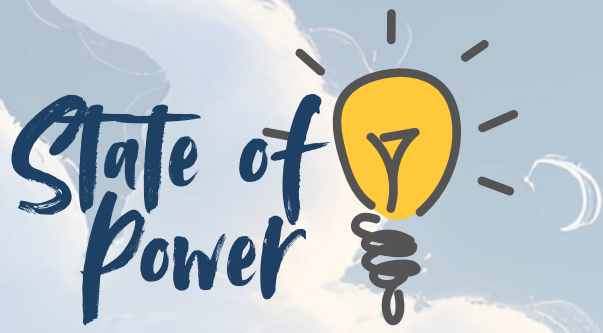




IN PRIMARY HEALTHCARE

Orodata
SCIENCE

Grid Ghost Towns: Elevating Power Across Nigeria's Primary Health Centers



2024/25 EDITION

Orodata Science and Civic Tech for over 10 years, has combined data science, technology, design, and research to improve institutional reforms, foster media innovation, bolster health systems, and facilitate access to inclusive and rich data.

Our vision is to empower people, institutions, and organisations at different levels with knowledge and information that leads to the development of solutions that impact the lives of millions.

Our focus areas include; Reinforcing Health Systems, Enabling Community Media, Ensuring Accurate and Inclusive Data, AI Accountability, and Supporting Institutional Reforms.

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Disclaimer: This report has been produced by Orodata to provide information and data on the status of Primary Health Centres in Nigeria, and underlying issues. Orodata certifies that all the views expressed in this document accurately reflect our fact-based and reliable analytical views. Whilst reasonable care has been applied in crafting this report, no responsibility or liability is accepted for errors or any views expressed herein by Orodata for actions taken due to information provided in it.

Health Sector Abbreviations

- **PHC** – Primary Health Care
- **NPHCDA** – National Primary Health Care Development Agency
- **BHCPF** – Basic Health Care Provision Fund
- **FGN** – Federal Government of Nigeria
- **WHO** – World Health Organization
- **UNDP** – United Nations Development Programme
- **OECD** – Organisation for Economic Co-operation and Development
- **UHC** – Universal Health Coverage
- **NHIS** – National Health Insurance Scheme
- **NHIA** – National Health Insurance Authority
- **BMC** – BioMed Central
- **GAVI** – Global Alliance for Vaccines and Immunization
- **UNICEF** – United Nations Children's Fund
- **SDG** – Sustainable Development Goals
- **CSO** – Civil Society Organization
- **NGO** – Non-Governmental Organization
- **DRPC** – Development Research and Projects Centre
- **NCDC** – Nigeria Centre for Disease Control
- **FMoH** – Federal Ministry of Health
- **RMNCH** – Reproductive, Maternal, Newborn, and Child Health
- **LGA** – Local Government Area
- **LCOE** – Levelized Cost of Energy
- **NHW** – Nigeria Health Watch
- **PPP** – Public-Private Partnership
- **M&E** – Monitoring and Evaluation
- **HRH** – Human Resources for Health
- **CHW** – Community Health Worker
- **HIV/AIDS** – Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
- **TB** – Tuberculosis
- **NMEP** – National Malaria Elimination Programme
- **FP** – Family Planning
- **ANC** – Antenatal Care
- **IMNCH** – Integrated Maternal, Newborn, and Child Health
- **EPI** – Expanded Programme on Immunization
- **NIMR** – Nigerian Institute of Medical Research
- **NISRN** – Nigerian Institute of Social and Rehabilitation Nursing
- **FCT** – Federal Capital Territory
- **NURHI** – Nigerian Urban Reproductive Health Initiative
- **NACA** – National Agency for the Control of AIDS
- **NHREC** – National Health Research Ethics Committee
- **NPC** – Net Present Cost
- **ROI** – Return on Investment
- **IoT** – Internet of Things
- **SEforALL** – Sustainable Energy for All
- **PV** – Photovoltaic



State of Nigeria Primary Health Care Center



Lagos Buban Health Post, Donga, Taraba State



Wurno Government Secondary School Clinic, Wurno, Sokoto State





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We extend our deepest gratitude to Akinsanmi Olusinminrin (Sinmi), whose initial vision and conceptualization for this energy report were the catalyst for its development. His insightful ideas provided the foundational framework and inspired the direction of our research. Sinmi's expertise in renewable energy and infrastructure, unwavering dedication, and collaborative spirit were truly invaluable in bringing this Orodata Science energy report to fruition.

Executive Summary

Nigeria's power sector woes—marked by insufficient generation, high tariffs, and reliance on costly fossil fuel backups—had profound fiscal and economic repercussions across the nation, including in Osun, Anambra, Taraba, Sokoto, Cross River, and Benue. The national grid's output, averaging 3,500-4,500 MW for over 220 million people, translated to persistent outages, forcing states to grapple with revenue shortfalls and rising costs. Revenue generation in these states was hampered by the sector's inefficiencies, as businesses reliant on grid power faced higher operational costs, reducing taxable income. For instance, the tariff hike from ₦24/kWh in 2023 to ₦48-~~₦54~~/kWh in 2024 for residential users (and up to ₦206/kWh for Band A customers by 2024) eroded consumer purchasing power, shrinking the state's internally generated revenue (IGR). The Nigerian Economic Summit Group (NESG) reported that IGR growth varied widely across states, with Sokoto doubling its IGR in prior years through tax reforms, while Osun saw declines due to economic stagnation—trends likely exacerbated in 2024 by power-related cost pressures. We continue to review intersecting factors such as expenditure patterns, debt levels, state-specific economic contexts, and policy responses.

Expenditure

Expenditure in several Nigerian states surged in 2024 as households and governments increasingly relied on diesel generators amid unreliable grid power. By October 2024, diesel prices had risen to approximately ₦1,462 per liter, reflecting an 80-100% year-on-year increase from ₦815 per liter in June 2023, driven by fuel subsidy removal and naira depreciation.

In rural-heavy states like Taraba and Benue, where grid electricity access remained below 25%, households spent an estimated ₦29,000-~~₦43,000~~ monthly on diesel—roughly 25-35% of the median rural income of ₦120,000—placing significant pressure on local budgets. State governments in these regions allocated funds to subsidize diesel for public facilities like hospitals and schools, though exact figures for 2024 are not yet documented.

In more urbanized states like Cross River and Anambra, industrial costs escalated due to higher electricity tariffs and diesel reliance. By mid-2024, business electricity tariffs averaged ₦63-~~₦75~~/kWh for subsidized bands (B-E), while Band A tariffs reached ₦225/kWh for those with 20+ hours of supply, affecting 15% of consumers. Diesel prices in Cross River hit ₦1,920 per liter by June 2024, exacerbating industrial expenses. While specific state relief programs lack confirmation, economic pressures likely prompted increased spending on palliatives, mirroring national trends.

Nationally, the federal government spent over ₦2 trillion (\$1.26 billion at ₦1,588/USD) on power sector subsidies in 2024, far exceeding the budgeted ₦450 billion, diverting funds from infrastructure projects. States like Osun and Sokoto followed suit, prioritizing citizen relief over capital investments, though detailed 2024 state budgets remain unavailable. This reliance on subsidies and diesel underscored Nigeria's ongoing energy crisis, straining both household and government finances.



