

CASE STUDY

Nigerian minigrids improve power reliability and utility revenues for communities under the grid

HOMER[®] Pro



Safety. Science. Transformation.™

HOMER® Pro

Nigerian minigrids improve power reliability and utility revenues for communities under the grid

Challenge

The town of Toto, located in the central Nigerian state of Nasarawa, is wired for electricity. Though poles and wires dotted the landscape, the area’s residents still lived without electricity.

Like many African communities, Toto’s power supply was poor to nonexistent. Though the town had a power grid, the infrastructure was in shambles, impaired by lack of maintenance and widespread theft. People living in these grid-connected communities, or “under the grid,” often struggle with unpredictable blackouts, power rationing, affordability and lack of power.

System approach

In a win-win-win arrangement, microgrid developer PowerGen Renewable Energy used HOMER Pro to design a minigrid for Toto that supplies reliable power during the daytime, and the Abuja Electricity Distribution Company (AEDC) delivers electricity from the grid at night. The collaboration is an all-around success, providing the community with reliable power, the utility with new revenues, and PowerGen with revenue from operating and maintaining the minigrid and new distribution system.

Design solution

PowerGen Microgrid Engineer Elisha Chesir has designed dozens of African minigrids using HOMER Pro. He used the software to create simulations of the new Toto system, determine optimal solar and battery system sizes and find the levelized cost of energy (LCOE) for customers. However, the Toto minigrid presented additional challenges, including modeling the contribution of grid power from the distribution company (DisCo) and predicting loads for new electricity users.

“HOMER Pro allows us to make good decisions because we were able to input so many parameters; the HOMER model can balance all this information,” Chesir said.

To calculate electrical loads to model in HOMER Pro, PowerGen’s customer acquisition teams conducted site studies and surveys, starting with estimates of the largest loads from businesses, hospitals, schools and government buildings. Extensive experience in Africa enables the company to estimate residential electricity use and growth rates using survey data. PowerGen will implement electrification in phases, using early project data to inform the next phase.



Impact

The Toto, Nigeria, minigrid could establish a precedent for the estimated 200 million undergrid households worldwide.* The system:



Delivers reliable 24/7 power



Supports the financial stability of the regional distribution utility



Uses new smart meters to provide remote monitoring that helps reduce theft and vandalism while improving revenue collection



Provides new economic opportunities, enables students to study at night and supports critical social services



© PowerGen 2022

Location	Technologies	Goals achieved
<ul style="list-style-type: none"> Toto, Nasarawa State, Nigeria 	<ul style="list-style-type: none"> PV solar Energy storage Generators Distribution system 	<ul style="list-style-type: none"> Reliable 24/7 electricity Increased utility revenues Reduced theft

*Graber, Sachiko, Patricia Mong and James Sherwood. *Under the Grid: Improving the Economics and Reliability of Rural Electricity Service with Undergrid Minigrids*. Rocky Mountain Institute, November 2018. www.rmi.org/insight/under-the-grid/

Phase One Toto, Nigeria

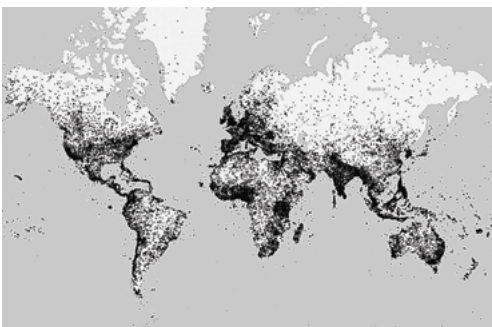
- New local distribution system
- Minigrid connecting about 1,600 households with 8,000 people
- 400-kilowatt (kW) peak power demand
- 375-kW photovoltaic (PV) solar
- One megawatt hour energy storage
- New backup diesel generators



© PowerGen 2022

PV array on a recently commissioned PowerGen microgrid in Nigeria. Project photos and software screen captures courtesy of PowerGen

Founded in Nairobi, PowerGen Renewable Energy develops off-grid systems. The Toto minigrid is PowerGen's first minigrid for a grid-connected community. The company hopes its arrangement with the AEDC will establish a positive precedent for future projects. The company uses HOMER Pro for many of its minigrid projects across Nigeria.

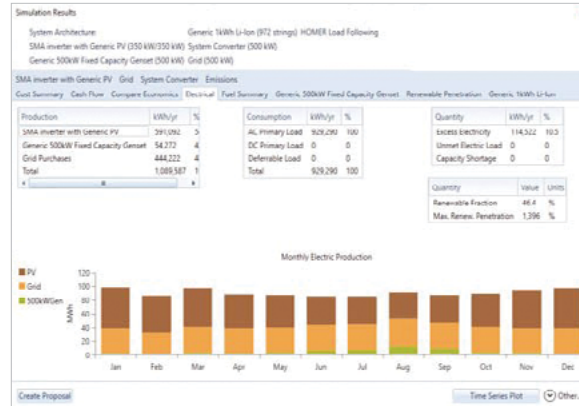


Locations of 250,000+ users performed by HOMER software in more than 190 countries

Modeling results

The HOMER Pro screenshots below show critical parameters modeled to design the solar-plus-storage minigrid in Toto, Nigeria. The system operates in concert with grid power.

The graph shows HOMER Pro's comparison of production from different energy resources and varying electrical consumption.



HOMER Pro shows the total load met by renewable energy.



Why choose UL Solutions and HOMER Pro

Only HOMER software combines economics and engineering in one model, then rapidly performs complex calculations to find the least-cost solution. UL Solutions' expertise and long-standing independent engineering reputation, combined with trusted HOMER software, deliver accurate modeling, design, economic evaluation and optimization. License the software to perform your own modeling or let us do it for you.

Find more information and get a complimentary trial of UL Solutions HOMER Pro when you visit [UL.com/HOMERsoftware](https://ul.com/HOMERsoftware).



[UL.com/Solutions](https://www.ul.com/Solutions)

© 2023 UL LLC. All rights reserved. This document may not be copied or distributed without permission. It is provided for general information purposes only and is not intended to convey legal or other professional advice.