



Use case I Nigeria Diesel Power Plant

Configuration for lowest energy costs:



Off-grid



Diesel genset



BESS



PV

460 kW

387 kWh

167 kW

Benefits: microgrid vs. conventional

CAPEX (k€/p.a)

Microgrid 732k

Conventional

OPEX (in k€/p.a)

Microgrid 205k

Conventional 313k

-35%

0.425

-17%

0.356

Levelized cost
of energy* (€/kWh)

5.5

Years

Break even compared
to conventional (2021 costs)

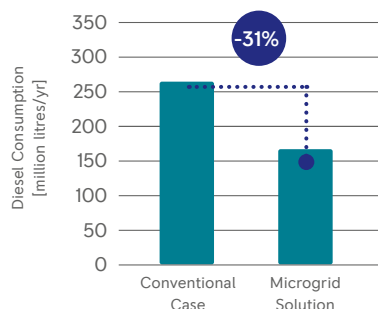
CLEAN, AFFORDABLE AND RELIABLE ENERGY SUPPLY FOR A GATED COMMUNITY IN NIGERIA

Microgrids deliver cost effective and sustainable off-grid solutions
for remote locations

Executive summary

Remote communities often do not have access to a suitable grid connection and are traditionally tied in to using expensive and carbon-intensive diesel generation. This use case shows an example of how a gated community could cut operating cost by 35%, whilst at the same time generating over 31% of their energy from renewables.

Diesel fuel savings



31%

Annual Energy
Generation
from renewables

Who:

Local utility / network provider currently supplying a community of 1,510 households with 100% diesel generation, operating 24/7.

Where:

Nigeria

Why:

Looking for an off-grid energy supply that is a reliable, affordable and green alternative to conventional diesel-only generation, with a focus on reducing energy costs and carbon emissions.

Main benefits:

- Access to power
- Energy cost optimization
- Positive environmental impact



A Rolls-Royce
solution

OPTIMIZING ENERGY COSTS WITH MICROGRIDS

To demonstrate the potential for savings with microgrids, we have calculated an example business case for a remote community in Nigeria, using HOMER GRID™ simulation software.*

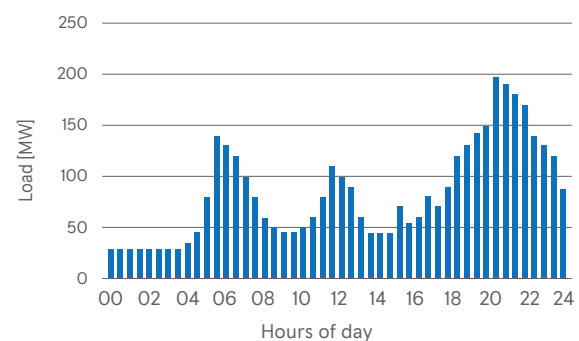
Fluctuating demand throughout the day represents an opportunity for energy storage to smooth the demand profile

The lack of reliable grid energy in remote communities forces a reliance on off-grid energy solutions. However, the conventional diesel solution's expenses are unsustainable due to high fuel costs (transportation and storage), and operation and maintenance costs for the generators.

In our example in Nigeria, the gated community has plenty of space to install Photovoltaics (PV) and take advantage of plentiful cheap renewable energy. With a fluctuating demand profile and high annual peak, a combination of Battery Energy Storage (BESS) and traditional diesel generation is required to provide a stable and reliable supply.

Typical daily load profile

Annual Electricity demand: 737 MWh / Annual Peak Load: 196 kW



Base Case

A gated community in Nigeria powered by two diesel generators:

- 1) 360 kW Diesel Generator
- 2) 100 kW DSGAA Diesel Generator

Annual electricity consumption is 737 MWh. The calculated fuel price is 0,75€ per liter.

Microgrid Solution:

Reduced Energy Costs & Emissions

**-31%
OPEX**

The community produces 31% of its own energy from PV enabling significant operational cost (OPEX) cost reductions. The remaining energy is generated from two diesel generators to be used for back-up power and for periods when there is no sun. A BESS is used to store PV energy, provide grid stability, and optimize operation of the diesel generators.

