Energy Sector Insights
Kenya

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Amatka – Insight Africa Services

Amatka (Pty) Ltd is a South African company founded and owned by Finnish entrepreneurs based in Cape Town. Amatka provides knowledge and views of business opportunities in Africa with focus on Southern and Eastern Africa. Insight Africa also supports networking and go-to-market actions in these countries.

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Tekes

Tekes – the Finnish Funding Agency for Innovation

Tekes is the main public funding organisation for research, development and innovation in Finland. Tekes funds wide-ranging innovation activities in research communities, industry and service sectors and especially promotes cooperative and risk-intensive projects. Tekes’ current strategy puts strong emphasis on growth seeking SMEs.
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Introduction


The report has been prepared by an international team coordinated by Amatka (Pty) Ltd based in Cape Town, South Africa. The report is part of Team Finland’s Future Watch Program in Africa, called “Strategic Partners for Innovation Actives Africa Services”, and is coordinated by Tekes, the Finnish Funding Agency for Innovation.

The reports, and this service, focuses on issues, facts, signals and insights that are likely to play a role in the energy sector in Kenya in medium term future (1-10 years). This report does not provide sales leads or provide a picture of how to establish operations in any of the countries.

It is strongly recommended that the readers always check the latest information; situations in Africa can change overnight. Amatka has made every attempt to ensure the accuracy and reliability of the information provided in this report. However, the information is provided “as is” without warranty of any kind. Amatka does not accept any responsibility or liability for the accuracy, content, completeness, or reliability of the information contained in this report. No warranties, promises and/or representations of any kind, expressed or implied, are given as to the nature, standard, accuracy or otherwise of the information provided in this report nor to the suitability or otherwise of the information to any particular circumstances. Amatka shall not be liable for any loss or damage of whatever nature (direct, indirect, consequential, or other), which may arise as a result the use of this report, or from use of the information in this report.
The Government of Kenya’s Vision 2030 economic development blueprint program aims to double Kenya’s rate of growth. Investment in the electricity services industry is critical if the government is to achieve the Vision 2030 blueprint.

While access to electricity in Kenya has rapidly increased over the past few years, about half of Kenya’s population still lives in darkness. This is partly because many live in communities far from the national grid, making it too expensive to connect them to it and the cost per kWh is out of reach for many households. Much of the off-grid power is provided for via the burning of charcoal and kerosene lamps / burners.

Kenya Power has 4.8m customers (households) in a population of c. 48m (UN estimate 2016) which @ 5 people / household = 10% penetration.

Kenya currently has a power generating capacity of ~2,300 MW

- 37% hydro, 27% geothermal, 30% thermal, 2.5% Gas Turbine, 1% Wind, 1% cogeneration and 0% solar PV.

**CURRENT GENERATION CAPACITY**

<table>
<thead>
<tr>
<th>Type</th>
<th>Installed MW</th>
<th>Effective MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>820.73</td>
<td>800</td>
</tr>
<tr>
<td>Geothermal</td>
<td>632.00</td>
<td>624</td>
</tr>
<tr>
<td>Thermal (MSD)</td>
<td>716.32</td>
<td>690</td>
</tr>
<tr>
<td>Temporary Thermal</td>
<td>36.00</td>
<td>30</td>
</tr>
<tr>
<td>Thermal (GT)</td>
<td>40.00</td>
<td>30</td>
</tr>
<tr>
<td>Wind</td>
<td>25.50</td>
<td>20</td>
</tr>
<tr>
<td>Biomass</td>
<td>28.00</td>
<td>24</td>
</tr>
<tr>
<td>Interconnected System</td>
<td>2312.28</td>
<td>2247</td>
</tr>
<tr>
<td>Off grid thermal</td>
<td>27.00</td>
<td>23</td>
</tr>
<tr>
<td>Off grid wind</td>
<td>0.57</td>
<td>1</td>
</tr>
<tr>
<td>Off grid solar</td>
<td>0.58</td>
<td>0</td>
</tr>
<tr>
<td>Imports</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>Total Capacity</td>
<td>2,341</td>
<td>2,378</td>
</tr>
</tbody>
</table>

Figure 1 – Kenya’s Current Generation Mix (source: MoEP)
Figure 2 – Kenya’s Target Generation Mix by 2020 (source: MoEP)

This is expected to increase to ~5,000 MW over the next 5 years and to 26,000 MW by 2030.

