Powering Healthcare

Nigeria Market Assessment and Roadmap

Acknowledgements

This document was developed by Sustainable Energy for All (SEforALL), under the Power Africa-funded Powering Healthcare Africa Project. The team and authors include Luc Severi, Jaryeong Kim, Hannah Kabir and Dr. Muntaqa Umar-Sadiq.

We would like to acknowledge the specific support, contributions, and peer review by key stakeholders from the energy and health sectors including the Rural Electrification Agency (REA), the National Primary Health Care Development Agency (NPHCDA), USAID/Power Africa, USAID Nigeria Power Sector Program (NPSP), USAID Integrated Health Program (IHP), as well as the members of the Coalition for Sustainable Electrification of PHCs in Nigeria.

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REA RURAL ELECTRIFICATION AGENCY ENERGY=EMPOWERMENT=EFFICIENCY
NPHCDA National Primary Health Care Development Agency

Acronyms

Term	Definition
ACE TAF	Africa Clean Energy Technical Assistance Facility
AfDB	African Development Bank
ANRIN	Accelerating Nutrition Results in Nigeria
ARBR	Alliance for Responsible Battery Recycling
BHCPF	Basic Health Care Provision Fund
BMGF TSU	Bill and Melinda Gates Foundation Technical Support Unit
Bn	Billion
CAPEX	Capital Expenditures
CET	Common External Tariff
CHW	Community Health Workers
COVID-19	Coronavirus disease
CSOs	Civil Society Organisations
DDI	Diamond Development Initiatives
DFF	Decentralized Facility Financing
DFI	Development Finance Institutions
DisCO	Distribution Company
D-RECs	Distributed Renewable Energy Credits
EAAS	Energy As A Service
EAIF	Emerging Africa Investment Fund
ECREEE	Economic Community of West African States Centre for Renewable Energy and Energy Efficiency
ElectriFI	Electrification Financing Initiative
EPC	Engineering, Procurement and Construction
EPSRA	Electric Power Sector Reform Act
ESCO	Energy Services Company
ESIA	Environmental and Social Impact Assessment

ESMAP	Energy Sector Management Assistance Program
MTF	Multi-Tier Framework
ESP	Economic Sustainability Plan
EU	European Union
EU JRC	European Union Joint Research Centre
FCDO	Foreign, Commonwealth and Development Office
FCT	Federal Capital Territory
FFS	Fee for Service
FGN	Federal Government of Nigeria
FIRS	Federal Inland Revenue Service
FMoH	Federal Ministry of Health
FTHIs	Federal Tertiary Health Institutions
GAVI	Global Alliance for Vaccines and Immunizations
GIS	Geographic Information System
GIZ	German Agency for International Cooperation
GWh	GigaWatt hour
HBF	Heinrich Boll Foundation
HF	Health Facility
HFE	Health Facility Electrification
IDCOL	Infrastructure Development Company Limited
IEP	Integrated Energy Plan
IFU	Investment Fund for Developing Countries
IGR	Internally Generated Revenue
IHP	Integrated Health Program
IUD	Intrauterine Device
kVA	kilo-volt-amperes
kWh	KiloWatt hour
LACA	Local Agency for Control of AIDS
LCOE	Levelized Cost of Electricity
LGA	Local Government Area
LMIC	Lower Middle Income Countries
M&E	Monitoring and Evaluation
MCH	Maternal and Child Health

MDGs	Millennium Development Goals
MEL	Monitoring, Evaluation and Learning
MEPS	Minimum Energy Performance Standards
MJ	MegaJoules
Mn	Million
MOH	Ministry of Health
MW	MegaWatt
MWp	MegaWatt peak
NACA	National Agency for Control of AIDS
NAFDAC	National Agency for Food, Drug Administration and Control
NC	North Central
NCDC	Nigeria Centre for Disease Control
NCS	Nigeria Customs Service
NDC	Nationally Determined Contribution
NE	North East
NEEAP	National Energy Efficiency Action Plan
NEMSA	Nigerian Electricity Management Services Agency
NEP	Nigeria Electrification Project
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGO	Non-Governmental Organization
NHIS	National Health Insurance Scheme
NIMR	National Institute for Medical Research
NIPRD	National Institute for Pharmaceutical Research and Development
NPHCDA	National Primary Health Care Development Agency
NPSP	Nigeria Power Sector Program
NREEEP	National Renewable Energy and Energy Efficiency Policy
NSHDP	National Strategic Health Development Plan
NSIA	Nigeria Sovereign Investment Authority
NW	North West

O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OOPE	Out Of Pocket Expenditure
OPEX	Operating Expenses
PenCom	National Pensions Commission
PHCs	Primary Healthcare Centres
PHCUOR	Primary Healthcare Under One Roof
PMU	Programme Management Unit
PPP	Purchasing Power Parity
PV	Photovoltaic
RBF	Results Based Finance
RE	Renewable Energy
REA	Rural Electrification Agency
REF	Rural Electrification Fund
RESIP	Rural Electrification Strategy and Implementation Plan
REUCS	Rural Electricity Users Cooperative Society
RI	Routine Immunization
SACA	State Agency for Control of AIDS
SAS	Standalone Systems
SDGs	Sustainable Development Goals
SE	South East
SE4ALL AA	Sustainable Energy for All Action Agenda
SEforALL	Sustainable Energy for All
SERC	Schatz Energy Research Center
SHS	Solar Home System
SLA	Service Level Agreement
SMOH	State Ministry of Health
SMOLGA	State Ministry of Local Government Affairs
SNP	Solar Nigeria Programme
SON	Standards Organization of Nigeria
SONCAP	Standards Organization of Nigeria Conformity Assessment Programme
SPHCDA	State Primary Heath Care Development Agency

SREC	Solar Renewable Energy Credits
SS	South South
SSA	Sub-Saharan Africa
SSHIA	State Social Health Insurance Agency
STI	Sexually Transmitted Infections
SW	South West
SWOT	Strengths, Weaknesses, Opportunities and Threats
TA	Technical Assistance
UNICEF	United Nations Children's Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USADF	United States African Development Foundation
USAID	United States Agency for International Development
USD	United States Dollar
USTDA	United States Trade and Development Agency
VAT	Value Added Tax
VHW	Village Health Workers
W	Watt
WB	World Bank
WDC	Ward Development Committees
Wh	Watt hour
WRI	World Resources Institute

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01 | Introduction

Objectives, Scope and Approach

The Powering Healthcare Roadmap for Nigeria was developed by Sustainable Energy for All (SEforALL), under the Power Africa-funded Powering Healthcare Africa Project.

Rationale

- Data on Health Facility Electrification (HFE) is sparse, outdated, and/or stored in multiple locations.
- There is limited coordination between energy and health sector actors (e.g. on medical appliances or HFE investments).
- There is a lot of duplication happening across multiple interventions (e.g. needs assessment tools, system design, research on medical appliances, testing sustainable delivery models).

Roadmap objectives

01 Provide the government and its development partners with market intelligence and the evidence base for advancing HFE in Nigeria.

02 Provide the strategic information and implementation guide needed by governments and their partners to increase investment in and the sustainability of HFE efforts.

03 Provide practical recommendations targeted at the government and its development partners in terms of the planning and coordination of HFE efforts.

Methodology

Data collected through various qualitative and quantitative methods including:

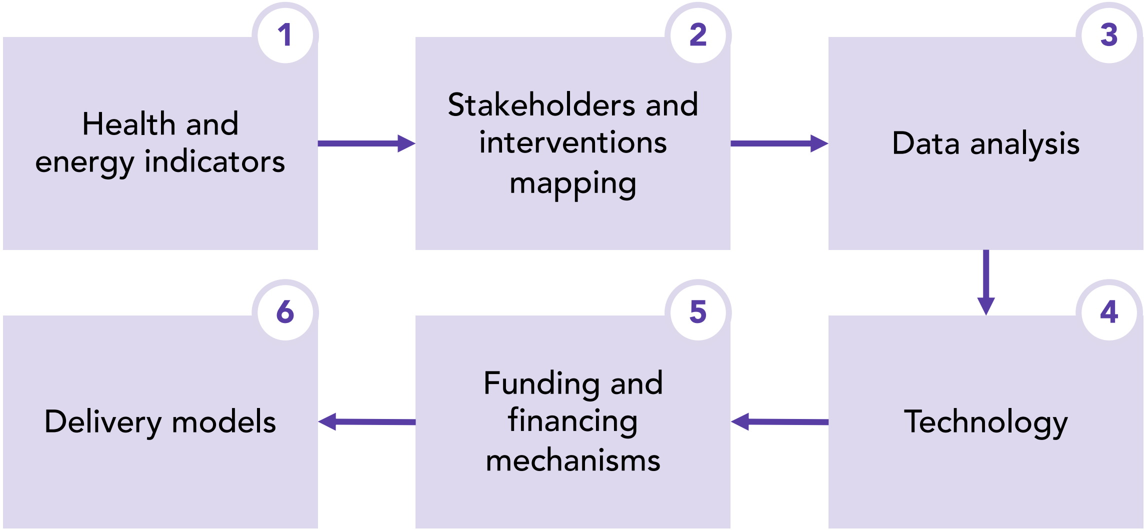
- Document review and realist synthesis,
- Stakeholder mapping,
- Semi-structured interviews,
- Co-creation, validation and dissemination.