100% Diesel: 460 kW



Diesel:
PV plant:

379 kW
2.0 MWp

BESS:

387 kWh



Levelized cost of energy*

€ 0.425 per kWh

Annual operating costs:

€ 313k per year

Levelized cost of energy**

€ 0.356 per kWh

Costs per year:

€ 205k

Savings per year:

€ 108k

* Numbers are indicative based on simulation in Homer GRID software

ANALYSIS OF THE BUSINESSCASE

In this use case we compare the conventional case, where 100% power is supplied by diesel generation, with an optimised microgrid solution.

Investing in microgrid solutions with PV and BESS

Conventional case:

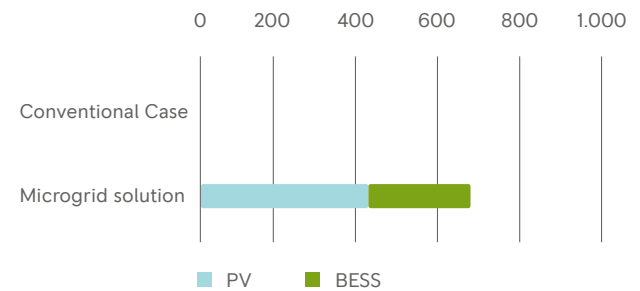
The conventional case consists of 460 kW of diesel generation that is already installed.

Microgrid solution:

The microgrid solution requires a large capital investment with 167 kWp PV generation and a 387 kWh battery to balance the load. In addition, only two diesel generators are required for back-up power, peak load, and extended periods with less sunshine (e.g. over night).

Total capital investment: € 732k

CAPEX (in k€)



Significant operational cost savings

Conventional case:

In the conventional case, all energy is generated by diesel with an assumed cost of €0.75/liter. Operating and maintenance (O&M) costs of the diesel generators are also high due to the high running hours (24/7 operation).

Total operating costs: € 313k / year

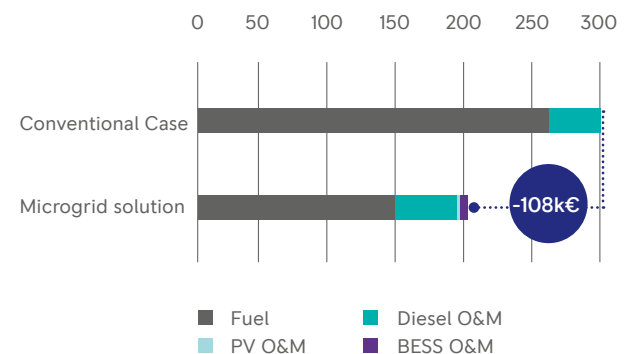
Microgrid solution:

In the microgrid case, 31% of the annual energy generated is produced from the PV panels resulting in reduced operating hours of the generators and therefore reduced O&M costs. The additional use of the battery to enable the generators to run at more efficient operating point, enables an overall fuel reduction of -33%.

Operating costs of the BESS and PV installations are relatively small allowing significant annual operational savings.

Total operating costs: € 205k / year

CAPEX (in k€)

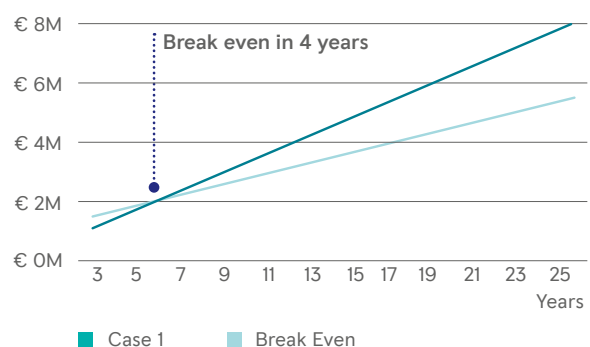


Payback Period

Despite a larger upfront capital investment of €732k, the microgrid solution delivers a very fast pay back period of just 5.5 years.