Figure 3 – Kenya’s Energy Generation vs Demand forecast to 2030 (source: MoEP)
Significant capacity additions are planned for coal and wind power with a single ~1,000 MW coal power plant and ~300 MW of new wind farms.

Kenya also has at least 1 billion metric tons of recoverable coal in four exploration blocks in the Mui coal basin (250 sq km area) located over 200 km southeast of Nairobi where mining planning has commenced.

Additionally, in September 2016 Kenya signed a nuclear power deal with a South Korean company. Kenya aims to add nuclear power with a capacity of 4,000 MW by 2033.

A 700MW LNG power plant is planned at Dongo Kundu but concerns exist regarding the scaling, consumption of this power and grid stability. The high voltage grid is being upgraded and expanded across Kenya – 5,000km of new HV transmission lines is being built by Ketraco.

In a major policy shift, from Q1 2017 Kenya will begin to implement the energy auction system for large grid-connected generation (10MW+ Solar PV, 30MW+ Wind, 10MW+ hydro) in which specific projects are tendered for, as is the case now for geothermal. This is a 180-degree change in policy from the current policy which supports IPPs using the FIT programme but where there is a backlog of incomplete and stalled IPP projects to c. 2,000+ MW (mostly solar PV and Wind).

With an ambitious target of achieving universal access to electricity by 2030, Kenya, among many other countries, is now exploring mini grids for electrifying communities away from the grid. These localized electricity networks—typically harnessing energy from available solar, mini/micro-hydro and some biomass—could hasten connectivity for millions of people.

The Rural Electrification Authority is rolling out up to 25 rural solar/diesel hybrid micro grid-connected systems in 2017 plus solar PV for up to 15,000 primary schools and 10,000 secondary schools, plus police posts, medical centres, and community buildings.

LPG is used across the country for cooking gas by the middle and higher income households and commercial / industrial consumers, however the market is estimated to be at least 3x to 4x under-supplied for reasons of market domination of large players, fickle brand loyalty of the consumer, oligopoly forces, and the limitations of current LPG cylinder production and LPG storage facilities.

Supply side of energy is and will be emphasised for the near to medium term future. The major challenge faced in Kenya is distribution using cost effective strategies, hence solar PV, small to medium biomass, rural grid-connected micro-generation, off-grid generation are key.

Demand side management is already a strong theme with Kenya Power to minimise energy losses within commercial and residential buildings. Commercial properties must undertake annual energy audits and there is widespread promotion of L.E.D light bulbs, plus mandated solar-water heaters on new buildings, smart metering and wider use of pre-paid meter systems.

Energy demand management in Kenya is becoming an ever growing concern, but it is still ‘less sophisticated’ than in Finland, prepaid meters being an example.
Figure 4. Energy Demand Side Strategies and Technologies

Key Players

The key public sector institutions involved in managing and regulating the Kenyan electricity sector are (see also Figure 3):

Ministry of Energy & Petroleum (MOEP)
Responsible for national energy policy formulation including determining the policy on Feed-in-Tariffs (FIT) and for creating a framework to allow growth, investment and efficient operations in the sector. It also grants and revokes generation and distribution licenses upon the recommendation of ERC.

Energy Regulatory Commission (ERC)
Responsible for regulation of the energy sector. The Energy Act of 2006 established ERC as an independent energy regulatory authority with responsibility for economic and technical regulation of electric power, renewable energy and downstream petroleum sub-sectors, including tariff setting and review, licensing, enforcement, dispute settlement, and approval of power purchase and network service contracts.