The Market Assessment and Roadmap was developed in close collaboration with key stakeholders from the energy and health sectors, including the Rural Electrification Agency (REA), the Federal Ministry of Health (FMOH), the National Primary Health Care Development Agency (NPHCDA), USAID Nigeria Power Sector Program (NPSP), USAID Integrated Health Program (IHP) and the Coalition for Sustainable Electrification of PHCs.

Approach

The Market Assessment and Roadmap consists of several components, including stakeholder and interventions mapping, data analysis, technology assessment, funding and financing mechanisms, and delivery models.

Market assessment and roadmap



02 | Market Assessment

Health and Energy Access Challenges

57%
of population has access to electricity

40%
of PHCs lack access to electricity

512/100,000
Maternal mortality rate (Rank 165/183)

6 - 10 hours
Average power supply from any combination of sources

70/1,000
Infant mortality (Rank 185/193)

205/208
Life expectancy rank

Access to electricity challenges

1

Demand challenges

- Population growing faster than electrification rate
- Lack of access to financing mechanisms for providers and users
- Inadequate access to electricity for social/public services such as healthcare and education

2

Supply challenges

- Inadequate generation, transmission and distribution infrastructure
- Heavy reliance on self-generation using fuel generators
- Alternative renewable energy supply sources available but upfront CAPEX high

Health system challenges

1

Demand challenges

- Increasing population
- Cultural norms / low awareness
- Lack of access to finance for medical equipment and infrastructure upgrades
- Fragmented systems and institutions
- Lack of financial protection / high cost of care
- Poor perception of service quality

2

Supply challenges

- Commodity stock-outs
- Equipment inadequacy
- Weak standards
- Inadequate working conditions
- Inadequate power or water supply
- Suboptimal health worker capacity, inadequate relative to population size

Poor energy access outcomes for health facilities

- 57% of population have access to electricity
- 40% of PHCs without access to electricity
- 6-10 hours average power supply from any combination of sources
- Absence of electronic health, logistics and financial information systems

Poor quality of health care services and sub-optimal health outcomes

- Poor preservation of vaccines
- Poor water supply, sanitation and hygiene
- Maternal mortality 512/100,000 live births rank: 165/183
- Infant mortality 70/1,000 live births rank: 185/193
- Life expectancy rank: 205/208

Sources: IHP Data Analysis, Improving Primary Healthcare (Nigeria) 2008) for % of PHCs without electricity; SEforALL IEP, eHealth Africa (2021), Fraym (2018), Nigeria Demographic and Health Survey, 2018, WHO Ranking (2019), World Bank, RISE 2020

Health policy context

Landmark policies and plans

2004 Health Policy
Primary Health Care became the entry point and cornerstone of the National Health System.

2014 National Health Act
Legislative framework for all health-related matters. Basis for the regulation, development and management of a Health System and set standards for rendering health services in Nigeria.

2016 National Health Policy
Factored in global and national targets signalled by the Sustainable Development Goals (SDGs) and the push for countries to attain Universal Health Coverage.

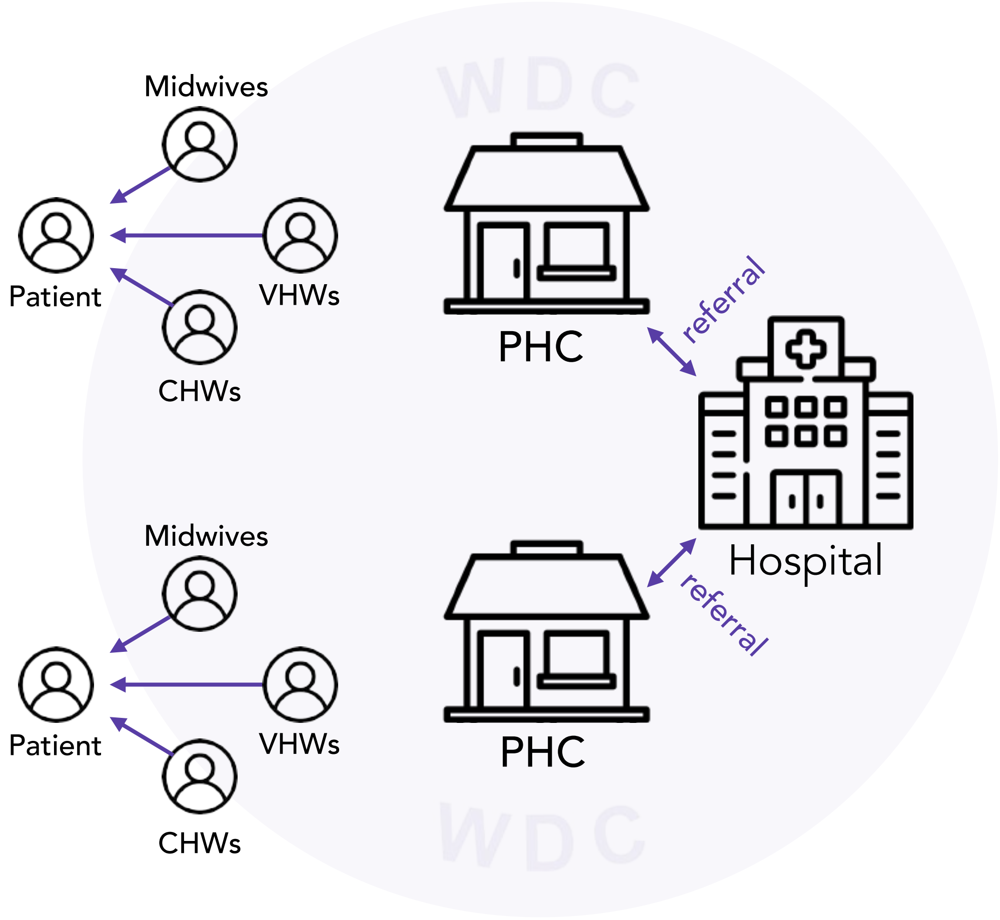
2018-2022 National Strategic Health Development Plan (NSHDP)
Designed to operationalise targets specified in the National Health Act 2014 and National Health Policy 2016. Hinged on a vision "to ensure healthy lives and promote the wellbeing of the Nigerian populace at all ages".

Landmark programmes and interventions

- Primary Healthcare Under One Roof programme (PHCUOR): Backed by the 2014 National Health Act, the programme is designed to address the fragmentation in PHC delivery and bring the governance of primary care under a central body in each State.
- One PHC per ward programme: In line with 2016 National Health Policy and NSHDP, the programme was designed to make at least one PHC fully functional in each of the approximately 10,000 political wards in Nigeria.
- Basic Healthcare Provision Fund (BHCPF): A major financing reform introduced by the 2014 National Health Act is the establishment of the BHCPF to address critical supply and demand funding gaps that have limited access to healthcare services.

NPHCDA '1 PHC per ward' revitalization plan

NPHCDA has outlined a vision to revitalize at least 10,000 PHCs across the country (~1 PHC ward), improve PHC service availability to communities and strengthen linkages to referral hospitals. Type 2 PHCs have been prioritized in the plan.