Debt Levels

Debt levels in Nigerian states rose in 2024 as borrowing offset revenue shortfalls and funded energy alternatives like diesel generators. By June 2024, the naira had depreciated by 55% (from ₦463/USD in May 2023 to ~₦1,488/USD), which increased the cost of imported equipment and increased reliance on loans; by Q1 2024, external debt had reached ₦56.02 trillion. Nationally, Over ₦2 trillion legacy debt in the power sector deterred private investment, mirroring liquidity traps in states dependent on federal allocations.

In Benue and Cross River, prior fiscal challenges and high diesel costs (e.g., ₦1,920/liter in Cross River, June 2024) likely worsened debt-to-revenue ratios. Anambra's industrial base may have mitigated some impacts via private investment, despite tariff hikes. The Debt Management Office reported total public debt at ₦142.3 trillion by September 2024, with an estimated average maturity of ~10 years; interest payments consumed 58-70% of federal revenue (₦7 trillion servicing vs. ~₦10-12 trillion revenue), a burden stark in low-buffer states like Taraba and Osun.

The Economic Context

The economic context across these states reflected a mix of stagnation and resilience. In Sokoto and Taraba, agriculture-driven economies suffered as power shortages disrupted agro-processing, deepening poverty (46% nationally per the World Bank). Anambra's commercial hubs like Onitsha adapted via private solar solutions, though high upfront costs limited scalability. Osun and Benue, with weaker industrial bases, saw slower growth, while Cross River's tourism sector faced setbacks from unreliable power, reducing visitor spending. The African Development Bank projected national GDP growth at 3.2% in 2024 and 3.4% in 2025, but power constraints tempered these gains, particularly in rural states.

Policy Implications varied by States

The Electricity Act 2023, devolving power regulation to states, opened opportunities for localized energy markets, but progress stalled by early 2025. Enugu, alongside Ekiti and Ondo, had enacted laws by March 2025—Enugu's by September 2024—positioning it as a pioneer near Anambra, which could leverage proximity for regional collaboration, as suggested by Energy for Growth Hub. Sokoto's moderate IGR growth (e.g., ₦19.65 billion in 2022) signals potential for solar investments in the high-irradiance north, though no major projects are confirmed. Taraba's Kashimbila dam, operational since March 2023 with 40 MW, showcases targeted hydropower, yet its impact remains localized due to transmission delays.

Osun, Benue, and Cross River, without comparable projects, faced NESG calls for tax reforms and public-private partnerships to fund off-grid solutions like mini-grids, amid reliance on diesel. Nationally, the 2023 subsidy removal and the \$2.3 billion Siemens project (ongoing since 2019) aimed to modernize the grid, with transformer deliveries underway, but state-level capacity shortages—technical and financial—threatened inefficiencies without coordinated regional efforts, as grid capacity lingered at 4,000-5,000 MW in 2024.

Nigeria's power crisis strained revenue, drove up expenditure, and deepened debt across Osun, Anambra, Taraba, Sokoto, Cross River, and Benue, with economic stagnation and policy inertia compounding the challenge. Tailored strategies—renewables in Sokoto, industrial support in Anambra, rural electrification in Taraba—could unlock potential, but require overcoming fiscal and institutional hurdles



Background: Powering Primary Health Care in Nigeria — A Ground View

Primary Health Care (PHC) remains the bedrock of Nigeria's health system, yet its operational reality paints a different story—crippled by unreliable electricity, constrained resources, and slow infrastructural transitions.

Drawing insights from the 2024 Budget review and supplementary datasets on state healthcare spending, it is evident that while states like Anambra, Benue, Cross River, Osun, Sokoto, and Taraba reported significant revenues and expenditures on health in 2024, investments in sustainable energy for PHCs are still fragile and uneven.

Anambra recorded a revenue of ₦379.9 billion against an expenditure of ₦410.1 billion, yet data shows a near-absence of dedicated power investments at PHC levels.

Benue, with ₦225.7 billion expenditure, allocated modestly towards health equipment (₦135.56 million) and hospital construction (₦192.2 million), but little documentation exists tying these to energy resilience.

Cross River, despite a substantial ₦295.6 billion revenue, reflected only ₦120.75 million on equipment and ₦1 million towards hospital infrastructure—a faint footprint for a region battling energy poverty at health facility levels.

Even in states like Osun, which allocated ₦712 million towards hospital provision, or Taraba, which injected ₦13.3 billion into infrastructure projects, energy planning for PHCs was not a distinct line item.

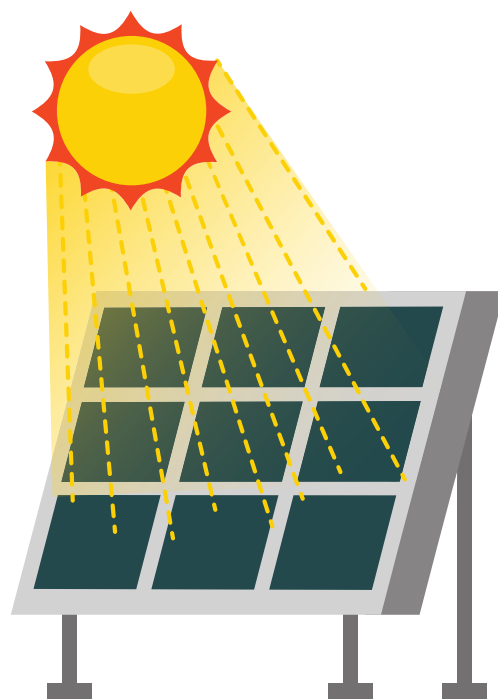
Power Sector Interventions: Early But Isolated Gains

Notable solar energy initiatives targeting PHCs were recorded between 2024 and early 2025: Médecins Sans Frontières (MSF) installed a solar system at a health centre in Bauchi State (Dec 2024), enabling consistent services amidst persistent grid unreliability.

In Kano, the Marmara PHC Solar Installation (Oct 2024–Feb 2025) enabled the facility to operate 24 hours during blackouts, a significant local innovation credited to the Kano State Government and Ward Development Committees.

The WACT-APM Terminals Nigeria project in Rivers State (Jan 2025) donated solar systems to two PHCs in Onne and Ogu—strengthening healthcare delivery via clean, independent energy.

However, these interventions were largely isolated—driven by NGOs and private CSR, not systematically embedded in state-level PHC energy policy or health budgets.



Sector Dynamics: A Fragmented, Underfunded Transition

The broader energy interventions at the PHC level between 2024–2025 highlight:

- Heavy reliance on ad hoc solar donations, without a coordinated national or state strategy.
- Limited integration between ministries of health and energy agencies.
- Absence of performance-based tracking tying health outcomes to energy reliability.

Despite Nigeria installing 73MW of new solar capacity in 2024, verifiable allocations to health centres remain marginal, untracked, or anecdotal.



Nigeria's Solar Energy Surge: Implications for PHC Electrification

In 2024, Nigeria ascended to become Africa's fifth-largest installer of solar energy, adding 63.5 megawatts peak (MWp) to its capacity. This milestone reflects a growing commitment to renewable energy solutions, driven by the need to address the country's persistent electricity challenges.

Key Drivers

Economic Imperatives: Unreliable electricity supply has been causing annual economic losses estimated between ₦7 to ₦10 trillion.

Policy Initiatives: The establishment of GET.invest Nigeria aims to mobilize investments in renewable energy, signaling governmental support for sustainable energy projects. Business Day.

This review, grounded in verifiable fiscal, infrastructural, and project data, underscores a pressing reality:

Nigeria's PHCs are operating on a fragile, patchwork power system, with few systematic efforts to scale resilient energy solutions beyond small pilots. As health demands surge and climate vulnerabilities deepen, the nexus between energy security and health system resilience can no longer remain a footnote—it must become a central pillar of primary healthcare reform. Private sector and NGO projects fill gaps where government budgeting has not intentionally aligned energy and health. Lack of energy maintenance plans for installed systems is a rising risk.