Kenya Power & Lighting Company (KPLC) known as Kenya Power
Kenya Power is presently the wholesale buyer of electricity and is obligated to purchase electricity from all power generators including KenGen and IPPs on the basis of negotiated Power Purchase Agreements.

Note that this will change in 2017 with the movement of this ‘purchasing’ responsibility to Ketraco, where Ketraco will manage the ‘National Dispatch Centre’ where it will balance power supply with demand and purchase the necessary power from generators.

Kenya Power will be reduced to a low voltage distribution and sales company. Other local mini-grids also have the right to generate, distribute and sell power. Kenya Power is listed on the Nairobi Stock Exchange, it is 49.9% owned by private shareholders, with the remainder owned by the Government of Kenya.

Kenya Electricity Generating Company (KenGen)
Manages all public power generation facilities and is the main generator of electricity (72% of total national generation) which it sells on a wholesale basis to Kenya Power. KenGen is responsible for developing new public sector generation facilities to meet increased demand. KenGen is listed on the Nairobi Stock Exchange, is 30% owned by private sector shareholders and 70% owned by the Government.

Geothermal Development Company (GDC)
100% owned by the Government of Kenya. GDC has the mandate to undertake the high-risk exploration and development of geothermal fields, including exploration, appraisal and production drilling, and the management of proven steam fields. GDC is also responsible for entering into Steam Sales Agreements with investors in the electricity sector, including
KenGen and IPPs, in order that these entities can develop electricity generation capacity with energy sourced from geothermal wells.

**Kenya Electricity Transmission Company (KETRACO)**
In 2008, the Kenyan government created KETRACO to develop new, high-voltage electricity transmission infrastructure to facilitate grid access for rural areas, allow for grid interconnection with new generating plants, and enable regional power trade with neighbouring countries. KETRACO is 100% owned by the Government and is responsible for planning, designing, constructing, owning, operating, and maintaining new high voltage electricity transmission infrastructure.

Ketraco is expanding the its existing 4,000 km network by a further 5,000 km of lines within the next 4 years whilst also establishing a new Dispatch Centre to match real-time demand with the necessary mix of generation.

In 2017 Ketraco will also manage the new Dispatch Centre operations matching supply with demand real-time, and become the buyer of power from IPPs and KenGen as opposed to the current PPA arrangement with Kenya Power.

**Independent Power Producers (IPPs)**
IPPs are private investors in the power sector involved in generation either on a large scale or in renewable energy projects under the Feed-in-Tariff Policy. The IPPs contribute about 28% to the country’s installed capacity.

IPPs will, from 2017, be subject to a tender system (reverse auction), where lowest offer for the supply of power and suitability of the bidder wins the PPA contract. The existing FiT for grid-connected Solar PV (12 $c / kWh) and Wind (11 $c / kWh) will be shelved.

**Kenya Nuclear Electricity Board (KNEB)**
Has the responsibility of developing a comprehensive legal and regulatory framework for the use of nuclear energy in Kenya.

![Figure 5. Key energy players in Kenya](image-url)
Cases

Lake Turkana Wind Power

The Lake Turkana Wind Power Project (LTWP), set to be operational from 2017 onwards, is the single largest private investment in Kenya's history. The wind farm aims to provide 310MW of wind power to Kenya's national grid, equivalent to approximately 15 per cent of the country's current installed electricity generating capacity. On completion, the project will comprise 365 wind turbines, each with a capacity of 850 kW, the associated overhead electric grid collection system and a high voltage substation that will be connected to the national grid. The power produced will be bought at a fixed price by Kenya Power over a 20-year period in accordance with the Power Purchase Agreement.