- **National target of 10,000 Type 2 PHCs; with 3,433 PHCs so far renovated** by Federal, State and various stakeholders.
- **Adopts political wards** as the operational implementing units for PHC programmes with a goal to improve and ensure sustainable health services in each ward, with full and active participation of people at the community level.
- **Ward development committees (WDCs)** play important roles in this system:
  - Ensure beneficiaries are aware and receive the benefits.
  - Monitor implementation within the community.
- **Referral hospitals** key for providing services for complicated births.
- The '1 PHC Per Ward' investment plan has **explicit provisions for solar power infrastructure and OPEX for maintenance.**

Source: Post polio PHC summit (2021 - 2030) Discussion Document . WDC: Ward Development Committee.
* Type 2 PHCs focus on mid-level, local referral services and emergency care; antenatal/postnatal care, higher-risk pregnancy delivery, newborn care; IUD insertion, nutrition assessment, malaria treatment and other curative care; injectable immunization and STI treatment, measles treatment. See page 28.

HFE governance and coordination

Public sector HFE governance arrangement

- On the public side, the NPHCDA and REA have important roles to play in the stewardship, planning, resource mobilization and coordination required to provide sustainable energy solutions in primary healthcare centres in Nigeria.
- Early synergies in planning, selection of criteria and intent on facility audits on both COVID-19 and ESP interventions. This collaboration can be sustained and enhanced for future health and energy related interventions.

Multi-sectoral coalition

Coalition objective

The Coalition for Sustainable Electrification of PHCs is a collective of cross-cutting, like-minded entities focused on increasing sustainable electricity access for PHCs and other critical services across Nigeria.

A call to action

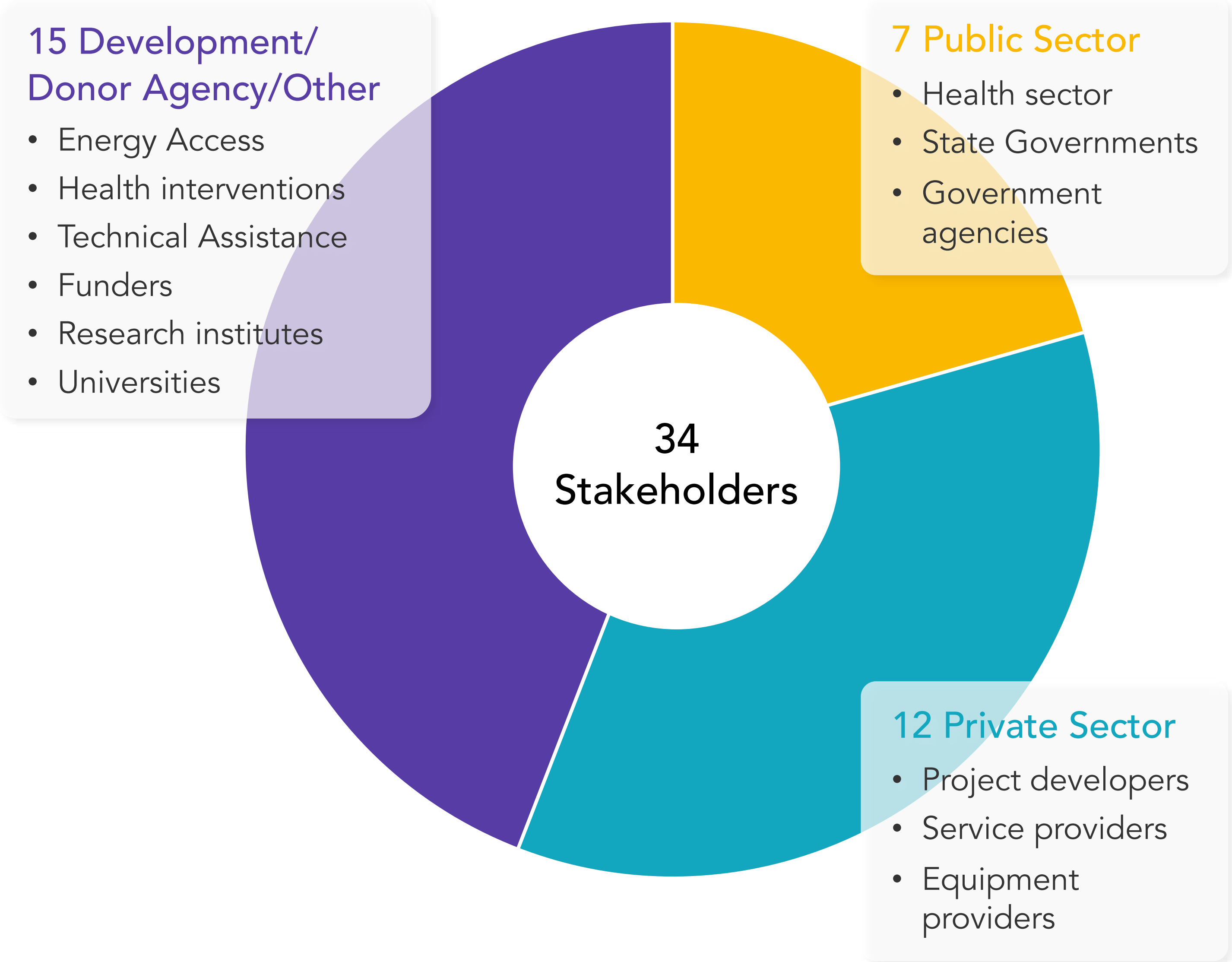
Members are working on a call to action to set an ambitious national sectoral target to electrify PHCs in the country.

70+ members including:

Stakeholder Mapping

Stakeholder consultations

34 public and private sector stakeholders were consulted and interviewed as part of the Roadmap development



1. Public sector: National Primary Health Care Development Agency (NPHCDA), BPHCF, Rural Electrification Agency (REA), Kaduna State Government – Kaduna State Power Supply Company, LASG, FMP, EKITISG
2. Private sector: Arnergy Ltd, PAS Solar, VESTA, Schneider, Just StandOut Ltd, Blue Camel, Okra/SAO, EM-ONE, GVE, Greenmax, Havenhill, Nextier Power
3. Development partners: African Development Bank, USAID-Nigeria Power Sector Program, USAID-Integrated Healthcare Program, Delegation of the European Union to the Federal Republic of Nigeria and ECOWAS, AECOM, Africa Clean Energy –Technical Assistance Facility, Nigeria Economic Summit Group, Heinrich Boll Foundation, Good Governance Team, World Resources Institute, All On, Clinton Health Access Initiative, Renewable Energy Association of Nigeria, USTDA, GIZ, WHO, GAVI, Global fund

Observed HFE selection criteria

Stakeholders and focus areas

Public sector

Enabling environment, policy and regulatory frameworks

Private sector developers

Understanding of supply and demand market solutions, capacity to deliver

Data providers

GIS locations, electrification status, health database management, impact data

Development partners

Coordination of ongoing and planned intervention, adoption/validation of roadmap, technical support, grant funding

Investors

Sustainability and business models, access to capital considerations, concessional financing

Criteria used by different stakeholders to select health facilities for electrification interventions

PHC system readiness: Public sector, development partners

- Functionality / operational status of facilities
- Scope of PHC services delivered in the facilities (including vaccines storage capacity, MCH and neonatal, family planning)
- Health worker density (complement of nurses, midwives, physicians etc)

Electrification status: Data providers, Private sector, Investors, Development partners

- Grid status
- Sources of power
- Access, security and ease of deployment

Donor partner / sponsor considerations: Development partners, Investors

- Donor partner focus States; donor facilities

Optimizing impact and sustainability on population and health burden: Public sector, Development partners, Investors

- Disease burden (e.g. maternal and child health mortality/health outcomes)
- Size and density of the community around PHC, clustering of integrated health facilities and proximity to households
- Governance arrangement and political will (to support sustainability)
- State readiness, budgetary considerations and willingness to pay

Policy alignment: Public sector

- 1 PHC per ward facilities
- Geopolitical spread (including rural versus urban settlements)
- Equity considerations (access/coverage of basic primary healthcare services etc.)

PHC functional status considers five domains around infrastructural status, human resource for health (HRH), provision of a system that ensures the availability of medical equipment, drugs and consumables, the service package as well as availability of a ward mechanism that will ensure community ownership and accountability.

Summary of interventions

While less than 500 health facilities benefitted from HFE intervention in recent years, a pipeline is identified of almost 20,000 facilities (status: ongoing and planned).

