



Strategic Roadmap for Universal Electricity Access in Myanmar

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Abbreviations

ESMAP	– Energy Sector Management Assistance Program
GEP	– Global Electrification Platform
GIS	– Geographic Information System
IEA	– International Energy Agency
IRENA	– International Renewable Energy Agency
MV	– Medium Voltage
OnSSET	– Open Source Spatial Electrification Tool
PV	– Photovoltaic
QGIS	– Quantum Geographic Information System
SHS	– Solar Home Systems

Executive Summary

This study applies the Open-Source Spatial Electrification Tool (OnSSET), supported by geospatial analysis using QGIS, to assess least-cost electrification pathways for Myanmar. Using nationally relevant demographic, technical, and financial assumptions, two scenarios were developed and analyzed: a Grid Prioritized Solution and an Off-grid Prioritized Solution. The modelling incorporates spatial settlement patterns, infrastructure availability, population growth, and technology costs to identify optimal electrification technologies for different areas across the country.

The Grid Prioritized Solution represents an integrated long-term strategy combining grid densification and extension with decentralized off-grid systems. This scenario requires a total investment of approximately USD 3.8 billion, equivalent to around USD 760 million annually. Under this pathway, 41 percent of new connections are achieved through grid densification, 27 percent through grid extension, 20 percent through solar mini-grids, and 12 percent through stand-alone solar home systems. This approach supports higher levels of electricity consumption, enables productive uses of energy, and aligns with the Electricity Master Plan by strengthening generation and transmission infrastructure.

The Off-grid Prioritized Solution offers a lower-cost and more flexible alternative, with a total investment requirement of USD 720 million, or approximately USD 144 million per year. This scenario places strong emphasis on stand-alone solar home systems, which account for 45 percent of new connections, while grid extension plays a smaller role. Although this approach enables rapid and affordable expansion of basic electricity access, it primarily supports low-tier energy services and may limit opportunities for industrial growth and productive economic activities.

Key observations from the analysis highlight important planning considerations. The number of settlement clusters is nearly double the number of villages, indicating that last-mile electrification will be more complex and costly than initially assumed. Household income levels, affordability, and productive-use potential must therefore be carefully assessed to ensure financial sustainability and social inclusion. Environmental and social safeguards are also essential to mitigate risks associated with infrastructure development and to promote community acceptance. Furthermore, a clear distinction between public-led and private-led electrification is necessary, with public investment focused on core grid infrastructure and private sector engagement driving decentralized solutions.

Overall, the study concludes that a hybrid electrification strategy is the most practical and sustainable pathway for Myanmar. While the Grid Prioritized Solution offers a robust framework for long-term, reliable, and development-oriented electrification, the Off-grid Prioritized Solution provides a viable short-term option in fragile and hard-to-reach contexts. A balanced approach that combines grid expansion with decentralized off-grid systems, supported by strong public–private collaboration, will be essential for achieving universal, affordable, and sustainable electricity access by 2030.

1. Introduction

Myanmar is the largest country in mainland Southeast Asia, located between Bangladesh, India, China, Lao PDR, and Thailand. Despite its potential, Myanmar is one of the least developed countries in Southeast Asia, with a legacy of conflict, isolation, and ineffective policies. Its population of 54.5 million had a gross domestic product (GDP) of \$ 1,359.1 per person in 2024¹. Myanmar's energy consumption is among the lowest in the ASEAN countries with an average annual consumption per person of around 354 kilowatt-hours (kWh), which is ten times less than the world average. About 50% of the population, and 80% of rural households, lacked grid electricity access in 2024. Off-grid schemes are rare and typically provide high cost, low reliability power service for a few hours per day.

The Myanmar Electrification Plan targets the electrification of 8 million households and the achievement of universal electricity access by 2030. The Plan estimates investment requirements of USD 3.8 billion over the next five years to expand the distribution grid and electrify off-grid areas. Achieving scale in electricity access will require sector reforms and enhanced private sector participation. The Myanmar Off-Grid Initiative is expected to play a critical role in supporting the private sector to develop a viable commercial market for standalone solar systems and mini-grids as an integral component of national electrification efforts.