The project proponent is the LTWP consortium comprising KP&P Africa B.V and Aldwych International as co-developers, Investment Fund for Developing Countries, Vestas Eastern Africa Limited, Finnish Fund for Industrial Cooperation Ltd, KLP Norfund Investments AS and Sandpiper Limited. Interesting detail is that upon completion of the project in 2017, Google will acquire Vestas’ 12.5 per cent stake.

Billed as the largest private investment in the country, the project is expected to reduce the cost of electricity by half. The has been some land disputes as the local residents have accused Lake Turkana Wind Power Limited of acquiring 150,000 acres of their ancestral land for the project without following due process.

Powerhive

Scalable solar mini grids will play a central role in the rural electrification agenda in developing countries in the future. This will be fuelled by the increased entry of private players into the field, and the change of regulations in respect to generation and supply of power from scalable mini grid solutions. These two are already being witnessed in Kenya.

The project, which is an investment between U.S-based Powerhive and Enel Green Power (EGP) seeks to build and develop solar mini-grids in 100 villages in the Western part of Kenya. The solar mini grids will have an installed capacity of 1MW and will bring clean power to households, small businesses, schools, and healthcare centers and serve a total of 90,000 people. The micro-grids will be powered by First Solar’s solar PV technology and operated with Powerhive’s control technology. Francesco Venturini, CEO of EGP indicated the micro grid rural electrification solution will be linked with advanced mobile payment or billing systems, meaning it will adopt a mobile phone prepayment application. The system will use solar power panels, battery storage, and local distribution facilities.

Powerhive became the first company to receive a utility concession from The Kenya Energy Regulatory Commission in 2015. The granting of the permit also signified a turning point for power generation in the country and more changes are expected in the regulations of off grid and micro-grid energy sectors, because previously, the government has used public utility for power generation and supply. It could end their monopoly, although the strategy is meant to help supply power to areas where there are difficulties in extending the grid, said Powerhive. Director of Renewable energy at the ERC, Pavel Oimeke said last year that the deal would not as such threaten a
well-funded Kenya Power Lighting Company, and that it would be a win-win for Kenya. In addition, he said more players are expected to come onboard if they made a good business case.

Emerging markets may witness more mini grid connectivity in the future as more private companies continue to invest in off-grid power alternatives. From January 2016, Caterpillar Ventures, Total Energy Ventures, First Solar, Tao Capital Partners, Pi Investments and other firms joined Prelude Ventures and Powerhive in their $20M Series A financing round to support Powerhive’s expansion of its micro grid energy portfolio in Africa and the Asia Pacific.

Success in the energy access industry requires a keen grip on site performance and revenue streams, detailed insights into consumption patterns, and the ability to rapidly acquire suitable customers and site locations. Powerhive’s innovative technology platform is the solution for penetrating and scaling in emerging energy markets.

Figure 6. Powerhive’s Products (source: www.powerhive.com)
Conclusions

Key Learnings

Key learnings include:

- Five markets: central grids, mini and micro grids (villages, small businesses), off-grid A (rural poor household), off-grid B (energy independence/security seekers), co-generation (off-grid/on-grid of industrial generation such as bagasse)
- Grid-connected solar PV, Wind moving to a tender system; standardised FiT to be shelved
  - New IPP EoI issuance by MoEP has already stopped
  - Multi-nationals will dominate the grid-connected solar PV & Wind IPP projects from 2017
- Kenya Power becoming a low voltage distribution and sales business whilst Ketraco will buy power and manage supply ‘vs demand
- Ketraco, KPLC and REA have extensive distribution network construction and upgrade projects running that require extensive Smart Grid and SCADA solutions
- Energy/electricity plays a crucial role in development of all sectors relevant for Kenya’s development (healthcare, education, agriculture).
- The economic feasibility of electricity provision to customers is a key consideration in developing replicable models for mini-grids. Look for anchor-users.
- USAID’s Power Africa is a big player and strong promoter of US companies (also in tech sector). You’ll not be competing against local players but against US / Western players with sometimes Kenyan façade.
- Some Community-based micro-grids provide connections to community infrastructure including maternal clinics and schools.
- There is to be heightened focus on off-grid biomass generation by MoEP in 2017
- The Rural Electrification Authority is rolling out schools and public building electrification in large numbers (10s thousands) from 2014 onwards plus rural distribution (remote mile) and grid-connected remote mini-generation
- Companies such as PowerGen Renewable Energy in Kenya install micro-grids that allow customers to make upfront payments for energy consumption via mobile money, and through GSM metering technology the operator is able to switch off energy supply for non-payment. These technologies are allowing companies to build scalable models.