Research Introduction and Insights

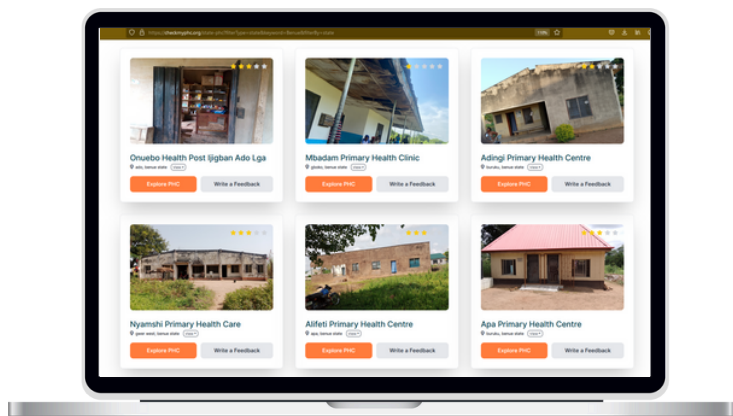
Checkmyphc Report

Healthcare services in Anambra, Benue, Cross River, Osun, Taraba, and Sokoto states are critical for social and economic development, yet they face significant challenges. These states, with diverse rural and urban landscapes, struggle with power instability, infrastructure deficits, and personnel shortages, which hinder the delivery of quality, accessible, and affordable healthcare. Strengthening these systems is essential for building resilient communities and supporting Nigeria's broader economic stability.

This report examines the state of power supply in 345 Primary Health Centres (PHC) across six states: Osun, Anambra, Taraba, Sokoto, Cross River, and Benue. Findings show that 66% of PHCs lack a reliable power source, with only 45% connected to the national grid. Solar energy adoption stands at 26%, while 25% rely on generators. The lack of stable electricity significantly impacts vaccine storage, emergency services, and patient care, resulting in avoidable delays, inefficiencies, and increased mortality rates in rural communities.

A report by Sustainable Energy for All (SEforALL) states that over 80% of PHCs do not utilize renewable energy, despite solar energy being the most viable alternative for rural health facilities. Furthermore, PHCs connected to the grid receive an average of 6–10 hours of power daily, leaving critical medical services vulnerable. The unreliable power supply exacerbates healthcare delivery challenges, affecting maternal health services, surgical procedures, laboratory operations, and storage of essential medicines and vaccines. Without immediate intervention, health outcomes in underserved communities will continue to deteriorate.

To ensure reliable power in PHCs, we must expand solar solutions, improve grid access with government support, explore diverse energy alternatives, and foster strong public-private partnerships for long-term sustainability. Additionally, policy reforms must prioritize rural electrification programs, ensuring that healthcare facilities are integrated into broader national energy planning efforts.



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Checkmyphc

The Critical Role of Electricity in PHC Delivery

Electricity is the backbone of modern healthcare, determining the functionality of essential medical equipment, vaccine storage, and emergency response systems. However, power supply remains one of the biggest barriers to healthcare efficiency in Nigeria's PHC system, especially in remote and rural areas where health facilities are already under-resourced.

According to the Nigeria Roadmap Powering Healthcare Report (SEforALL, 2022), 40% of PHCs lack any form of electricity, and those with access experience severe power fluctuations, affecting their ability to provide consistent medical services. PHCs without stable electricity are unable to support life-saving procedures, operate basic diagnostic equipment, or store vaccines at optimal temperatures, putting millions of patients at risk.

The absence of stable electricity reduces operating hours, affects staff efficiency, and increases patient referrals to distant hospitals. In many instances, expectant mothers, accident victims, and critically ill patients are turned away or referred to better-equipped hospitals miles away, leading to worsened health outcomes and increased fatalities.

This report leverages field surveys, stakeholder insights, and CheckMyPHC variables to assess power availability, reliability, and its effect on healthcare service delivery. It highlights major gaps in PHC electrification, the impact of power shortages on healthcare delivery, and viable solutions to address these challenges. By analyzing energy challenges and potential solutions, this report provides actionable recommendations for sustainable power infrastructure in PHCs with a focus on scalability, efficiency, and long-term sustainability.



Research Insights

To strengthen this report's findings, a combination of quantitative and qualitative research tools were used:

Power Availability:

- **34% of PHCs** have at least one power source.
- **66%** operate without any electricity

Types of Power Sources:

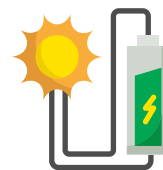
- **National Grid:** 25% of PHCs.
- **Generators:** 35% (mostly as backup power).
- **Solar Power:** 15% (mainly in donor-supported PHCs).
- **Hybrid Systems:** 10% (solar + grid power).
- **Private Power Providers:** 5% (community-funded initiatives).



Power Reliability and Usage

Backup Power Solutions:

- **21%** of PHCs rely on generators or solar but are not connected to the national grid.
- **12%** of PHCs use both generators and the grid.
- **9%** depend on solar and grid
- **8%** combination of solar and generators



Impact of Power Supply on Healthcare Services

Medical Equipment Dependency:

- **Vaccine storage refrigerators:** 6% of PHCs lack fridges due to power issues.
- **Oxygen supply:** 83% of PHCs cannot support emergency oxygen therapy.

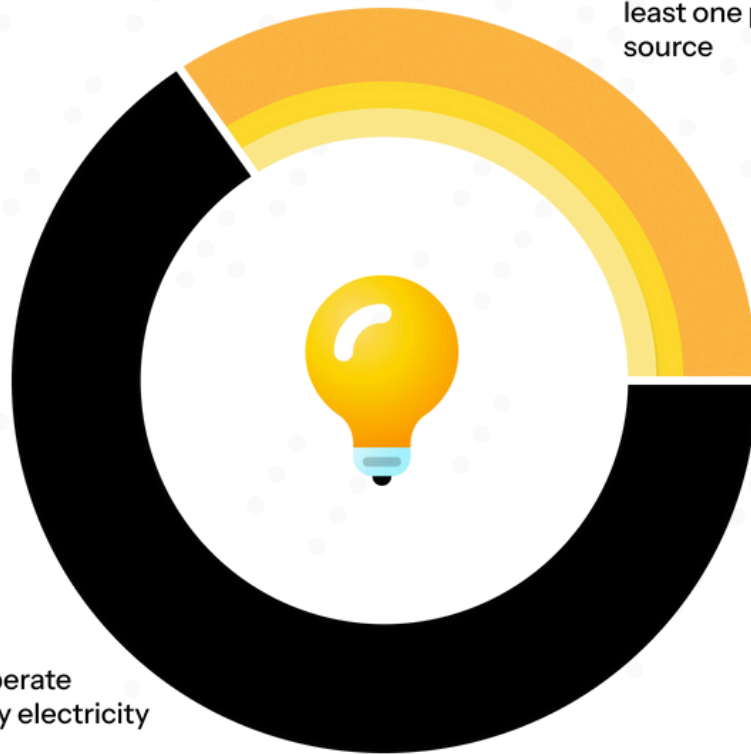
Service Disruptions:

- **Immunization Quality:** 50% of PHCs report poor to very poor immunization services, despite 25% having a power source—suggesting power instability.
- **Referral Cases:** 23% of patient referrals are due to power failures affecting equipment functionality.