This report seeks to inform Myanmar's electrification strategy through an assessment of multiple pathways toward universal electricity access by 2030. The analysis employs the OnSSET model to identify cost-effective electrification solutions while accounting for financial constraints, infrastructure limitations, emissions minimization, and settlement distribution. It presents two electrification scenarios developed during the EMP-A 2026 OnSSET training. The study emphasizes spatial least-cost modelling to inform national policy decisions and determine the most suitable electrification technologies.

The primary objective is to identify the most effective approach for achieving national electrification targets by evaluating optimal electrification pathway scenarios toward universal access by 2030. This includes comparing least-cost scenarios that integrate grid and off-grid solutions, developing spatially referenced data to support energy access planning, and generating policy and investment insights based on modelling results.

¹ The World Bank, <https://data.worldbank.org/country/myanmar>

2. Methodology

2.1. Modelling Tools

The Open-Source Spatial Electrification Tool (OnSSET) was applied to analyze six scenarios and identify the most financially and environmentally viable options for least-cost electrification planning. Implemented through Python-based Jupyter Notebooks, OnSSET determines least-cost energy solutions—including grid extension, mini-grids, and stand-alone solar home systems—for unserved population clusters. In parallel, QGIS was extensively used for spatial data processing, visualization, and advanced geospatial analysis of both inputs and results. This integrated methodology enables a detailed, spatially explicit assessment of electrification pathways across Myanmar.

2.2. Data Source

Input data were compiled from multiple reliable sources. Geospatial datasets—including administrative boundaries, road networks, existing national grid infrastructure, and health and education facilities—were obtained from the Myanmar Information Management Unit (MIMU)². Electricity access rates were sourced from the World Bank Global Electrification Database, which aggregates nationally representative household surveys and census data spanning 1990 to 2024. Demographic cluster data were retrieved from the Global Electrification Platform (GEP), while solar radiation and wind resource data were obtained from the Global Solar Atlas³ and Global Wind Atlas⁴, respectively. Information on mini grids was collected from Smart Power Myanmar⁵.

2.3. Assumption

The modelling incorporates a set of technical and demographic assumptions aligned with Myanmar's prevailing national context. Population clusters with fewer than 50 households, as well as clusters located within 5 kilometres of existing medium-voltage networks, were excluded from consideration for mini grids electrification. A uniform financial discount rate of 12% was applied across all scenarios. Technical parameters for solar PV efficiency and the lifetimes of batteries, inverters, and charge controllers were based on established industry standards.

² <https://themimu.info/>

³ <https://globalsolaratlas.info/map>

⁴ <https://globalwindatlas.info/en/>

⁵ <https://smartpowermyanmar.org/integrated-electrification>

Key Assumptions

- Population (start year) : 54.5 million (2024)
- Population (target year): 56.35 million (2030)
- Target access rate : 100%
- Urbanization : 31.5%
- Household Size : Rural (4.3), Urban (4.2)
- Electricity Tier Goals : Rural (Tier 1~3), Urban (Tier 4)
- Power plant CAPAX : US\$ 1,500 / kW
- Discount rate : 12%

2.4. Scenarios

2.4.1. Scenario 1: Grid Prioritized Solution

This scenario is based on the assumption that all the funds for grid extension and densification is available and thus prioritized it. The scenario applied automatic OnSSET parameters for top-down forced-grid electrification methodology with population input values as 54.5 million in the base year of 2024.

2.4.2. Scenario 2: Off-grid Prioritized Solution

This scenario is based on the assumption that limited funds is available and thus prioritize off-grid solution for electrification. The scenario applied automatic OnSSET parameters for least cost electrification technology with bottom-up approach.

