Village
Data
Analytics

CASE STUDY

Predicting mini-grid performance in Tanzania using Village Data Analytics

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1 - Project goal

The goal of the project was to validate VIDA's site assessment capability by comparing VIDA predictions with the on-ground data of operational mini-grids. The test was performed together with ENGIE Energy Access on 12 mini-grid sites in Tanzania. Actual site performance was shared only after the VIDA prediction was made, then the two were compared.

2 - Main findings

Overall, the results were positive.

- VIDA's prediction of the viability of mini-grid sites closely matched the actual performance (mostly within 1 sigma or σ), with the exception of one site (2.2σ)
- VIDA was able to correctly predict high revenue in villages, even where survey data incorrectly suggested lower revenue potential.
- VIDA was able to correctly predict significant differences, even for villages that are located in close geographic proximity.
- As a result of the successful validation, the VIDA team might now assess 30 additional sites that ENGIE Energy Access considers for future development.

3 - The VIDA approach

VIDA is a highly modular tool that ingests satellite imagery, public data, and non-public, on-ground data. A set of machine learning-based algorithms for image processing and energy modelling are used to identify and evaluate viable mini-grid sites. The energy modelling is based on TFE Energy's long-standing expertise in electrification in frontier markets.

VIDA's data analysis workflow follows the four steps shown below. Both the extraction, as well as prediction steps are aided by a library of machine learning (ML) enabled algorithms.

Figure 1
Village Data Analytics' workflow

The result is a "smart map", including a ranking of sites and decision-making information at village level, specifically designed to reflect each user's site selection criteria.

ENGIE Energy Access shared the geolocations of 12 operatinal mini-grid sites in Tanzania with the VIDA team. VIDA first created a digital twin of the villages, using satellite imagery and other available data.

Through a library of algorithms, VIDA then extract relevant insights for each village, including on building number, density, rooftop sizes, road types, location of water bodies, hub-and-spoke-network analyses and the potential for productive activities such as fishing and agriculture.

Last, we combined the extracted insights and applied VIDA's socio-economic and energy modelling to calculate a score per village, representing viability. The villages were then ranked accordingly.

Figure 2
Digitalised buildings and main road in one of the mini-grid sites of ENGIE Energy Access

4 - Validation of results

ENGIE Energy Access then provided the VIDA team with the actual data of the sites, including total revenue per site, average revenue per user (ARPU), connection count, and total generation.

The on-ground validation data for two villages turned out to be unreliable. We therefore decided to exclude them from the analysis. For the remaining ten sites, we then compared the actual data with VIDA scores.

We found good correlations between different on-ground data parameters and VIDA score. The best correlation was with total monthly mini-grid revenue (see below figure 3). Indeed, our coefficient of determination (r^2) of 0.8 is much higher than the values we have seen from on-ground surveys conducted elsewhere in Africa for mini-grid site selection (between 0.4 and 0.6).