Power Availability

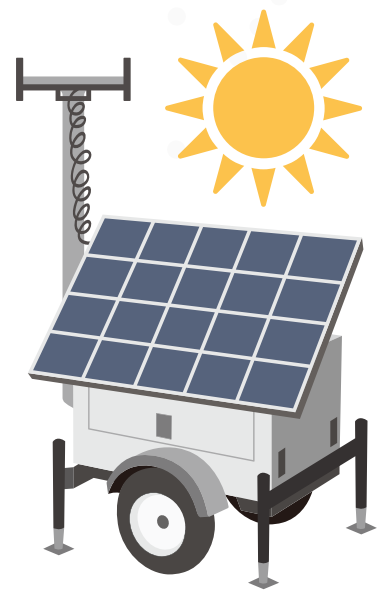
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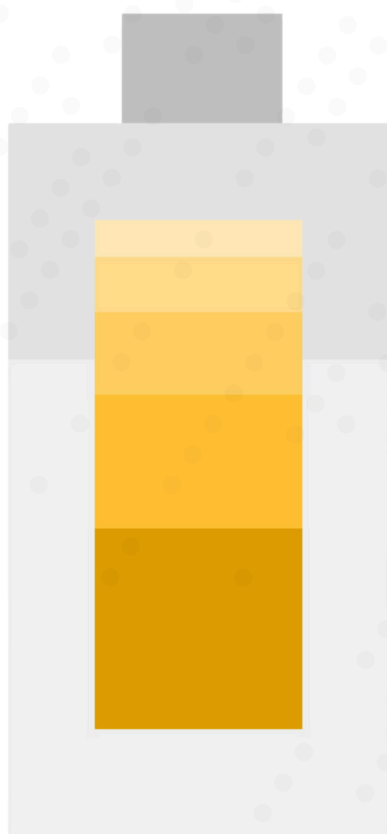
Power Availability:

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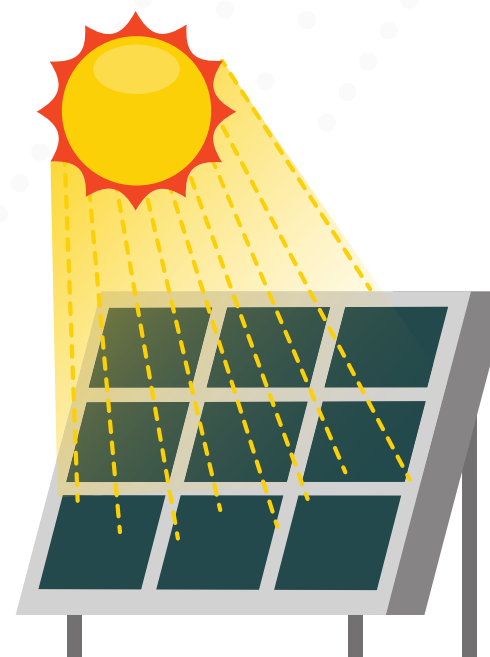
How Are PHCs Powered?



- **Private Power Providers**
5% (community-funded initiatives)
- **Hybrid Systems**
10% (solar + grid power).
- **Solar Power**
15% (mainly in donor-supported PHCs)
- **National Grid**
25% of PHCs
- **Generators**
35% (mostly as backup power)

Types of Power Sources:

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- **Private Power Providers:** 5% (community-funded initiatives).





How Reliable is PHC Electricity?

21% of PHCs

rely on generators or solar but are not connected to the national grid.

12% of PHCs

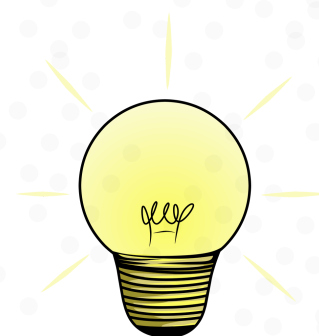
use both generators and the grid.

9% of PHCs

depend on solar and the grid

8% of PHCs

use a combination of solar and generators



Backup Power Solutions:

- 21% of PHCs rely on generators or solar but are not connected to the national grid.
- 12% of PHCs use both generators and the grid.
- 9% depend on solar and grid
- 8% combination of solar and generators



Electricity is not optional—it is a primary healthcare input.



83%

can't provide emergency oxygen therapy



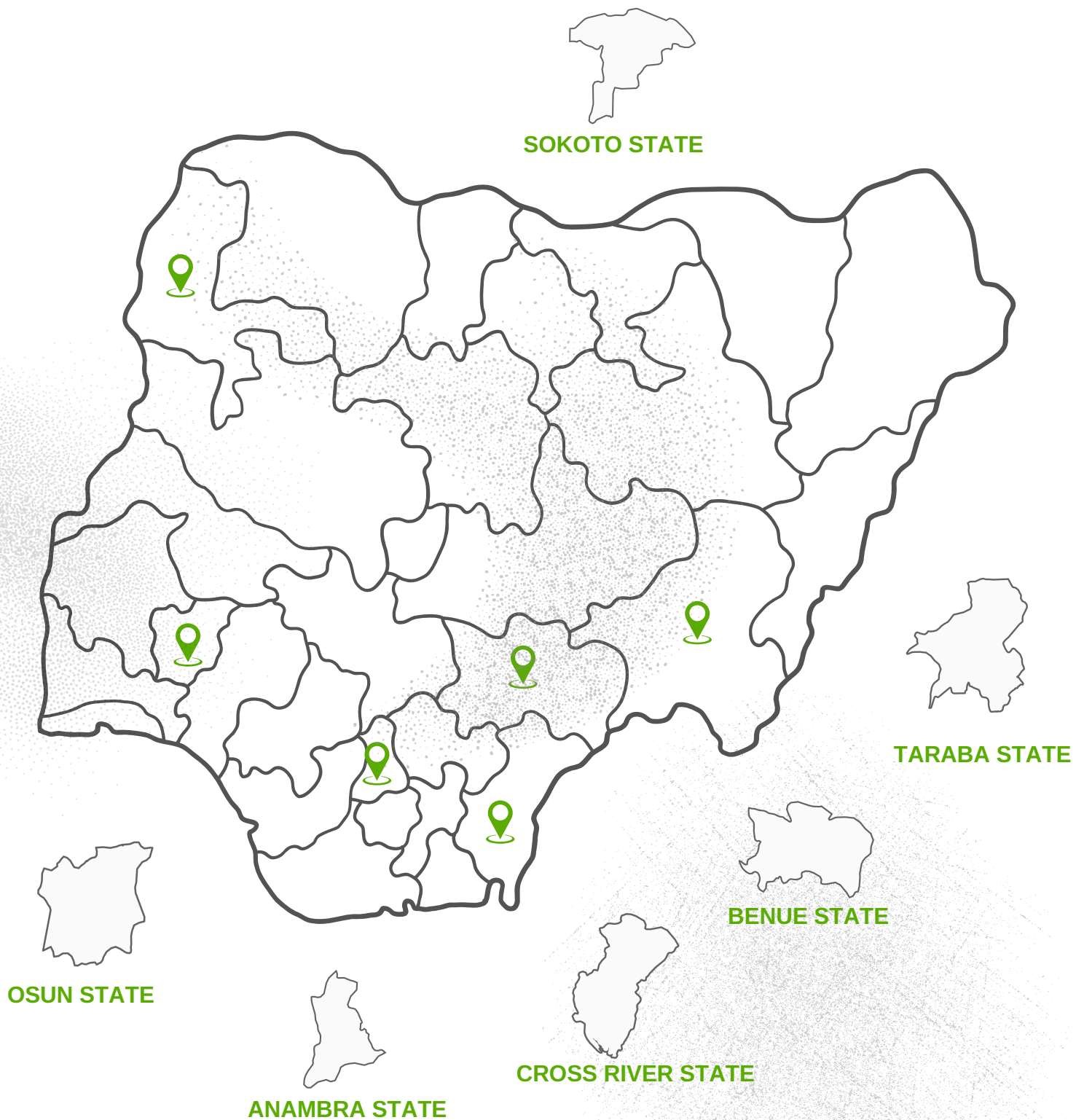
6%

have no fridges due to lack of power

Medical Equipment Dependency:

- **Vaccine storage refrigerators:** 6% of PHCs lack fridges due to power issues.
- **Oxygen supply:** 83% of PHCs cannot support emergency oxygen therapy.