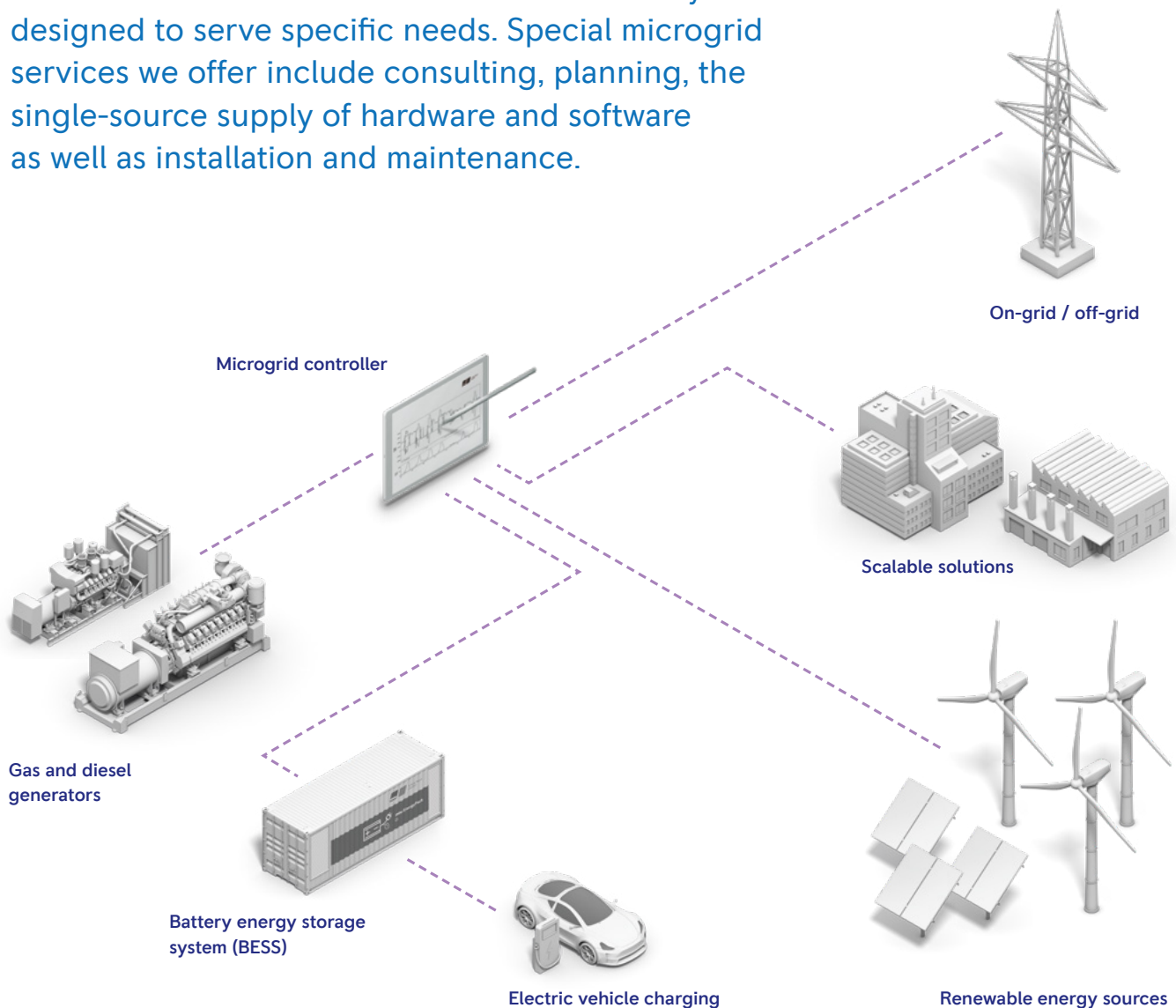
This is mainly achieved through the low energy costs from the PV enabling significant operational savings of € -108k per year. Across the lifetime of the installation this provides a well worthwhile investment.

Cost comparison



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