Dugnafang (100 MW), Boko (100 MW), Bofan (100 MW) and Fentale (50 MW). All these projects are at the due diligence phase, with cost estimation and assessment yet to be conducted. Initial engagement with these projects will present business opportunities for any company with competitive products and/or services.

Map 5. MORPHOLOGY OF THE ETHIOPIAN RIFT VALLEY[42]





3.4 HYDROPOWER

Due to the numerous rivers, river basins and lakes in Ethiopia, there is abundant potential for hydropower generation. Ethiopia's annual surface run-off is approximately 122 billion m³ of water, constituting 20% of the total technically feasible potential for hydropower in Africa.[43] Of the 12 major river basins found in Ethiopia, eight are identified as offering hydropower potential. Within those eight basins, around 300 potential hydropower plant sites have been identified. In addition, 192 sites show promise as small-scale plants (less than 40 MW).

OPPORTUNITIES

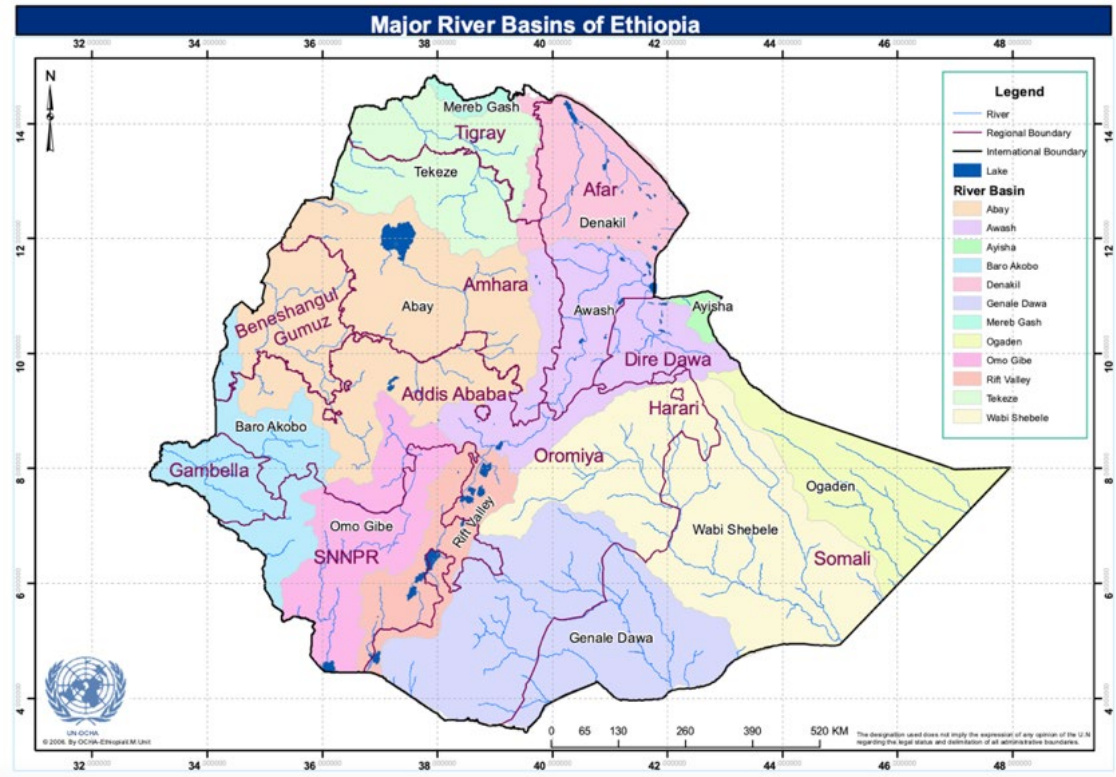
The Ministry of Finance approved five hydropower projects in 2018 for which it is looking for companies interested to partake in PPPs. The five hydropower projects are Chemoga Yeda I and II (280 MW installed capacity, producing 1,102 GW), Halele Werabesa (436 MW installed capacity, producing 2,029 GW), Genale Dawa V (100 MW installed capacity, producing 578 GW), Genale Dawa VI (246 MW installed capacity, producing 1,542 GW) and Dabus (798 MW installed capacity, producing 3,433 GW). Feasibility studies are financed by the AfDB and are currently under revision. These projects are available to investors in IPP or EPC, which presents opportunities for companies active in planning, design, construction, operation and maintenance.