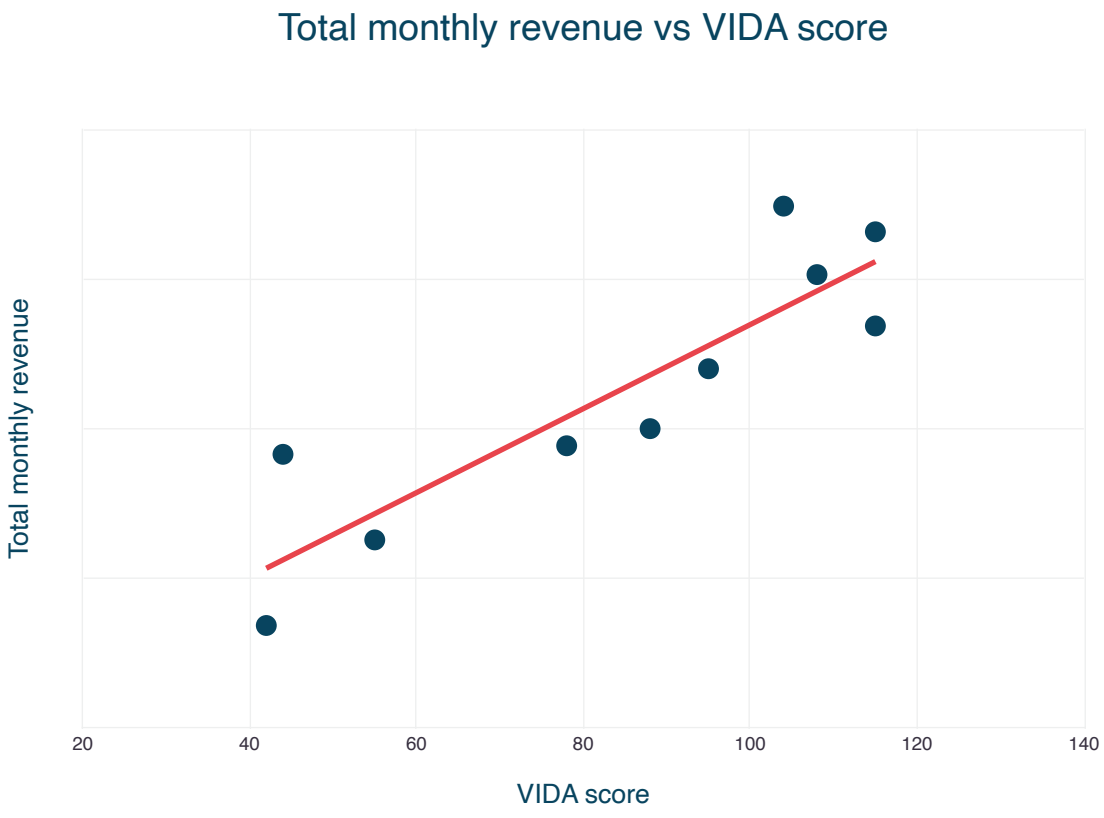


Figure 3
Correlation of VIDA score with monthly revenue of sites

The four villages with the highest VIDA score are also the ones with the highest total revenue. Moreover, the standard deviation between VIDA score and revenue was less than 1σ in eight out of ten cases. This is a strong indicator of the accuracy of the VIDA prediction. One village had a standard deviation of 1.3σ and the main outlier had a standard deviation of 2.2σ. This is represented in figure 4.