COVID-19 electrification interventions

Total completed	11 facilities by 3 interventions: • Kaduna State • All On/GVE/Arnergy • REA/Blue Camel
Total ongoing	100 facilities by 1 intervention: • REA-NEP
Total planned	0

Health facilities electrification interventions

Total completed	328 facilities by 6 interventions: • FCDO / EU Solar Nigeria Projects • REA ESP • GVE • Havenhill • Volsus Energy
Total ongoing	575 facilities by 2 interventions: • Kaduna State • EM-One and USTDA
Total planned	18,984 facilities by 7 interventions: • USAID IHP and NPSP • Okra-SAO • Havenhill • Volsus Energy • We Care Solar • REA • Federal Government

Stakeholders and intervention mapping: findings and recommendations

Situation

- The mapping and landscaping exercise indicated that in the last 6 years a total number of 9 interventions were implemented that electrified 339 health facilities
- In the next 5 years, the review indicates that there are 11 ongoing and planned interventions seeking to deploy power solutions to 675 and 18,984 health facilities respectively
- HFE interventions are still heavily donor dependent with most interventions initiated and implemented by donor partners
- National Primary Healthcare Development Agency has outlined a revitalization plan targeting 10,000 PHCs for solar power interventions under its 1 PHC per ward plan

Findings and gaps

Public sector

- Public sector involvement in HFE is growing especially on the energy access side, with some states (e.g. Kaduna and Lagos) championing sub-national HFE interventions
- Health sector stakeholders have expressed a desire for RE electrification of public PHCs, with reference made to 1 PHC per ward facilities as an important starting point
- On the public side, NPHCDA and REA have important roles to play in the stewardship and coordination required to provide sustainable energy solutions in primary health care centres across the country

Private sector

- Private sector involvement still minimal, with some interventions in the planning stage – reflective of the regulatory, market and financial risks in the sector

Selection criteria

- In selecting HFE intervention sites, the criteria used by different stakeholders varied, ranging from PHC readiness, electrification status to donor priorities

Gaps

- Limited dialogue and alignment between energy and health sector actors in the planning and coordination of health sector electrification policies, programs and interventions
- Lack of multi-sectoral data visibility, sharing and evidence-based planning for HFE interventions
- Majority of the funding and delivery models used in past are donor led EPC models, that have since been confronted sustainability related challenges

Recommendations

- Convergence between energy access interventions and health sector electrification policies and plans.
- Cross-sector coordination - leveraging on emerging coalitions such as the Coalition for Sustainable Electrification of PHCs - needed for better evidence-based implementation, resource utilization, funding/financing flows and alignment towards achieving national targets and SDGs 3, 6, 7 and 13.
- Improved information sharing between the coalition and key stakeholders will foster dialogue and adoption of best practices.
- Secure buy-in from Federal, State and local governments and ministries to create a policy and partnership framework conducive for project planning, synergies, sustainability and impact.

Data Insights

Sources:
- NPHCDA Post Polio PHC Strategy report 2020
- Interviews with NPHCDA, VESTA, HBF, SNP Systems Data, Adewole I., Thirty-Six States and the FCT are to Share $1.5m FG Fund for Primary Health Care. (2016)
- HSDF 2020 Health Facility Assessment for % of PHC facilities that are open 24/7
- IHP Data
- HSDF 2020 Health Facility Assessment for % of PHC facilities without water available at anytime
- Improving Primary Healthcare (Nigeria) 2008) for % of PHCs without electricity; SEforALL IEP, eHealth Africa (2021), Fraym (2018)
- NPHCDA interview quoting PHC assessment report 2018

30% - 40%
of PHCs are considered fully functional

33% - 35%
PHC facilities are open 24/7

~ 40%
PHCs without access to electricity

6 - 10 hours
Average power supply from any combination of sources

80% - 83%
PHCs don't use solar power

22% - 25%
PHCs are appropriately staffed with health workers

Health facilities categorization and operating structure

The NPHCDA has defined minimum standards for ‘product offerings’ for each type of public facilities

Type 4: Teaching/tertiary hospital **TERTIARY LEVEL**	• Ultimate specialist units for expert referral services • Range of specialties in general hospitals or a specific discipline at a specialized hospital
Type 3: General hospital **SECONDARY LEVEL**	• Outpatient care in basic medical specialties, inpatient care, and labs • Emergency care and advanced referral services

Source: NPHCDA Minimum Standards

Akineowo Primary Health Centre (Ogun State)

Emuli Rural Health Clinic in FCT

Type 2: Primary Health Centre **PRIMARY LEVEL**	• Mid-level, local referral services and emergency care • Antenatal/postnatal care, higher-risk pregnancy delivery, newborn care • IUD insertion, nutrition assessment, malaria treatment and other curative care • Injectable immunization and STI treatment, measles treatment
Type 1: Health clinic **PRIMARY LEVEL**	• Antenatal/postnatal care, low-risk pregnancy delivery, newborn care • Contraceptive distribution, family planning counseling, malaria treatment and curative care for common ailments • Injectable immunization and STI treatment, measles treatment
Health post **PRIMARY LEVEL**	• Antenatal/postnatal care, low-risk pregnancy delivery if certified • Family planning counseling, malaria treatment, curative care for common ailments, non-injectable immunization • Community-based activities (e.g. outreach, health education and promotion)

Source: NPHCDA Minimum Standards

Top and bottom: Rural Health Post in Bauchi

Health facilities distribution and electrification status

1.4 healthcare facilities per 10,000 people

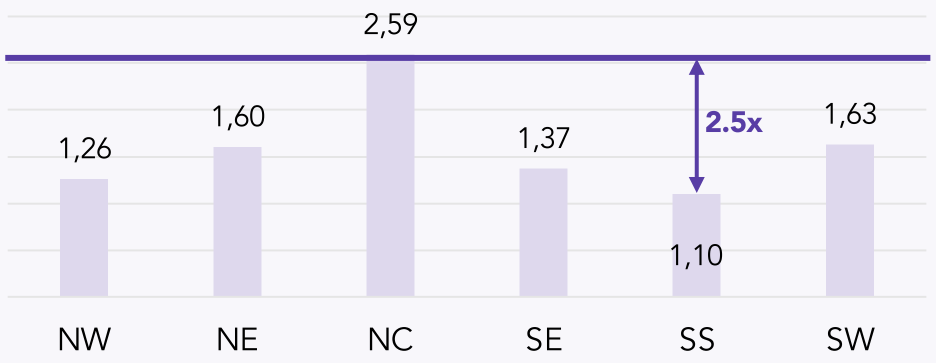
The Federal Ministry of Health estimates a total of 40,017 healthcare facilities in Nigeria

- While there are a large number of health facilities, they are distributed inefficiently and lack access to electricity, particularly for public facilities.
- Consistent with other desk review findings, HFE seems not to have improved over the years:
    - 40% of healthcare facilities in Nigeria are unelectrified (*2021)
    - More concentration of electrified HFs in the SS,SE,SW (*2021)
    - 36% health facilities in Nigeria have no energy access (**2021)
    - 30% health facilities in Nigeria have no electricity (***2013)

Sources: Nigeria Population Census 2006; World Bank: Improving Primary Healthcare (Nigeria) 2008.
*SEforALL IEP, eHealth Africa (2021), Fraym (2018); **Achieving universal electrification of rural healthcare facilities in sub-Saharan Africa with decentralized renewable energy technologies, EU-JRC, 2021; *** Electricity access in sub-Saharan African health facilities, Global Health Science and Practice, 2013