3. Results

The results of both scenarios are summarised as follows:

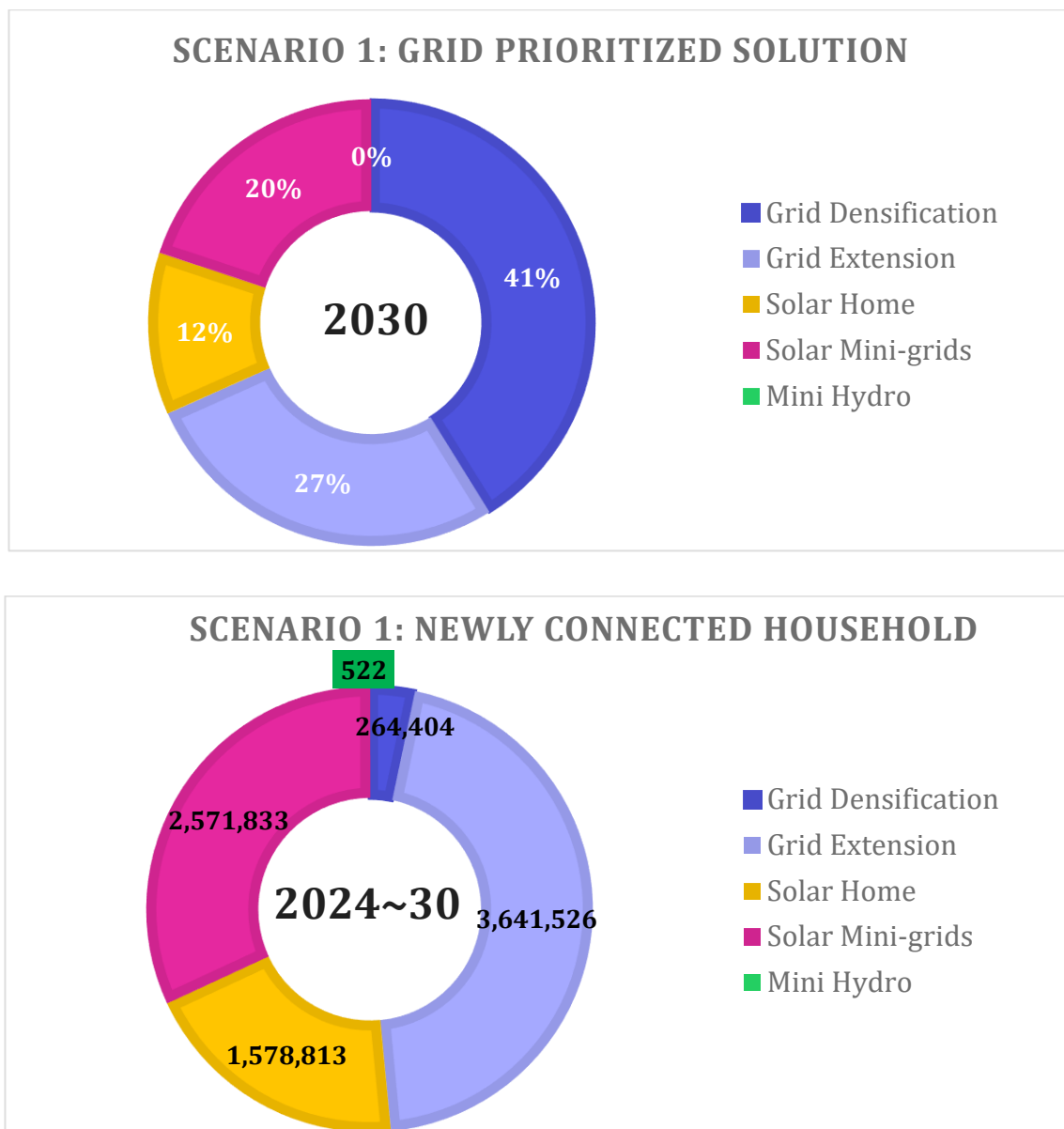
3.1. Scenario 1: Grid Prioritized Solution

This scenario achieves targeted objective of universal access to electricity by 2030 with following technologies with total investment of \$3.8 billion (approximately \$760 million per year).