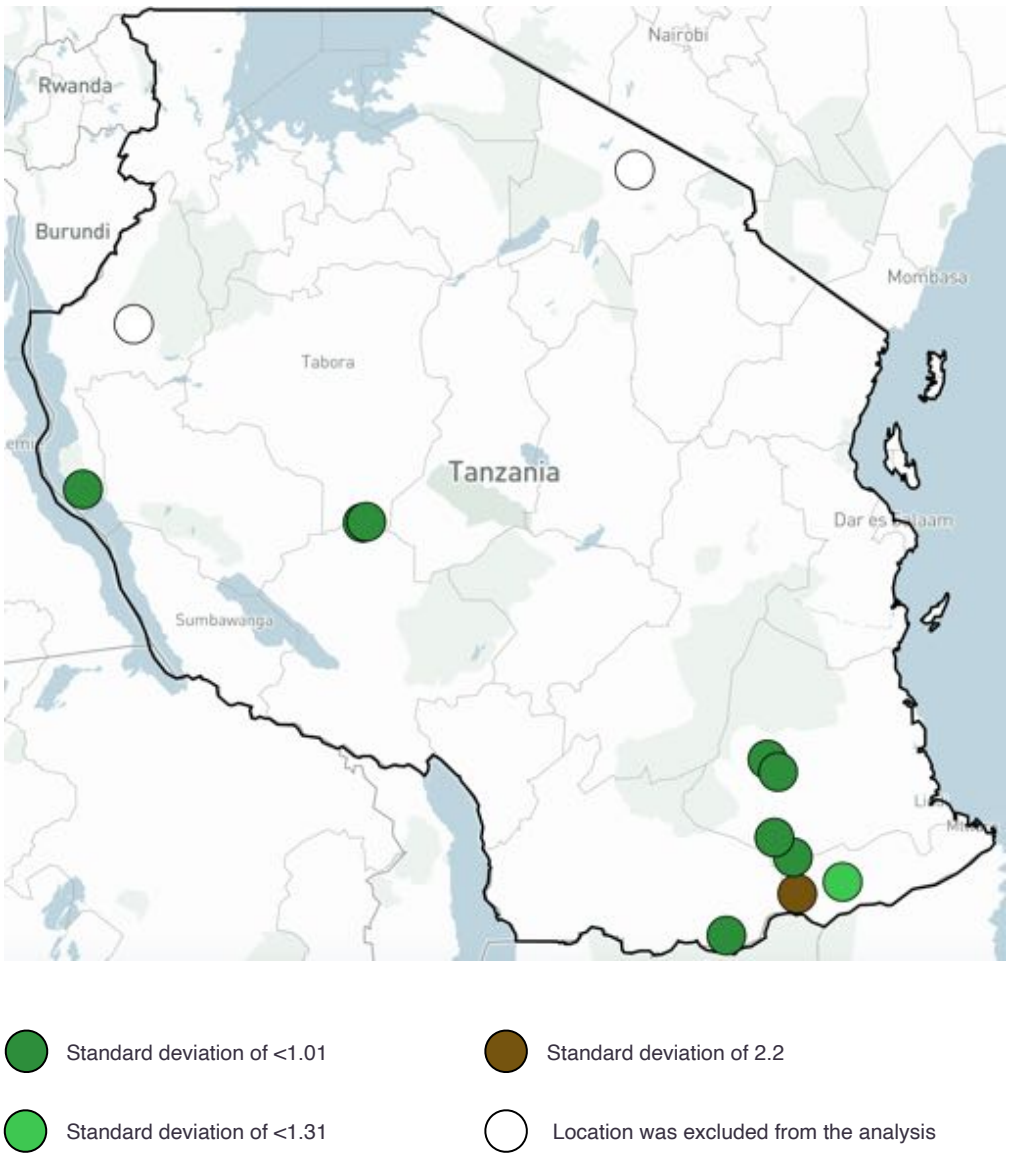


Figure 4
Analysis of correlation between VIDA score and monthly revenue on a village-by-village basis.

Of particular interest is one site, where the initial site survey conducted by the ENGIE Energy Access team predicted only a limited revenue potential, similar to other villages in the region. VIDA, however, correctly identified it as a positive outlier in terms of revenue potential.

Figure 5
Refrigerator in a shop powered by ENGIE Energy Access mini-grid in Tanzania

This real-world validation case study with ENGIE Energy Access shows that VIDA can accurately predict revenue potential of mini-grid sites, thereby significantly reducing investment risk.

Furthermore, after having validated VIDA in different geographic contexts in Africa with mini-grid and solar home system companies (see also our case study with Power Gen), VIDA has proved to be both country agnostic and use case agnostic as a tool for rural electrification planning.

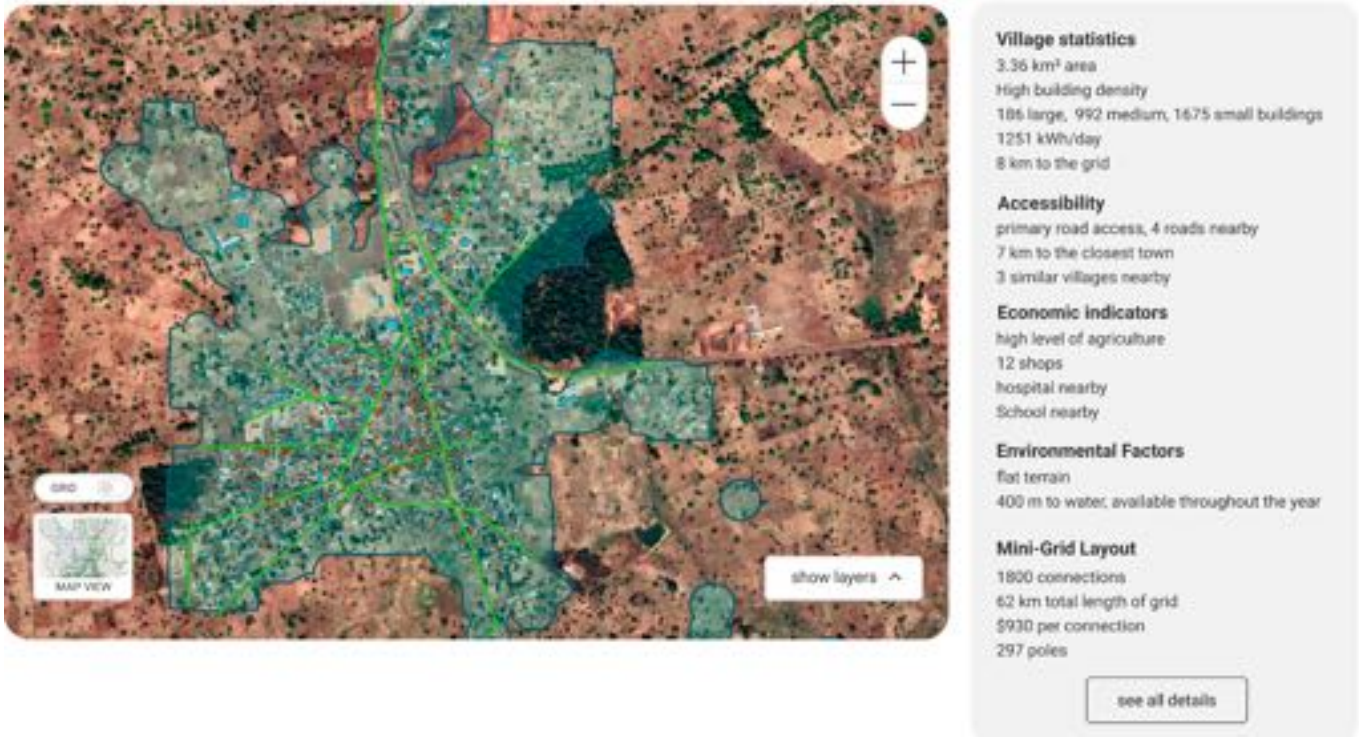
By offering a scalable, reliable and fast site-selection tool, VIDA can play a key role in helping the electrification sector grow profitably (for more, see our recent report on Data and Energy Access). This is essential, if we want to reach SDG7 and supply 1 billion unconnected people with modern energy services by 2030.