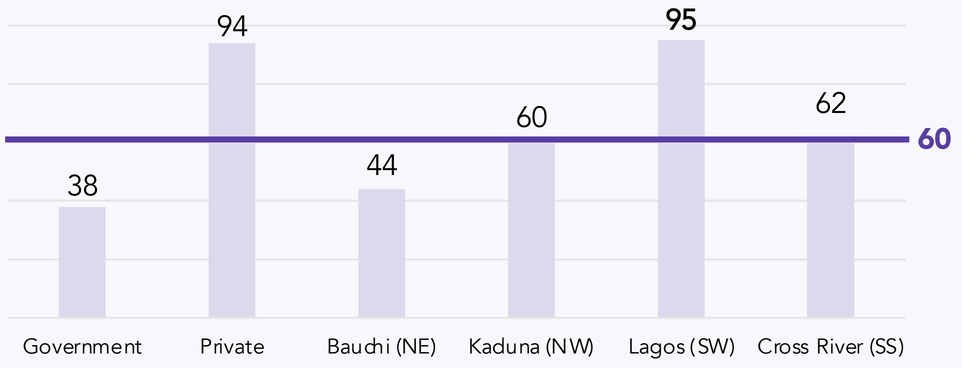
Variation among regions

Healthcare facilities per 10,000 people

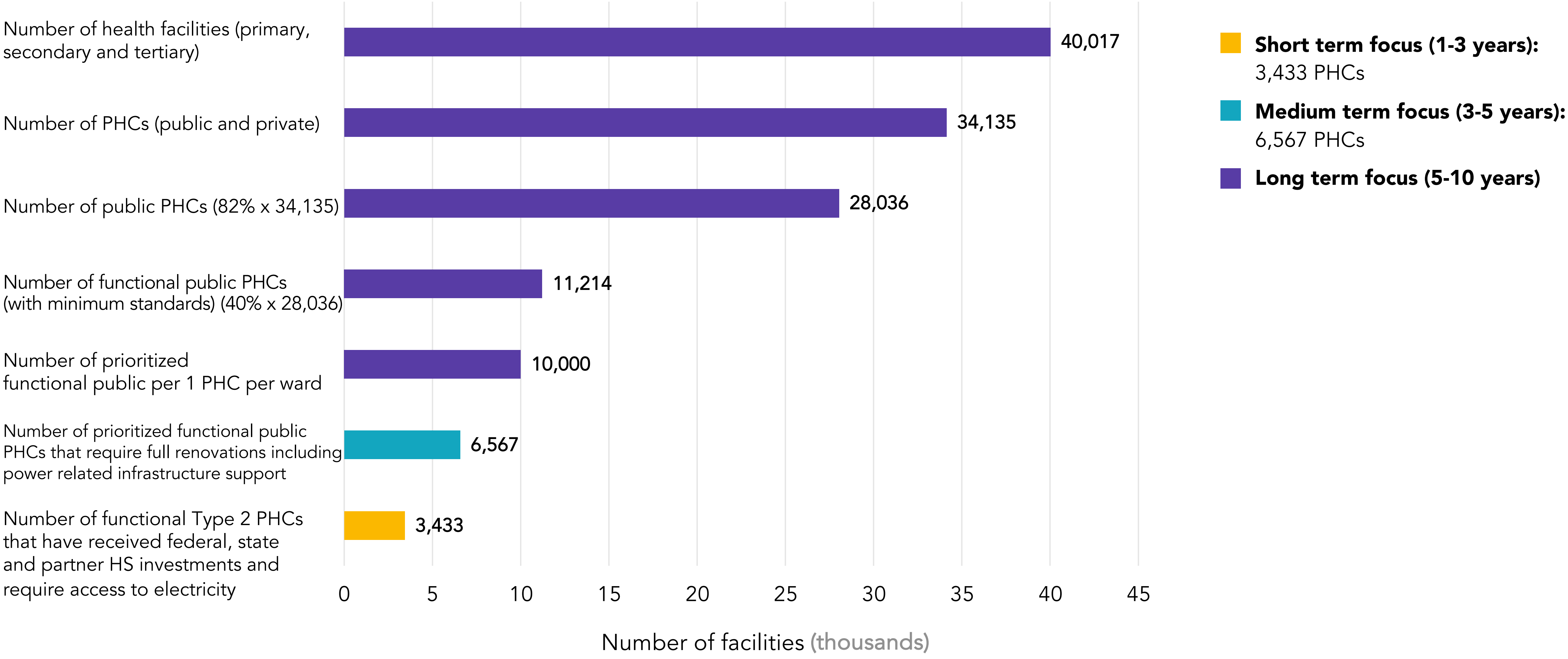


State of health facilities in Nigeria

Facilities with electricity (%)



Sizing the problem: How many facilities require electrification?



Data insights: findings and recommendations

Situation

- There are several HFE data sets developed by different health and energy stakeholders including Federal Ministry of Health, Health Facilities Registry, Energy Access Explorer, Clean Energy Access Tool, NPHCDA PHC database amongst others.
- There is no centralized robust health facility and electrification dataset.
- There is some variability in the information collected across various data sets. Some data sets include different combinations of public, private, formal and informal facilities across different levels of care.
- Various data collection templates and methodologies employed; from population-based surveys, self reporting systems to open-source dynamic databases.
- Increasing data coverage in terms of locations and coordinates of health facilities.

Findings

Size

- The Federal Ministry of Health estimates a total of 40,017 healthcare facilities in Nigeria - including public, private, formal and informal facilities – at different levels (primary, secondary and tertiary).
- The majority (85.3%) of health facilities in the country are primary healthcare centres; 28,036 of which are publicly owned with different levels of functionality.
- The private sector has a major role to play in service delivery as it already accounts for 44% of healthcare facilities in Nigeria.

PHC functionality

- The consensus from interviews was that ~ 30 – 40% of public PHCs were considered functional.

Electricity access

- ~ 40% of functional PHC facilities do not have access to electricity and ~80 – 83% and of PHCs are not powered using renewable sources.
- Although ~ 40% of health facilities have no access to electricity, majority of PHCs still have unreliable access to electricity from any combination of electricity sources.

Data gaps

- Data on locations of functional PHCs is only available on request, but may be outdated (2019).
- Limited guidance on prioritization or ranking of facilities
- Limited data granularity in terms of:
    - Electrification need, status and hours of electricity supply
    - Source of electricity supply
    - Monthly/annual budget and spend on electricity
- PHC ownership or management structure is not always specified.
- Electrification status is either binary (yes/no) or not provided at all.
- Fragmented and inconsistent data access profiles across various data sets.

Recommendations

- Build on existing tools and establish a central dynamic and standardized dataset that captures aforementioned data content and quality gaps including PHC functionality, electrification status, O&M regime and intervention health map.
- Technical assistance and programmatic support are required to bridge data and capacity gaps and update critical baseline inputs.
- Support may involve joint energy audits of PHCs (e.g. 1 PHC per ward facilities) and validation exercises.
- NPHCDA and REA could co-lead the coordination and planning of energy audits as well as data governance arrangements.
- The emerging Coalition for Sustainable Electrification of PHCs could function as the advisory body to foster multi-sectoral dialogue and data exchange on HFE.

Technology

Summary of findings

+/- 36 kWh
Daily energy need for a standard Type 2 PHC

5-10 kWp
Installed capacity sufficient to meet energy demand of Type 2 PHC

$6/Wp
Average installed cost for stand-alone solar PV and storage

$525m
To power 10,000 PHCs and keep operational for 15 years

Electricity supply technology mapped to ESMAP multi-tier framework

Note: MTF has limitations of being designed for residential consumption profiles rather than health facilities.

Tiers	Peak capacity/consumption (W, wh)	Electricity supply technology	Electricity services	Hours of supply (hours per day/ evening)	Recommended health facility type
Tier 1	Very low Min 3W (min 12wh+)	Solar lantern	Task lighting and phone charging	Min 4hrs/1hr	
Tier 2	Low Min 50W (min 200wh+)	Small solar standalone system	General lighting, phone charging, TV, fan	Min 4hrs/2hrs	Health post, Primary health clinics Type 1
Tier 3	Medium Min 200W (min 1kwh+)	Medium solar standalone system, mini-grid, hybrid systems	Tier 2 + medium power appliances	Min 8hrs/3hrs	Primary health clinics Type 1
Tier 4	High Minimum 800W (min 3.4kwh)	Large solar standalone system, mini-grid, hybrid systems, central grid	Tier 3 + high power appliances	Min 16hrs/4hrs	PHC type 2
Tier 5	Very high Minimum 2kw (min 8.2kwh)	Large solar mini-grid, central grid, fuel generator, hybrid systems	Tier 4 + very high power appliances	Min. 23hrs/4hrs	PHC, general hospitals, teaching/tertiary hospitals – type 2,3,4

Alternative multi-tier measurement of electricity supply for health facilities

- A WHO/WB publication (2014) proposed a framework for measuring electricity supply on a Tiered level, in line with the MTF.
- Based on daily power capacity needs of approximately 36kWh/day for Type 2 PHC (see page 36 for more info), this is in line with Tier 4 (advanced access) and above levels.