State by State Overview



ANAMBRA STATE



St. Stephen Primary Health Care Centre, Oyi, Anambra State



Ngo Health Post, Idemili South, Anambra State



Uruagu Health Centre, Idemili South, Anambra State



Isseke Primary Health Centre, Ihiala, Anambra State



Sokoto Road Health Post, Onitsha South, Anambra State



Oye Achina Primary Health Centre, Aguata, Anambra State



ANAMBRA STATE



Power Realities in Anambra's Primary Health Care (PHC) System

Out of 66 PHCs assessed in Anambra, power instability remains a significant barrier to quality healthcare delivery, directly affecting critical services and patient outcomes.

Power Access and Sources:

97% of PHCs

experience power outages

77% of PHCs

are connected to the national grid, but many face unreliable supply.



50% of PHCs

rely on generators, while only 9% use solar power

17% of PHCs

depend on generators or solar without grid access, and 33% use both generators and the grid

Impact on Healthcare Services:

- Vaccine Storage: 32% of PHCs lack refrigerators due to power issues, jeopardizing immunization programs.
- Emergency Care: 94% of PHCs cannot support emergency oxygen therapy, putting patients in critical condition at risk.
- Treatment Quality: Of 17 PHCs with poor treatment quality, 16 have power access, suggesting unstable and inconsistent supply.
- Patient Referrals: 20% of PHCs refer due to power failures impacting equipment functionality.

In Anambra, 97% of PHCs experience power outages, and 94% lack oxygen support. Benchmark: Countries like Kenya have cut oxygen-related deaths by 50% with reliable solar backups. Investing in decentralized solar hubs could drastically improve outcomes.

BENUE STATE



Nyamshi Primary Health Care, Gwer West, Benue State



Udebo - Igba Health Post, Ado, Benue State



Ikara Primary Health Post, Ado, Benue State



Mbagar Primary Health Centre, Gboko, Benue State



Yelewata Primary Health Centre, Guma, Benue State



Affoh Primary Health Centre, Gboko, Benue State





BENUE STATE

Power Realities in Benue's Primary Health Care (PHC) System

In Benue, power shortages pose a severe challenge to healthcare delivery, impacting essential services and compromising patient safety across 50 assessed PHCs.

Power Access and Sources:

60% of PHCs

have no power supply at all

42% of PHCs

are connected to the national grid, but many face unreliable supply.



26% of PHCs

rely on solar energy, and 26% use generators

18% of PHCs

depend on generators or solar without grid access

16% of PHCs

use both generators and grid power, while 10% combine solar with the grid

Impact on Healthcare Services:

- Vaccine Storage: 60% of PHCs lack refrigerators due to power issues, jeopardizing immunization programs.
- Emergency Care: 82% of PHCs cannot support emergency oxygen therapy, putting patients in critical condition at risk.
- Treatment Quality: Of 21 PHCs with poor treatment quality, 9 still have power, but likely face instability, while 12 lack power entirely.
- Patient Referrals: 36% of patient referrals are due to power failures disrupting essential medical equipment.

In Benue State, 60% of PHCs lack power; 36% of referrals are due to equipment failure. Solution: Microgrid models from India show how localized energy hubs can solve this. A phased rollout of community-based microgrids could create sustainable energy access.

CROSS RIVER STATE



Abachor Health Post Abachor, Ogoja, Cross River State



Abuekpo Mpam Lagos Health Post, Ogoja, Cross River State



Abuochiche Inland Health Post, Bekwarra, Cross River State



Patapata Health Post, Yakurr, Cross River State



Phc Ikoneto, Odukpani, Cross River State



Agba Health Post, Abi, Cross River State



CROSS RIVER STATE



Power Realities in Cross River Primary Health Care (PHC) System

In Cross River State, power shortages create significant barriers to healthcare delivery, threatening service quality and patient safety across 62 assessed PHCs.

Power Access and Sources:

47% of PHCs

have no power supply at all

26% of PHCs

are connected to the national grid, but many face unreliable supply.



37% of PHCs

rely on solar energy, and 23% use generators

27% of PHCs

depend on generators or solar without grid access

8% of PHCs

use both generators and grid power, 8% combine solar with the grid, and 6% use a mix of solar and generators

Impact on Healthcare Services:

- Vaccine Storage: 60% of PHCs lack refrigerators due to power issues, compromising immunization efforts.
- Emergency Care: 77% of PHCs cannot support emergency oxygen therapy, placing patients at critical risk.
- Treatment Quality: Out of 17 PHCs with poor treatment quality, 12 have no power, while 5 have unstable power, further impacting service delivery.
- Patient Referrals: 15% of patient referrals occur due to power failures affecting equipment functionality.

In Cross-river, 47% of PHCs lack power; 60% have no vaccine refrigerators. UNICEF-led solar refrigeration programs have reduced vaccine spoilage by 80% in similar regions. Scaling such solutions could prevent vaccine loss.

OSUN STATE



Isokun Primary Health Centre, Isokun, Osun State



Okuku PHC, Odo Otin, Osun State



Odeyinka Phc, Irewole, Osun State



Kitibi Healthcare Post, Egbedore, Osun State



Okomi Primary Health Centre, Ayedire, Osun State



Adeti Primary Health Centre, Ilesha West, Osun State



OSUN STATE



Power Realities in Osun Primary Health Care (PHC) System

In Osun State, power supply is more widespread, but instability still impacts healthcare delivery and service quality across 69 assessed PHCs.

Power Access and Sources:

16% of PHCs

have no power supply at all

81% of PHCs

are connected to the national grid, but many face unreliable supply.



29% of PHCs

rely on solar energy, and 13% use generators

4% of PHCs

depend on generators or solar without grid access

12% of PHCs

use both generators and grid power, while 26% combine solar with the grid

Impact on Healthcare Services:

- Vaccine Storage: 32% of PHCs lack refrigerators due to power issues, affecting vaccine availability and immunization efforts.
- Emergency Care: 93% of PHCs cannot support emergency oxygen therapy, endangering patients needing critical care.
- Treatment Quality: Among 11 PHCs with poor treatment quality, 5 have power, but instability likely affects service delivery.
- Patient Referrals: 9% of patient referrals happen due to power failures affecting equipment functionality.

In Osun, 16% of PHCs have no power, but 81% are connected to the grid, though many face instability.

In South Africa, grid-connected clinics with solar backups have achieved nearly 24/7 uptime. A similar hybrid approach could stabilize power for Osun's PHCs.