Ethiopia has one of the highest potential hydropower generation capacities in Africa. It is estimated that the water resources of the country could produce up to 45,000 MW of energy, while current production is only a little over 4,000 MW, indicating vast untapped potential. The GoE is planning to export the oversupply of electricity to neighbouring countries, but this future offtake will strongly depend on regional energy developments, which are currently experiencing significant in-country investments. As such, this sector could be confronted with neighbouring countries becoming unwilling to offtake Ethiopian-produced electricity. Ethiopian-produced green hydrogen could, therefore, become an attractive alternative, with significant global export potential. One Australian investor has recently obtained an investment licence to develop hydropower dams and produce green hydrogen and ammonia.

OPPORTUNITIES

EEP stresses the opportunity for foreign investors to explore and exploit the potential for green hydrogen production. Given that the Netherlands has been one of the leading countries in developing green hydrogen policy frameworks and exploitation strategies,[44] Dutch companies can explore associated business opportunities and set up long-term strategic partnerships. The GoE embraces any initiatives related to (small-scale) green hydrogen production, particularly those that capitalise on the readily available water resources.

Map 6. MAJOR RIVER BASINS IN ETHIOPIA[45]



Off-grid irrigation systems

The GoE is increasingly aiming at irrigation as a pathway for agricultural and economic development. In the Ten Years Development Plan (2021–2030), the design and construction of medium- and large-scale irrigation systems is stressed, as well as the application of modern irrigation techniques (sprinkler, drip) and increased water use efficiency. Moreover, the establishment of a new, separate Ministry of Irrigation and Lowlands stresses the increased attention on irrigation. In addition to state-planned irrigation, there is a high and growing number of small-scale commercial farmers who, in total, use considerable amounts of water.

OPPORTUNITIES

Using renewable energy for irrigation can enhance income streams for both large-scale and small-scale farmers, while simultaneously lowering the cost of diesel or kerosene fuel purchases.[46] Companies can engage in consultancy, supply and installation of irrigation systems that are operated by renewable energy technologies.

3.5 WASTE TO ENERGY

Waste in Addis Ababa alone increases 5% each year.[47] As organic waste can be transformed into bio-fuel, these waste flows can become a source of energy production and can provide heating solutions (e.g. for tea factories and breweries). Agricultural producers, in particular, face many challenges related to irrigation, pumping and temperature control. They require continuous and reliable electricity supply, for which the grid is unreliable. These producers are currently using alternative diesel-powered generators that are expensive and increase their carbon footprint.

Off-grid and on-grid biogas solutions – generating energy from organic waste – are a feasible alternative to produce energy. Addis Ababa has developed a large waste-to-energy plant, incinerating 1,400 to 1,500 tons of organic waste per day, with a generation capacity of over 600 MW of power flowing back into the national grid. Currently, there are no solutions for waste treatment into energy sources in other areas in Ethiopia, nor are there off-grid systems powering businesses. This presents opportunities for businesses active in the waste-to-energy sector to work together with local businesses or public spaces that create large amounts of organic waste.

OPPORTUNITIES

The current un(der)availability of waste-to-energy solutions presents many opportunities for companies engaged in the introduction of waste-to-energy systems. Ethiopia has many productive users with significant waste streams but with limited access to (reliable) electricity. Waste-to-energy alternatives can provide promising solutions for these users, e.g. long-term financial returns, reducing carbon footprint, and generating valuable outputs (e.g. organic compost). Any company that provides waste-to-energy solutions with a solid business case can therefore expect receptive clientele.

As such, there are opportunities for businesses development, distribution, installation and maintenance of waste-to-energy facilities, such as bio-boilers and biogas combustion systems. It is essential for these companies to assess the available waste streams to build a solid business case for productive users.

4. Annexes

ANNEX 1: DISTRIBUTION CHANNELS FOR SOLAR SYSTEMS

Model	Description	Strengths	Shortcomings
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.
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 programmes; 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.
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.
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.
NGO programmes focused on livelihoods	There are hundreds of women organised by NGOs for employment and business creation who distribute small solar products in areas they live by buying them for solar companies.	High social impact and great brand association.	Expensive to implement unless funded by an external body.

ANNEX 2: TENDER INFORMATION SOURCES

Newspapers

- Addis Fortune
- The Reporter
- Ethiopian Herald

Other

- 2Merkato
- World Bank
- United Nations
- African Development Bank

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