- Grid densification (41%)
- Grid extension (27%)
- Solar home (12%)
- Solar Mini-grids (20%)

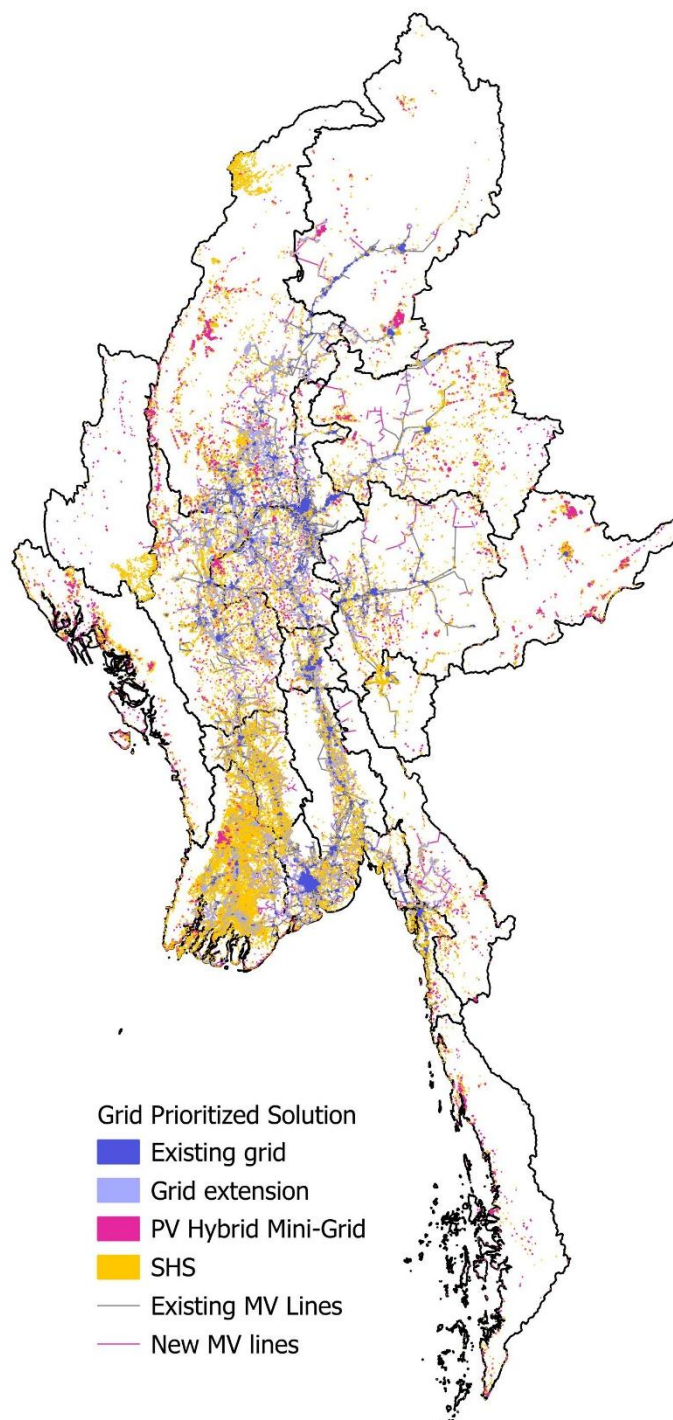
The figures below show the graphs based on summaries from the simulation of grid prioritized solution. This scenario will connect 264,404 households with grid densification, 3,641,526 households with grid extension, 1,578,813 households with individual solar home system, 2,571,833 households with solar mini-grids and 522 households with mini-hydro mini-grids.

Figure 1: Electrification by technology and newly connected households under Grid Prioritized Solution



The map below provides a visualization of Scenario 1: Grid Prioritized Solution in QGIS, showing how technologies and MV lines are distributed across the country.