TARABA STATE



Fada Primary Health Clinic, Donga, Taraba State



Primary Health Care Centre Sibre, Ardo Kola, Taraba State



Lagos Buban Health Post, Donga, Taraba State



Laapo Primary Health Care Center, Zing, Taraba State



Borno-Kuru-Kuru Health Post, Bali, Taraba State



Kankani Primary Health Clinic, Bali, Taraba State



TARABA STATE



Power Realities in Taraba Primary Health Care (PHC) System

In Taraba State, limited grid access and heavy reliance on alternative power sources affect healthcare delivery across 45 assessed PHCs.

Power Access and Sources:

36% of PHCs

have no power supply at all

16% of PHCs

are connected to the national grid, but many face unreliable supply.



44% of PHCs

rely on solar energy, and 36% use generators

49% of PHCs

depend on generators or solar without grid access

4% of PHCs

use both solar and the grid, while 18% combine solar and generators

Impact on Healthcare Services:

- Vaccine Storage: 47% of PHCs lack refrigerators due to power issues, threatening vaccine preservation and immunization programs.
- Emergency Care: 58% of PHCs cannot support emergency oxygen therapy, reducing their ability to handle life-threatening situations.
- Treatment Quality: Among 21 PHCs with poor treatment quality, 10 have power but likely face instability, while 11 lack power entirely.
- Patient Referrals: 29% of patient referrals occur due to power failures affecting medical equipment functionality.

In Taraba, 36% of PHCs have no power, with low grid penetration at 16%. Global Example: In Malawi, community-managed solar systems have powered rural clinics for over 7 years, reducing equipment failure by 60%. Implementing community-driven solar solutions in Taraba could bridge the energy gap.

SOKOTO STATE



Labsani Health Post, Tangaza, Sokoto State



Lahudo Primary Healthcare, Wurno, Sokoto State



Kadam Health Post, Tangaza, Sokoto State



Kwarakka Health Post, Tangaza, Sokoto State



Dinawa Primary Healthcare, Wurno, Sokoto State



Dango Health Post, Illela, Sokoto State

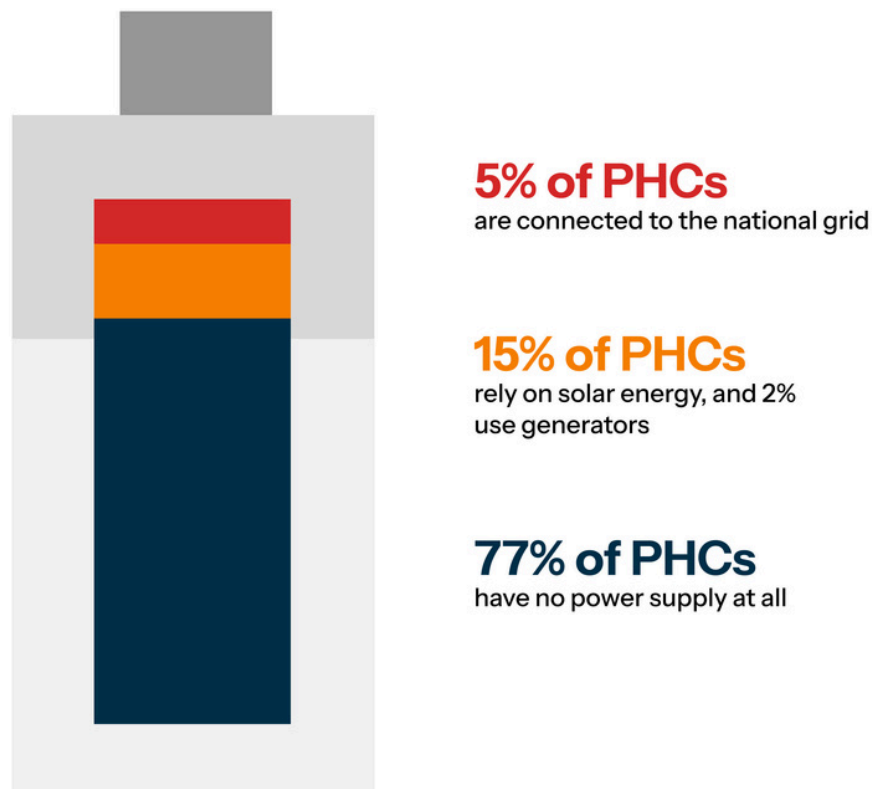


SOKOTO STATE

Power Realities in Sokoto Primary Health Care (PHC) System

In Sokoto State, limited grid access and heavy reliance on alternative power sources affect healthcare delivery across 45 assessed PHCs.

Power Access and Sources:



Impact on Healthcare Services:

- Vaccine Storage: 47% of PHCs lack refrigerators due to power issues, undermining immunization efforts.
- Emergency Care: 81% of PHCs cannot support emergency oxygen therapy, limiting their ability to handle life-threatening emergencies.
- Treatment Quality: Among 22 PHCs with poor treatment quality, 20 have no power, and the 2 with power likely face instability, showing the direct link between power supply and care quality.
- Patient Referrals: 40% of referrals occur due to power failures disrupting medical equipment functionality, forcing patients to seek care elsewhere.

In Sokoto, 77% of PHCs have no power, and only 5% are connected to the grid, leaving 81% unable to support emergency oxygen therapy. The WHO's solar mini-grid initiatives in Yemen sustained healthcare delivery during crises. Opportunity: Establishing community-led solar hubs, combined with IoT-powered energy monitoring, could bring sustainable, reliable power to Sokoto's most vulnerable communities.



Challenges and Barriers

1. Power & Energy Barriers

- No Dedicated Power Budgets: Health budgets often exclude power-specific allocations.
- Non-functional Solar Installations: Damaged panels, drained batteries, and missing components.
- Generator Fuel Shortages: Many PHCs can't afford fuel due to rising prices.
- Faulty Wiring & Technical Failures: Poor maintenance leads to frequent breakdowns.
- No Grid Connectivity: Some PHCs have never been connected or have been disconnected due to unpaid bills.
- Night-time Blackouts: Critical services like deliveries or emergencies lack lighting.
- No Local Maintenance Support: Absence of trained technicians near rural PHCs.

2. Infrastructure & Equipment Barriers

- Dilapidated Buildings: Leaking roofs, broken windows, collapsing structures.
- Inadequate or Missing Equipment: Sterilizers, vaccine fridges, or delivery beds often unavailable or unusable.
- No Storage for Medical Supplies: Insecure and poorly ventilated rooms endanger sensitive supplies.
- Unpowered Cold Chains: Vaccine fridges exist but without consistent electricity.

3. Human Resource Barriers

- Staff Shortages: Some PHCs are manned by only 1–2 staff or volunteers.
- Undertrained Personnel: Inadequate technical, clinical, and digital training.
- Burnout & Attrition: Long hours with little support push workers away.
- No Technical Support Units: No teams dedicated to infrastructure and energy systems upkeep.

4. Data & Monitoring Barriers

- No Real-Time Tracking: Outages, system breakdowns, and supply shortages are not monitored in real time.
- Weak Feedback Loops: Community complaints or observations are rarely recorded or addressed.
- Fragmented Records: Power, staffing, and facility reports are often paper-based and unintegrated.

5. Funding & Policy Barriers

- No Ring-Fenced Funds for Power: Capital projects rarely mandate energy inclusion.
- Overreliance on NGOs & Donors: Most energy fixes are NGO-initiated, not government-led.
- Short-Term Funding: No sustained investment for energy resilience or M&E systems.

6. Political & Governance Barriers

- No National Solar-for-Health Framework: Lack of a federal directive for clean energy in PHCs.
- Policy Neglect: Power infrastructure is not a priority in most PHC revitalization programs.
- Budget Delays & Misalignment: Funds don't arrive on time or match real infrastructure needs.
- Lack of Political Will: Local and state governments often deprioritize PHC power needs in broader development plans.