	Tier 0 No access	**Tier 1** Minimal access	**Tier 2** Basic access	**Tier 3** Intermediate access	**Tier 4** Advanced access	**Tier 5** Full access
Peak power capacity Watts (W)	<5	5–69	70–199	200–1,999	2,000–9,999	≥ 10,000
Daily energy capacity Watt hours (Wh) per day	-	20–279 Wh per day	280–1,599 Wh per day	1,600-31,999 Wh per day	32–220 KWh per day	>220 KWh per day
Duration of supply Hours/day	-	≥4	≥4	≥8	≥16	≥23
Evening peak hours supply Hours/day	-	-	≥2	≥2	4	4
Cost-effectiveness (affordability)* Lifetime costs per kilowatt hour	-	≤ 5 times benchmark	≤ 3 times benchmark	≤ 2 times benchmark	≤ 1.5 times benchmark	≤ 1 times benchmark
Quality No/poor/unstable voltage	-	-	-	Adequate	Adequate	Adequate
Reliability No outages of more than 2 hours in the past week	-	-	-	-	Adequate	Adequate
Operation sustainability Adequate operation and maintenance budget)#	-	-	-	Adequate	Adequate	Adequate
Environmental sustainability and health (g $CO_{2\text{-eq}}$ / kWh)[xxxii]	-	≤2,400 g $CO_{2\text{-eq}}$ / kWh	≤1,400 g $CO_{2\text{-eq}}$ / kWh	≤1,000 g $CO_{2\text{-eq}}$ / kWh	≤850 g $CO_{2\text{-eq}}$ / kWh	≤500 g $CO_{2\text{-eq}}$ / kWh

* The grid tariff applicable to health clinics located in the nearest electrified area is taken as a benchmark for affordability

Electricity is not vulnerable to interruption as a result of: unpaid utility bills and/or lack of budget for fuel purchases; maintenance; lack of spare parts or (PV) battery replacement.

Type 2 PHC appliances and load estimate

- Using the NPHCDA Minimum Standards for Primary Health Care in Nigeria document and the SERC WBG ECREEE Lighting Africa Requirements and Guidelines for Installation of Off-grid Solar Systems in Public Facilities document, the general and medical appliances were itemized, rated and the total power consumption estimated.
- The total power consumption over 24 hours is estimated at 36kWh per day, with a peak load of 3.6kW.
- Note that the general and medical appliances selected are indicative of an improved/model PHC electrification, going by the Type 2 PHC category.

Load	# Units per PHC	Power rating (W)	Hours of use (h)	Power consumption (Wh)
General appliances				
Ceiling Fan	15	50	12	9,000
Computer (laptop)	1	60	6	360
General Purpose Refrigerator/Freezer	6	130	24	18,720
USB Modem	1	2.5	6	15
Lighting (interior)	26	10	10	2,600
Lighting (outdoor/security)	4	10	10	400
Mobile phones	10	10	1	100
Remote monitoring	1	5	24	120
TV	1	100	6	600
Printer	1	100	2	200
Water pump	1	746	2	1,492
Medical appliances				
Procedure light	2	50	4	400
Centrifuge	1	110	2	220
Electric microscope	1	30	2	60
Fetal heart monitor	1	3	2	6
Oxygen concentrator	1	200	4	800
Portable ultrasound	1	28	1	28
Suction apparatus	1	185	5	925
			Total	**36,046**
			Peak load	**3,600 W**

Estimated system size for improved PHC

PRIMARY LEVEL

Type 2: primary health centre

- Mid-level, local referral services and emergency care
- Antenatal/postnatal care, higher-risk pregnancy delivery, newborn care
- IUD insertion, nutrition assessment, malaria treatment and other curative care
- Injectable immunization and STI treatment, measles treatment
- Operating 24 hours
- Standard 13 rooms and 2 units staff accommodation
- 10 staff
- Serving between 10,000 to 20,000 people

Solar PV

Between 5kWp to 10kWp

Battery bank

Between 36kWh and 72kWh with 1 day autonomy

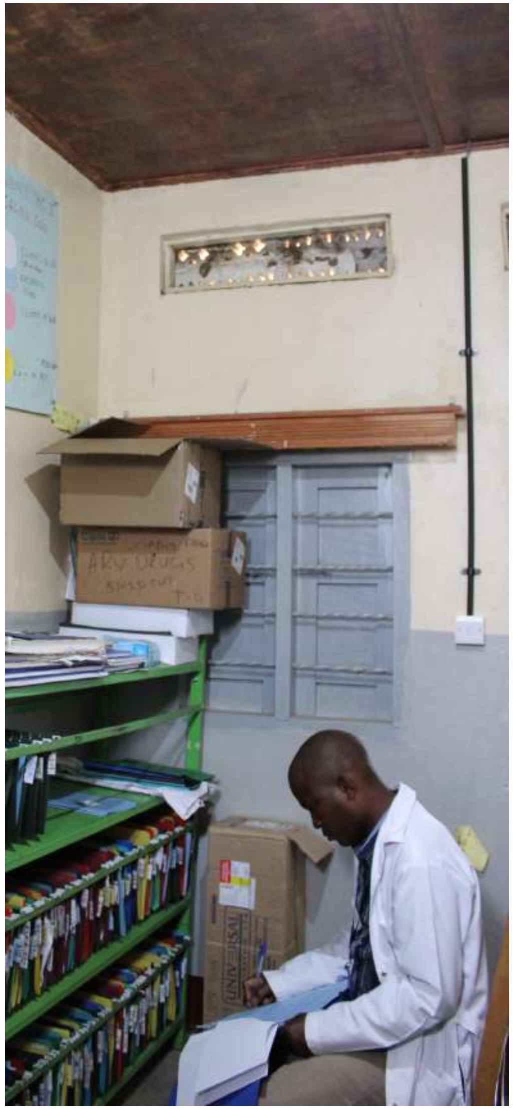
Inverter

Approx. 5KVA factoring in 30% oversizing

Diesel generator

Minimum of 10kVA

Further guidance on system design, component requirements, installation and safety, commissioning, operations and maintenance planning, service delivery and monitoring, and minimum energy service guidelines can be found in the Lighting Global document for off-grid solar system for public facilities



Findings and recommendations

Situation

- Framing HFE energy needs according to the different types of facilities is challenging as pre-defined minimum standards for health facilities do not always apply (according to stakeholder interviews); energy needs load profiles can vary significantly based on the facility size and services offered.
- Mapping health facility energy consumption profile to ESMAP MTF is also subjective as the framework was developed for households.

Findings, gaps and opportunities

Technology types

- The two prominent solar PV technologies are standalone systems or mini-grids:
    - Standalone solar PV systems are more suited to PHC electrification in terms of dedicated service provision, cost and affordability for locations without access to electricity and where mini-grids are not already present.
    - Mini-grids can serve PHC electrification if the intended deployment is primarily driven by other productive anchor customers within the community.

Sizing

- Suitable system sizes for typical Type 2 PHCs, systems between 5kWp and 10kWp to adequately supply electricity for estimated peak load of 3.6 kW and an average approximate load of 1.5kW over a 24-hour period.

Gaps and opportunities

- Standards for electrical wiring, components, installations, and ESIAs need to be adopted for HFE.
- Energy efficiency measures need to be designed into programme interventions from design phase.
- Installed cost of $6/Wp was derived from analysis of multiple aggregated project cost datasets and recent industry reports.
- To power 10,000 Type 2 PHCs in the next 5 years and keep power solutions operational for 15 years, it is estimated that for a minimum sized system of 5kWp, a total of $525m (CAPEX of $300m and OPEX of $225m) would be required over the next 15 years. This excludes project development and technical assistance costs.

Recommendations

- Standards and energy efficiency measures are outlined as additional considerations that can significantly determine the performance, lifespan and sustainability outcomes of installed systems.
- Mechanisms for funding or contributing towards CAPEX and OPEX of solar systems over the project lifecycle need to be provided for in HF revitalization budgets and HFE intervention plans for technical sustainability.
- Capacity building for local HF staff needs to be prioritized for first level maintenance and troubleshooting especially for systems without remote monitoring.