Figure 2: Map of Grid Prioritized Solution



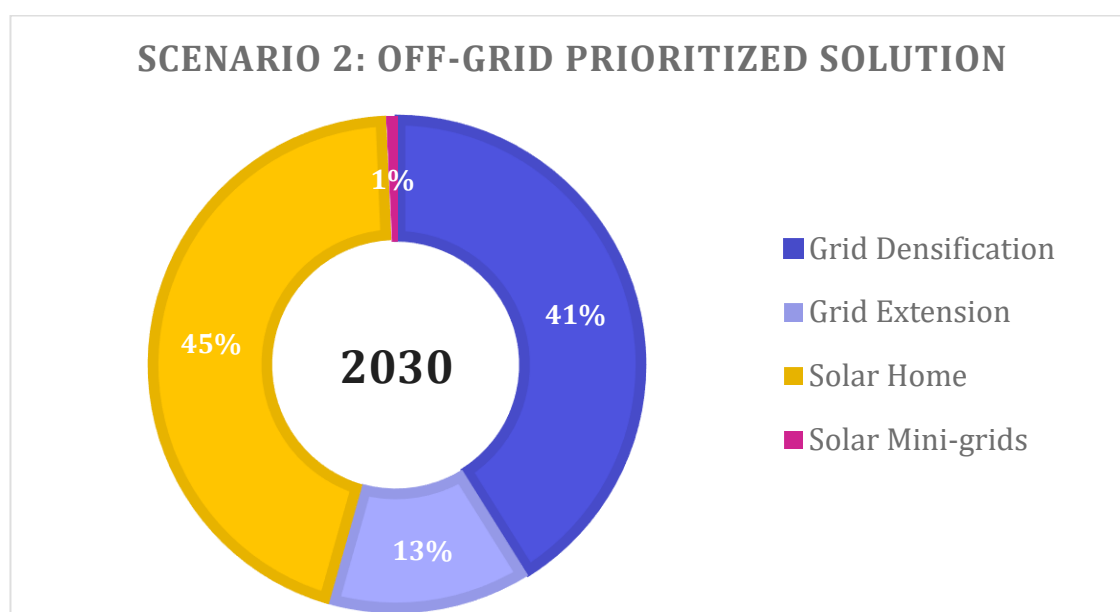
3.2. Scenario 2: Off-grid Prioritized Solution

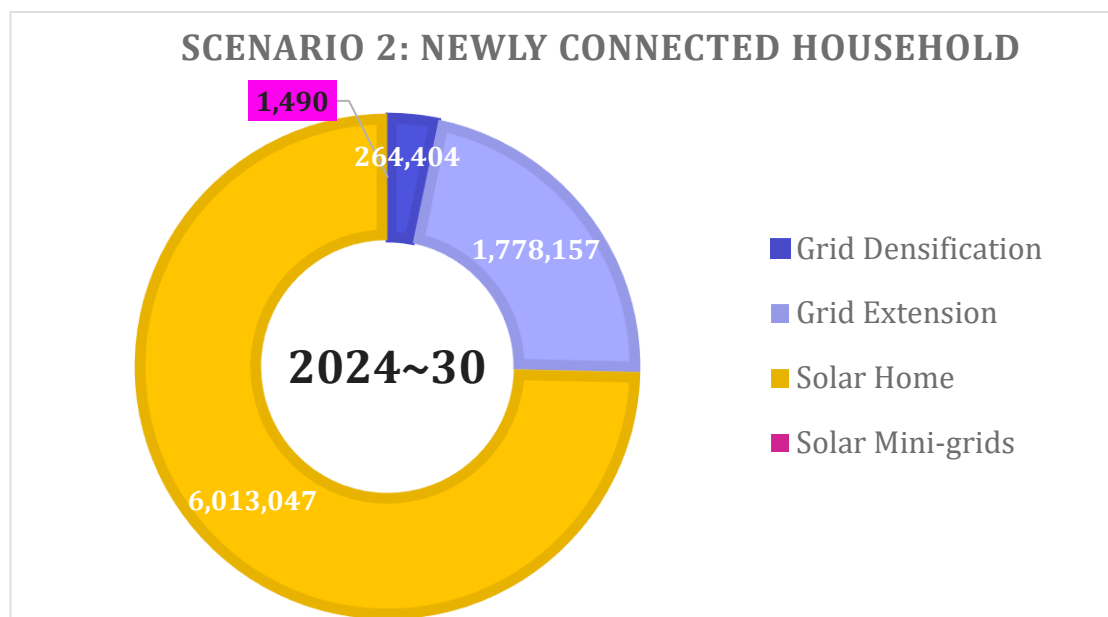
This scenario achieves targeted objective of universal access to electricity by 2030 with following technologies with total investment of \$720 million (approximately \$144 million per year).