Global Benchmarks and Solutions

There are several global examples that can inform solutions for Nigeria's PHC power challenges. Kenya has reduced oxygen-related deaths by 50% with reliable solar backups, offering a model for states like Anambra, where 94% of PHCs cannot support oxygen therapy. India's microgrid models demonstrate how localized energy hubs can improve rural power supply, providing a potential solution for Benue and Taraba, where grid access is limited.

UNICEF-led solar refrigeration programs in similar regions have cut vaccine spoilage by 80%, a strategy that could address Cross River's issue, with 60% of PHCs lacking refrigerators. South Africa's grid-connected clinics with solar backups achieve nearly 24/7 uptime, suggesting a hybrid approach for Osun, where 81% of PHCs are grid-connected but face instability. Malawi's community-managed solar systems have powered rural clinics for over seven years, reducing equipment failure by 60%, making it a viable option for Taraba and Sokoto, which rely heavily on alternative power sources.

Additionally, the WHO's solar mini-grid initiatives in Yemen sustained healthcare delivery during crises, offering a blueprint for Sokoto, where 77% of PHCs lack power, and grid connectivity is only 5%. These benchmarks emphasize the effectiveness of solar and community-driven solutions, particularly in off-grid and unstable power environments. Sources: “

World Health Organization (WHO), UNICEF, Ministry of New and Renewable Energy, International Energy Agency (IEA), South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPP), Malawi's Community Energy Malawi (CEM) projects, UNDP, World Bank, IRENA (International Renewable Energy Agency)”

Recommendations

Investment in Renewable Energy

Expand solar energy programs in off-grid PHCs, prioritizing states like Benue, Cross-River, Taraba, and Sokoto, with systems tailored to support critical equipment such as refrigerators and oxygen therapy units. Ensure sustainability through staff training on maintenance and operation, and explore financing options like pay-as-you-go or community contributions. Promote hybrid systems (solar + grid or generator) to enhance reliability, drawing from South Africa's model of near 24/7 uptime in grid-connected clinics.

Strengthen National Grid Connectivity

Conduct feasibility studies to extend the grid to peri-urban PHCs in states like Anambra and Osun, focusing on reducing outages through targeted infrastructure investments. Establish regional energy hubs with backup power solutions, such as generators or energy storage, inspired by India's microgrid successes, to support areas with unreliable grid supply.

Enhanced Policy Support & Partnerships

Develop a national strategy with state-specific targets, setting standards for power reliability and guidelines for selecting appropriate power sources. Foster government-private partnerships to fund and manage energy infrastructure while engaging NGOs and donors for sustainable projects in resource-limited areas. Implement a monitoring system to track power performance and healthcare impacts, adapting strategies based on data, and adopt community-driven models from Malawi for local ownership in states like Taraba and Sokoto.

Priority Actions:

Formalize a “Solar-for-Health” National Initiative:

Create a dedicated budget line within PHC revitalization programs tied directly to decentralized solar installations and maintenance funds.

Deploy PHC Energy Audits Nationwide:

Mandate state health ministries to carry out energy audits of PHCs quarterly, linked to budget releases for health projects.

Mandate 20% Energy Allocation in New Health Budgets:

Every PHC construction/renovation project should mandatorily allocate at least 20% of its capital cost to an independent clean energy solution (e.g., solar + battery bank).

Create Local Maintenance Clusters for PHC Solar Systems:

Train local youth solar technicians around PHC clusters with service contracts for upkeep.

Integrate GHG Emissions Tracking at the Health Facility Level:

Encourage PHCs to report on carbon footprint reductions from diesel displacement—tying health sector to climate action financing.

Economic Viability & ROI for Investors

Investing in solar power for healthcare facilities isn't just socially impactful—it makes financial sense.

A cost-benefit analysis indicates that integrating solar photovoltaic (PV) systems into healthcare facilities can significantly reduce energy costs over time. For instance, a study on Nigerian healthcare centers demonstrated that a hybrid system combining solar inverters with existing grid and diesel generators had a net present cost (NPC) of \$382,263, substantially lower than the \$1,663,158 NPC for facilities relying solely on grid electricity and diesel generators. The levelized cost of energy (LCOE) for the hybrid system was \$0.139/kWh, compared to \$0.642/kWh for the traditional setup. While the initial investment for solar PV systems is higher, the payback period is approximately 4.8 years, with a return on investment of 16% and an internal rate of return of 20.3% (journalcjust.com).

Similarly, another study focusing on a rural primary healthcare center in Nigeria found that implementing a stand-alone solar PV system resulted in a 64.4% savings in life cycle costs compared to using petrol generators. The analysis revealed that while the replacement cost is a significant factor for PV systems, the fuel cost constitutes the highest factor affecting the life cycle cost of petrol generators, accounting for about 87.6% (jest.utm.my).

These findings underscore the economic viability and long-term benefits of adopting solar PV systems in healthcare settings, particularly in regions with unreliable grid electricity.

- **Solar Deployment:** Reduces lifetime energy costs by 60% vs. diesel generators.
- **Community Impact:** lower mortality rates, increased healthcare access.
- **Revenue Streams:** Investors can earn returns through energy-as-a-service models or carbon credits.

Adding financial modeling would help show investors the expected payback periods and the long-term impact of infrastructure investments.

Tech-Driven Solutions for Scalability

- **AI-Powered Forecasting:** Tools like CheckMyPHC can predict power needs, optimizing solar and battery use.
- **IoT Monitoring:** Real-time energy tracking ensures PHCs stay powered, with predictive alerts for maintenance.

Pairing technology with power infrastructure strengthens the sustainability and reliability of energy systems — a critical factor for healthcare operations.

Actionable Investment & Partnership Pathways

1. **Solar & Microgrid Development:** Fund decentralized solar grids for off-grid PHCs, with maintenance built in.
2. **Public-Private Partnerships (PPP):** Co-finance grid extensions with the government and NGOs, using tax incentives to attract investors.
3. **Tech-Driven Energy Solutions:** Invest in IoT systems for real-time energy monitoring, creating recurring revenue models.
4. **Healthcare Resilience Funds:** Launch impact-driven funds for PHC infrastructure improvements, tied to measurable health outcomes.