Funding and Financing

Summary of findings

35%
National current health expenditure spent on PHC

5%
Government health budget as a % of total national budget

75%
of total health spending comes from household out-of-pocket expenditure

₦7,300 ($20)
PHC expenditure per capita per year

₦100,000 ($200)
Average monthly operational funds (potentially) available per PHCs

₦23,500 - ₦48,000 ($47 - $96)
Average amount per PHC per month spent on electricity from grid and fuel generators

Sources of cash in PHCs

PHCs receive little operating budget; available cash is mainly sourced from user fees

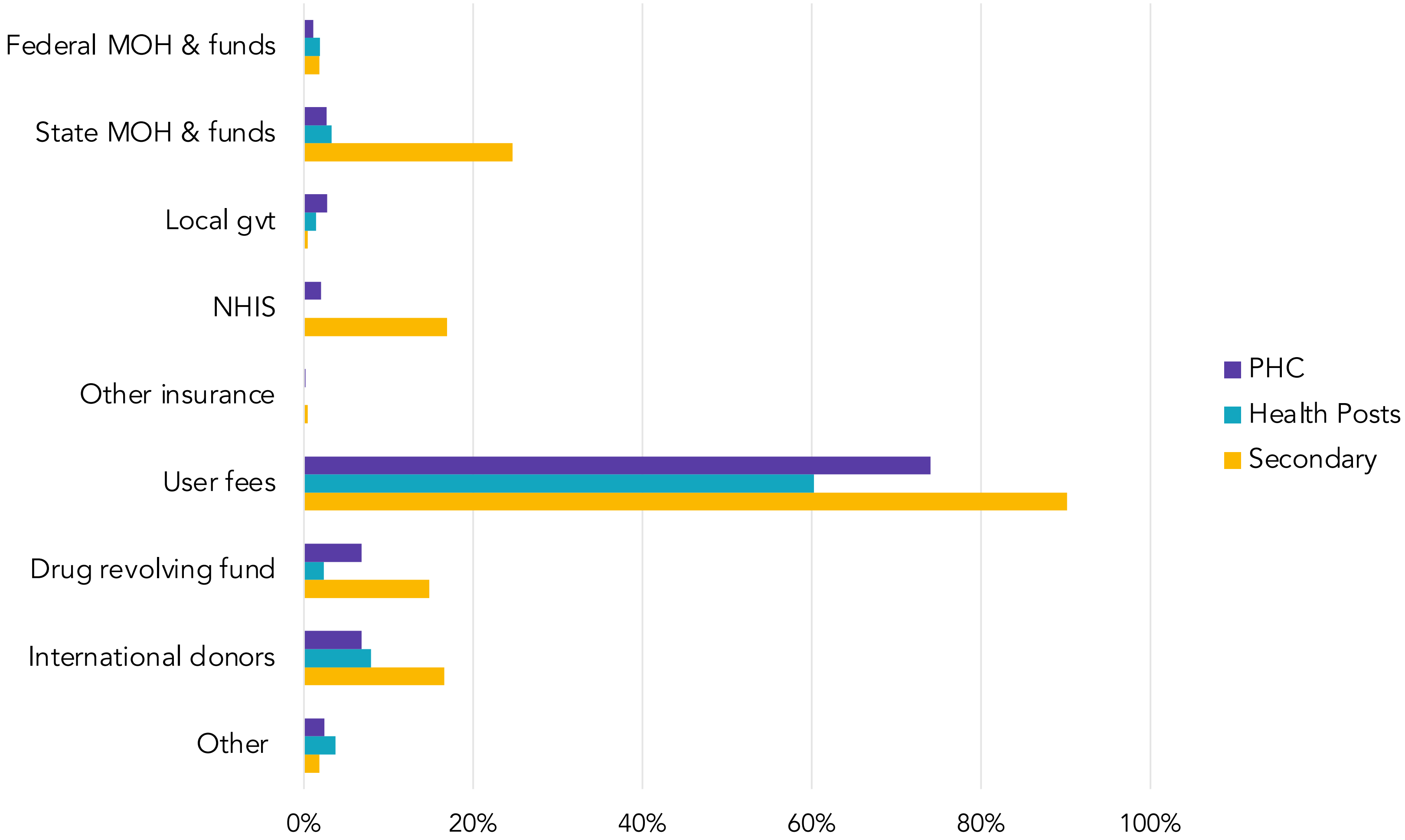
User fees and private expenditures by insurance, employers or individuals through out-of-pocket form another source of health expenditure. Overall, 77% of facilities report charging user fees especially at private and secondary facilities; user fees are predominantly collected for drugs, delivery services and antenatal care.

Drug revolving funds of different forms exist in Nigeria. Fees are charged for medicines dispensed. Facilities often have cost recovery objectives that may include financing of aspects of PHCs.

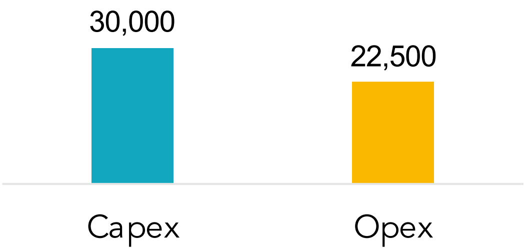
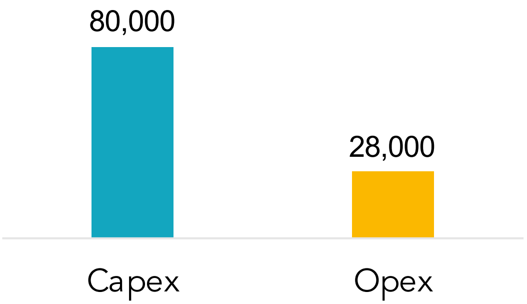
Government funding of PHCs is carried out by the 3 tiers of government – Federal, State, LGA, with weak interaction between them. The Federal government intervenes, through NPHCDA, NHIS and BHCPF funding directly at the facility level, while the State and LGA funds for PHCs are channeled through the SMOH and Ministry of Local Government as two separate pools.

National Health Insurance Scheme (NHIS) provides social health insurance in Nigeria where health care services of contributors are paid from the common pool of funds contributed by the participants of the Scheme. NHIS has developed various programmes to cover different segments of the society including formal sector, informal sector, vulnerable groups, public private partnership and community-based health insurance programmes.

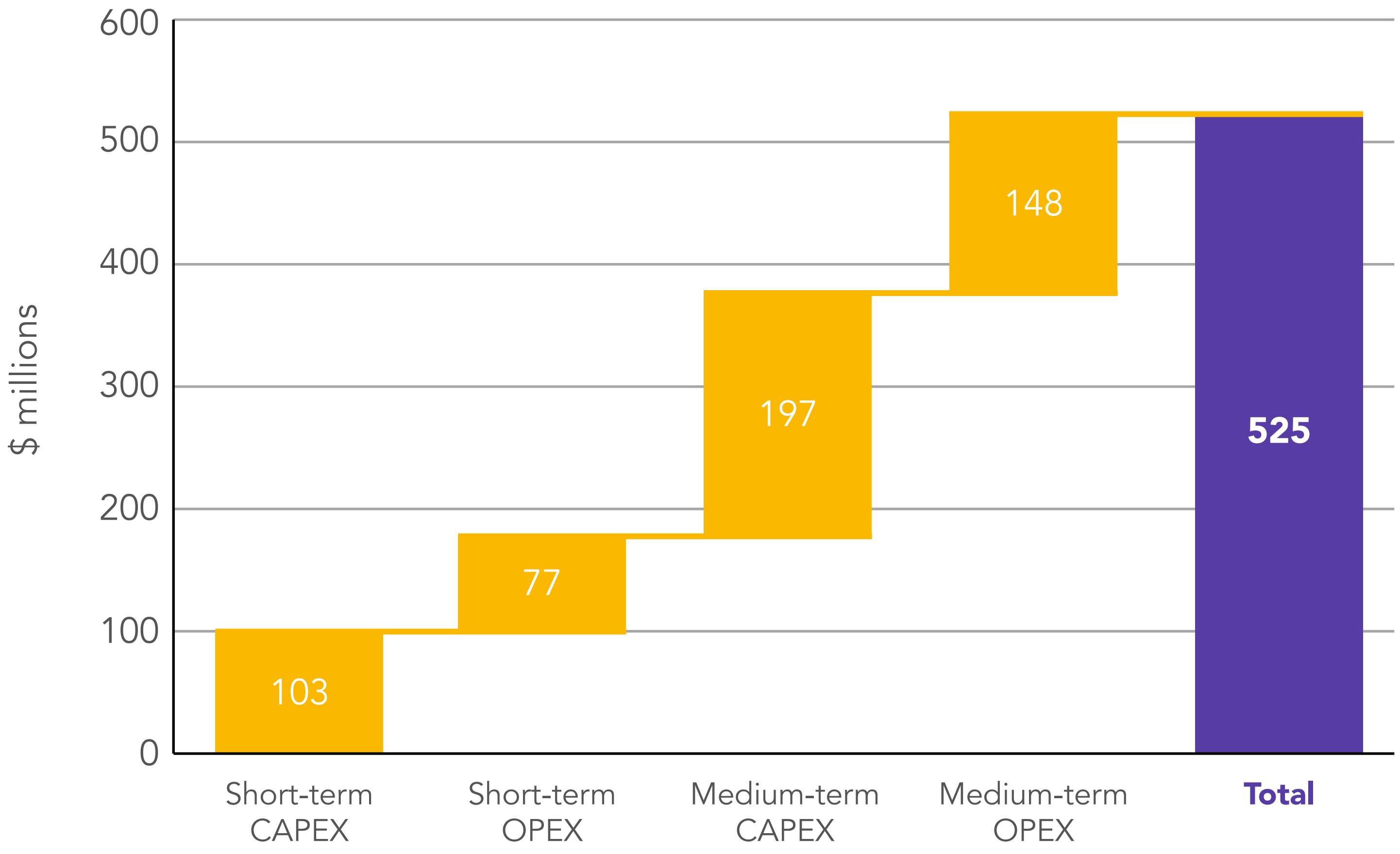
Proportion of facilities receiving cash funding, by source