- Grid densification (41%)
- Grid extension (13%)
- Solar home (45%)
- Solar Mini-grids (1%)

The figures below show the graphs based on summaries from the simulation of grid prioritized solution. This scenario will connect 264,404 households with grid densification, 1,778,157 households with grid extension, 6,013,047 households with individual solar home system, and 1,490 households with solar mini grids.

Figure 3: Electrification by technology and newly connected households under Off-grid Prioritized Solution



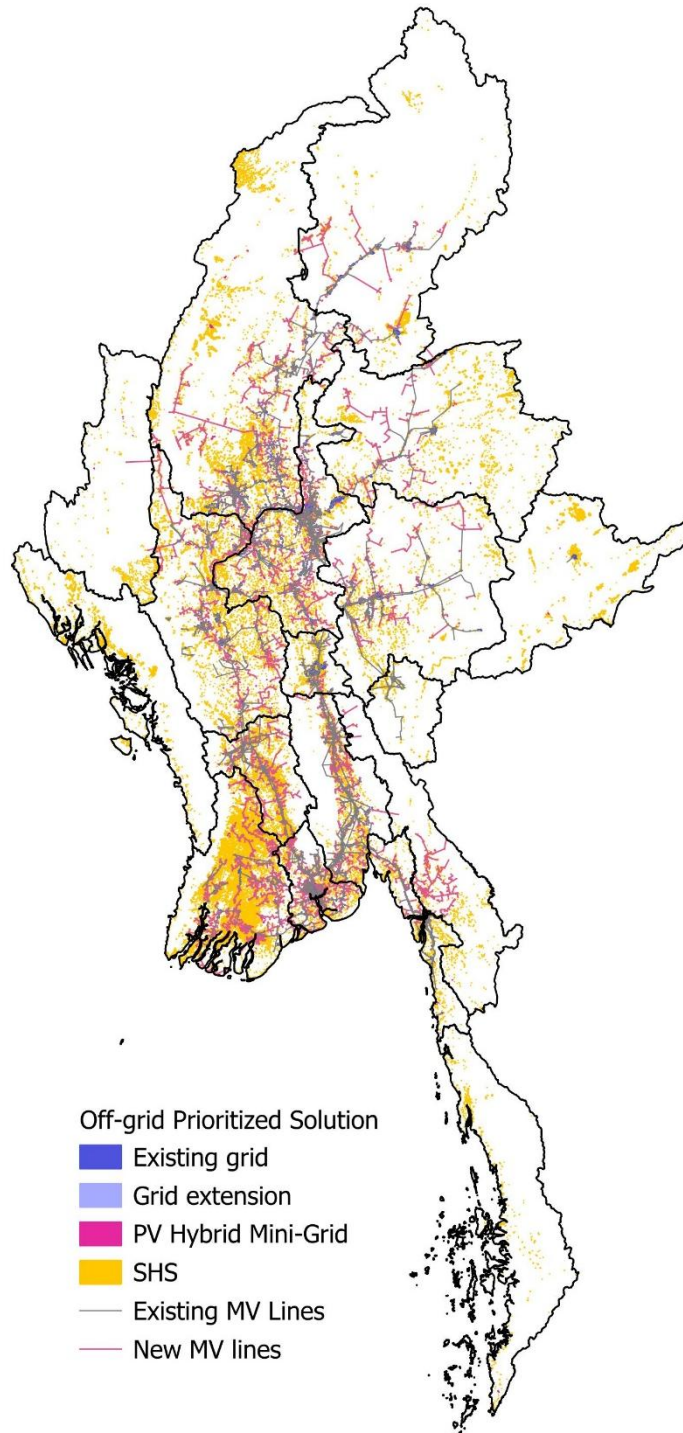


Overall, the table below summarizes the results of the two scenarios side by side over the duration of the simulation 2024 - 2040.