5 - Next steps

As a result of the successful validation, the VIDA team might now conduct a more granular and comprehensive analysis on 30 additional sites that ENGIE Energy Access considers for future development.

For a full analysis, the VIDA team can also utilize its machine learning-based library of algorithms to identify high-value customers, estimate demand, create preliminary mini-grid layouts and estimate connection values.

Figure 6
Example of VIDA's in-depth analysis of mini-grid viability



"Within ENGIE Energy Access, we acknowledge selecting viable sites for mini-grids as one of our top challenges. It is time consuming, costly and a key success factor. The possibility to use the intelligent mix of existing data of the VIDA tool can significantly accelerate the deployment of ENGIE Energy Access mini-grids. We're looking forward to continue to work with VIDA on this topic."

Marie-Flore Leclercq
Head of Product & Commercial - Mini-grid department

6 -The team

VIDA

Village Data Analytics

Village Data Analytics (VIDA) is an AI-enabled custom software that supports data-driven investment, business and policy decisions in remote, frontier markets. VIDA's goal is to catalyse the required large-scale investment into these markets to meet global development goals and benefit around 2 billion people.

A key barrier to effective development is the lack of information and transparency about remote, frontier markets. That makes planning and risk assessments imprecise, impact unmeasured and scale difficult to achieve.

VIDA addresses this challenge with a combination of high-impact technology and deep, on-ground sector expertise. VIDA is used by governments and development organisations, by investors and banks and by the companies and NGOs.

More examples of VIDA's work include:

- Identification of more than 2,500 potential off-grid villages for mini-grids in Ethiopia, linked to information about anchor loads, including schools, hospitals or telecom towers. Analysis includes a predicted distribution layout for mini-grid design.

- Identification of attractive sales regions for solar home systems in Kenya, based on settlements, grid and road access and potential sales and logistics hubs. Download the PowerAfrica report here.

- Detailed site assessment and evaluation for mini-grid companies in Tanzania, DRC, Nigeria and Kenya, including socio-economic assessments of villages, distribution layout, and assessment of productive use opportunities and anchor loads.

- COVID 19 response / rural health centre electrification in Africa: VIDA analysed over 1,000 unelectrified rural health centers and helped prioritize them for electrification, based on the population they serve, their strategic importance and the suitability of the surrounding village for electrification.

TFE Energy

TFE Energy (www.tfe.energy) is a values-led business based in Germany and South Africa. We use digital technologies and hard-won practical experience of frontier markets and electrification to support the goal of universal energy access. Village Data Analytics is a product developed by TFE Energy with support from the European Space Agency (ESA) and our AI partner appliedAI (www.appliedAI.de).

ENGIE Energy Access

ENGIE Energy Access (bit.ly/3nCokrX) is one of the leading Pay-As-You-Go (PAYGo) and mini-grids solutions providers in Africa, with a mission to deliver affordable, reliable and sustainable energy solutions and life-changing services with exceptional customer experience. The company is a result of the integration of Fenix International, ENGIE Mobisol and ENGIE PowerCorner; and develops innovative, off-grid solar solutions for homes, public services and businesses, enabling customers and distribution partners access to clean, affordable energy. The PAYGo solar home systems are financed through affordable instalments from $0.14 per day and the mini-grids foster economic development by enabling electrical productive use and triggering business opportunities for entrepreneurs in rural communities.

With over 1,700 employees, operations in nine countries across Africa (Benin, Cote d'Ivoire, Kenya, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia), and over 1 million customers and more than 5 million lives impacted so far, ENGIE Energy Access aims to remain the leading clean energy company, serving millions of customers across Africa by 2025.

Contact us

Publisher
Village Data Analytics
Franz-Joseph Str. 10
Munich 80801
Germany

Nabin Raj Gaihre
nabin.gaihre@villagedata.io
www.villagedata.io