Growth Areas

Potential high-growth areas include:

- Solar hybrid micro-grids projects for off-grid counties
- Private solar PV,
- Agricultural biomass-to-energy project development
- Last mile grid extension development
- Energy efficiency and renewable energy technology projects
- Renewable energy plant development, management & operations
- LPG (liquefied petroleum gas) storage and bottling facilities
• Future LNG power generation
• Development of bioethanol plants
• Infrastructure equipment and services in relation to all energy sources
• After diversification of energy system, energy demand management becomes critical
• Large generation tendering by multi-nationals
• Extensive requirements for Smart Grid and SCADA solutions
Practicalities to take into Consideration

Should Finnish companies providing solutions for the energy sector consider Kenyan energy sector as a short, medium or long term opportunity? While there most certainly are opportunities, there most definitely are factors and issues making it an unsuitable destination for the fainthearted. Opportunities, challenges and basic requirements are listed in the Figure 5 below.

Should Finnish companies think Kenya as a energy sector opportunity?

Regardless the target market or the product offered the following factors must be taken into account when approaching the Kenyan customers/partners/markets:

- Emerging markets for cleantech, environment and digitalization. These only play a (marginal) role with businesses partly or wholly funded by the West or local business trying to cut energy costs or make a difference to the environment.
- In general, locals like luxury
- “Green” or “Environmentally Friendly” is not a very good sales argument unless project is accompanied by funding mechanisms
- “Innovation” is almost as useless (unless project funded by the West).
- Job creation will be the key to long term success strategy for current work age population but also the next generation. As quality of education is relatively low, compared to other developed countries, companies must invest in training their employees. Sometimes from the very basics.
- The quality of workmanship, professional standards and individual workplace performance are significant challenges to companies entering the market.
- Many want to win (the future of) Kenya as the East African business hub now. Competition is tough.

Figure 7. Opportunities, Challenges and Requirements in Kenya for Finnish Companies
In case the potential customer base consists of governmental organisations, including state owned enterprises, the key factors that need to be taken into account in the short to medium term (0-5 years) include:

- Generally speaking, Kenyans are highly aspirational as most African nations are (like to make an impression by wearing expensive suites, drive an expensive car, show family photos taken in a luxury resort)
- Sell a package: community / society (for the people), turn-key (the solution), show-recognition (for the individuals), provide the financing (EXIM style Trade Finance / vendor finance / terms)
- Know the name of the game, don’t be easy-to-fool (an example: “for Scandinavians you sell female empowerment in order to get money”).

In case the potential customer base consists of local companies, the key factors that need to be taken into account in the short to medium term (0-5 years) include:

- There are very little potential customers at the moment.
- Partnership is the way to go forward. True partnership, not just sales partnership. Consider investing in a plant (if in manufacturing) or form a joint-venture (services).
- Finding right partners will take time. There is a lot of talk, yet often little action. There is no deal before you have the money.

In case the potential customer base consists of consumers, the key factors that need to be taken into account in the short to medium term (0-5 years) include:

- Most consumers simply have very little money, most are running on debt, yet they want to invest what they can in food (other than necessary) telecommunications, education, healthcare and beverage, education.
- Quality is not generally appreciated, yet brand and show-off value are.
- Culture of maintenance is generally lacking, still very much developing, hence there is little room for high-maintenance products unless it can be turned in to a plausible local business opportunity.
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