	Scenario 1 Grid Prioritized Solution			Scenario 2 Off-grid Prioritized Solution		
	Investment (million \$)	Population (%)	Household (number)	Investment (million \$)	Population (%)	Household (number)
Grid Densityfication	123.70	41%	264,404	123.70	41%	264,404
Grid Extension	1,852.03	27%	3,641,526	719.86	13%	1,778,157
Solar Home System	902.26	12%	1,578,813	3,436.33	45%	6,013,047
Solar Mini-grids	913.59	20%	2,571,833	0.53	1%	1490
Mini Hydro	0.22	0.1%	522			

The map below provides a visualization of Scenario 1: Grid Prioritized Solution in QGIS, showing how technologies and MV lines are distributed across the country.

Figure 4: Map of Off-grid Prioritized Solution



4. Discussion

The analysis highlights two contrasting but complementary electrification pathways. Scenario 1, the Grid Prioritized Solution, represents a more integrated and long-term approach by combining grid expansion with private sector-led off-grid electrification. Although it requires a relatively high investment of USD 3.8 billion, the annual requirement appears reasonable when aligned with national development objectives. The inclusion of incentives for private actors to develop mini-grids and solar home systems strengthens market participation and can accelerate access in remote areas. Moreover, the parallel implementation of the Electricity Master Plan, with a focus on generation and transmission, ensures that grid investments are supported by adequate supply and system reliability.

In contrast, the Off-grid Prioritized Solution, offers a low-cost and flexible alternative, requiring only USD 720 million in total investment. Its focus on stand-alone solar home systems makes it particularly suitable for fragile and unstable contexts where large-scale infrastructure development may not be feasible. However, while this approach can quickly increase basic electricity access, it may limit opportunities for higher levels of energy consumption and productive uses, which are essential for long-term economic growth.

The observations further emphasize key challenges and considerations for both scenarios. The fact that the number of settlement clusters is almost double the number of villages suggests that last-mile electrification will be more complex and costly than initially anticipated. This underlines the importance of carefully analyzing household income levels, affordability, and productive-use potential to ensure that electrification solutions are financially viable and socially inclusive. Additionally, environmental and social safeguard considerations are crucial, particularly for grid expansion and mini-grid development, to minimize negative impacts and ensure community acceptance.

Finally, the differentiation between public-led and private-led electrification is critical. While public investment is essential for backbone infrastructure such as generation and transmission, private sector participation is better suited for decentralized solutions, including mini-grids and solar home systems. Therefore, a hybrid strategy that combines the strengths of both scenarios—grid expansion where feasible and off-grid solutions for hard-to-reach areas—appears to be the most pragmatic and sustainable approach for achieving universal electricity access.

5. Conclusion

In conclusion, both scenarios present viable pathways to expand electricity access, but the Grid Prioritized Solution emerges as the more comprehensive and sustainable long-term strategy. Although it requires a higher investment of \$3.8 billion, this approach balances grid expansion with private sector-led off-grid solutions, encourages the development of mini-grids and solar home systems, and supports the parallel implementation of the Electricity Master Plan focusing on generation and transmission. However, the Off-grid Prioritized Solution, with its significantly lower investment requirement, remains a practical alternative in the short term, particularly if national conditions remain unstable. Ultimately, the choice between the two depends on the country's stability, financial capacity, and long-term development goals, with the first Scenario offering greater potential for integrated and reliable electrification.