Conclusion

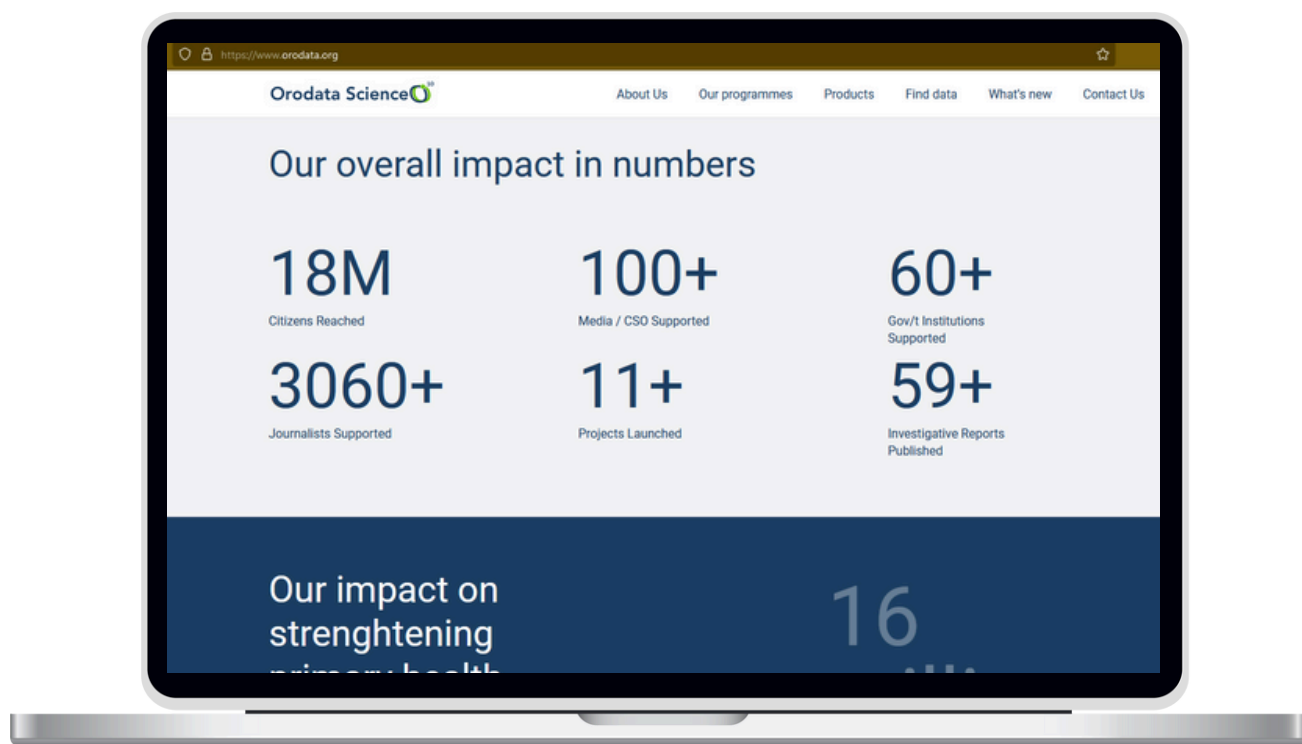
Power supply remains a critical barrier to efficient healthcare delivery in PHCs. Addressing infrastructure gaps, investing in renewable energy, and implementing strategic policies will significantly enhance healthcare service delivery, patient outcomes, and overall system efficiency. Future efforts should focus on scaling impact, leveraging AI for predictive energy needs, and strengthening data-driven decision-making in PHCs.

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3. Journal of Engineering Science and Technology (JEST) — Life Cycle Cost Analysis of Solar vs Petrol Generators for Rural Health Centers in Nigeria (jest.utm.my)
4. World Health Organization (WHO) — Energy for Health Program Reports
5. UNICEF — Reports on Solar Refrigeration for Vaccine Storage
6. CheckMyPHC — Field data collection and analysis tool for PHC infrastructure

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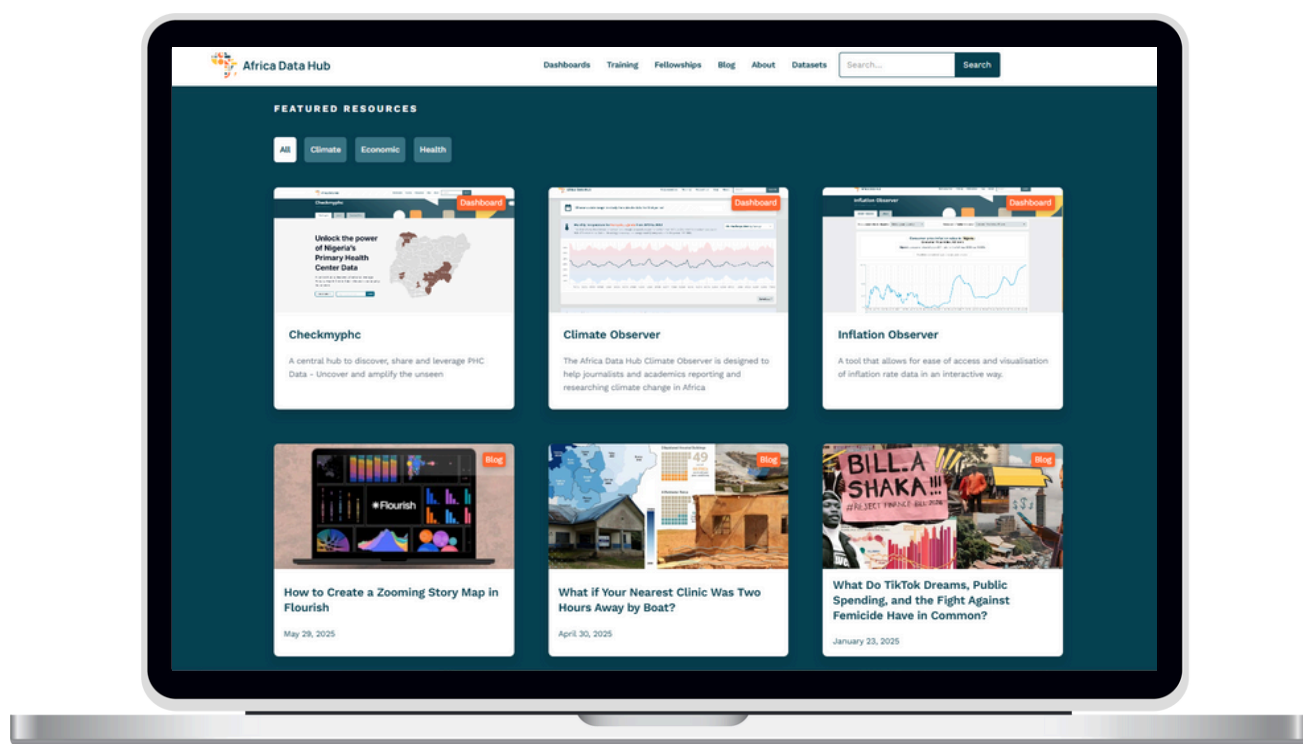
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Artificial Intelligence (AI) for Good

Since 2018, we've been applying Artificial Intelligence (AI) to address global challenges. Our work has spanned diverse areas, from enhancing civic education during elections to simplifying access to vital data for journalists. We've also developed practical guidelines for creating content responsibly using AI, auditing AI algorithms, and ensuring ethical AI development.

Our expertise in AI has been recognized globally. We've shared insights on the future of AI at international conferences and collaborated with leading organizations to design global AI-themed technology festivals.

We firmly believe in AI's potential to solve some of humanity's most pressing problems. For example, we're exploring how AI can analyze climate data to develop sustainable solutions and improve access to healthcare through AI-powered tools. By harnessing AI for good, we can create a better future for all.

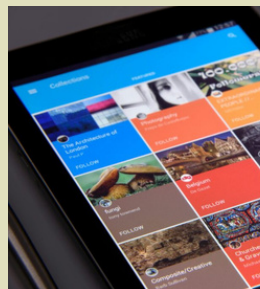
Additionally, we're committed to making more data accessible to organizations, enabling them to train AI models for public good.

AI milestones, projects and activities



Vote:ron AI

A conversational tool for voters to cast informed ballots using historical election data.



Fintel AI Envoy

Developed AI for robotic journalism and automated content production in news media.



Healthy AI Festival

We co-designed the healthy AI-themed Mozilla Festival of 2019 and 2021 with over 6,000 attendees.



Research mention

For pioneering the use of AI-powered tools to create news stories in the public domain in Nigeria.

Scan the QR code to learn more about our projects and how to partner with us on AI.