Highlights of findings

Scenarios	Base case assumption	Capex and Opex per PHC for 15 years ($)
1 PHC with 5kWp solar system without generator	$6/Wp is the estimated CAPEX cost of installed system 5% is the estimated OPEX cost per year for system without generator	
1 PHC with 10kWp solar system hybrid with generator	$8/Wp is the estimated CAPEX cost of installed system 35% is the estimated lifetime OPEX for hybrid system with generator	

Short and medium-term functional type 2 PHC electrification implications



Key insights:

- With approximately 3,433 functional Type 2 PHCs readily available for electrification in the short term, an estimated $180m is required to provide 17.2MW installed solar PV systems ($103m CAPEX and $77m OPEX cost at 5kWp per PHC, $6/kWP CAPEX, and OPEX estimated at 5% of CAPEX).
- In the medium-term, an additional 6,567 PHCs would require $345m to provide 32.8MW and achieve NPHCDA's overall target of 10,000 functional and electrified PHCs ($197m in CAPEX and $148m in OPEX).

Findings and recommendations

Situation

- Nigeria’s health sector is inadequately funded to meet its PHC financing needs. As a percentage of total national budget, health budget is on average 5%, far below the Abuja declaration of 15%.
- Nigeria spent ~₦1.3 trillion ($3.56 billion) on PHC, or ~35% of its current health expenditure, in 2016 this corresponds to ~₦7,300 (~20 USD) PHC expenditure per capita.
- States and Local Governments play an important authorizing role in facilitating payments of PHC utilities.
- As a result of the long delays in PHCs accessing allocated government funds, the major burden of contribution is financed by out-of-pocket expenses and user fees (~ 75% of total health expenditure).
- User fees are often charged by PHCs to plug financing deficits and pay for operational expenses including power utilities and maintenance.
- Anticipated health sector focused donor funds for the next 10 years are mostly targeted towards critical systems strengthening initiatives such as renovations, drugs, vaccines, performance and results-based incentives for PHCs and health workers that will not directly impact PHC infrastructure or electrification.

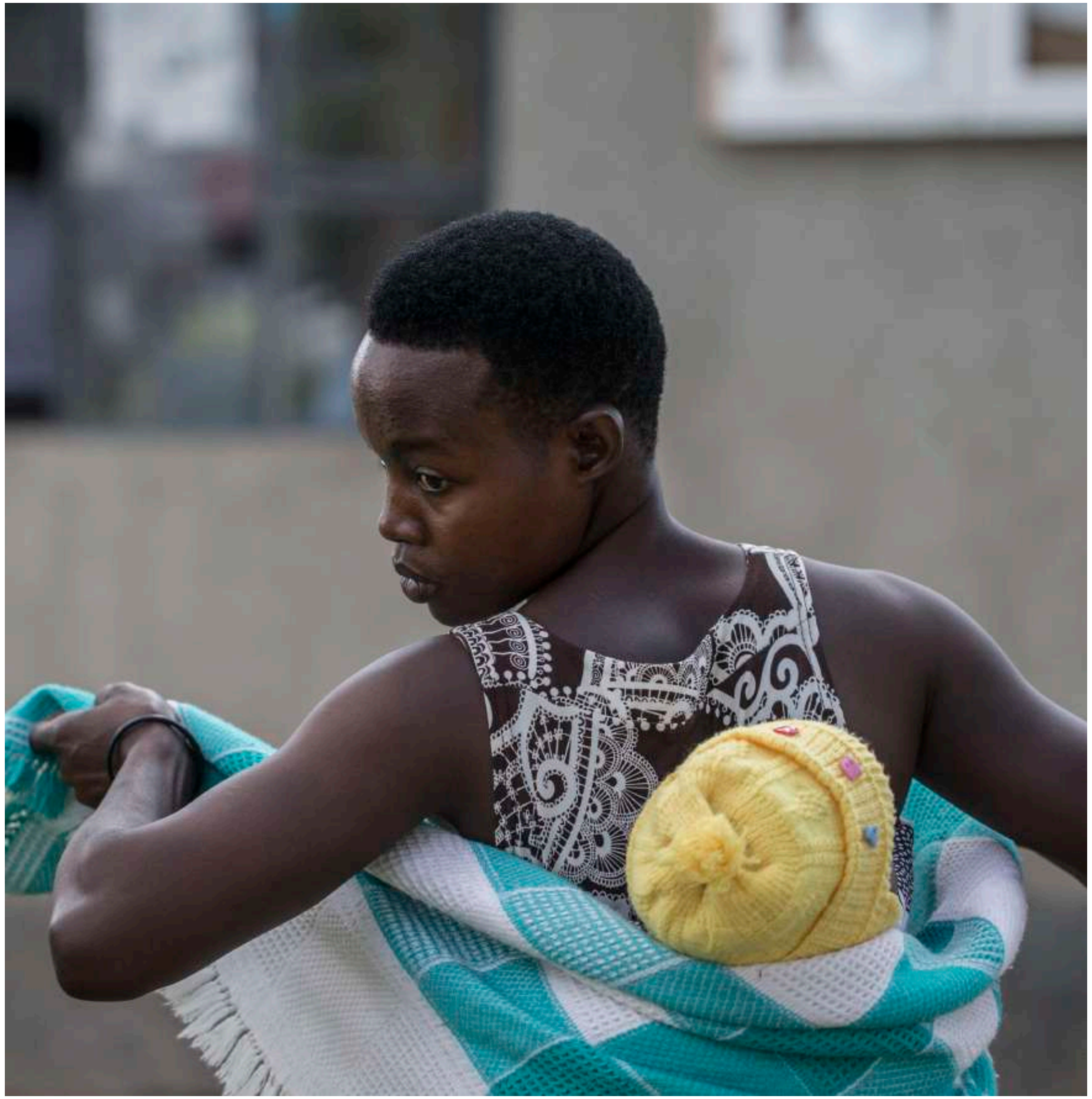
Findings

Public financing

- The majority of PHCs are publicly owned and therefore have limited budgets for affording electricity supply investments or payments for operational activities.
- Government funding of PHC is carried out by the 3 tiers of government - Federal, State, LGA, with weak interaction between them. The Federal government intervenes through NPHCDA, NHIS and BHCPF funding, directly at the facility level, while the State and LGA funds for PHC are channeled through the State Ministry of Health (SMOH) and Ministry of Local Government as two separate pools, in some cases.

Private financing

- Private sector commercial funding for SHS and mini-grids has shifted towards debt funding in recent years. The economics are suboptimal for the energy service provision to a social good on a fully commercial basis, as a result of access to capital constraints and other regulatory and market failures.
- Risks of non-repayments for services rendered is high, especially where institutions and agreements are weak. Private providers and investors highlighted the role of government or third-party subsidies, guarantees, concessional funding and credit enhancement products in improving the viability of HFE projects.



Gaps and opportunities

- With ~₦1.2 million ($2,400) per year per facility from NPHCDA Gateway and ~₦1.5 million ($3,000) per PHC per year from the NHIS Gateway, the Basic Healthcare Provision Fund (BHCPF), though sub optimal, may at best contribute partly to pay for monthly O&M costs in some settings, if implemented successfully.
- NPHCDA investment plan for the 1 PHC per ward programme makes provisions for solar power infrastructure and maintenance expenses.
- If successfully harnessed, BHCPF and NPHCDA's 1 PHC per ward programme investments may provide promising opportunities for funding more sustainable delivery models for HFE. However, Health Facilities Electrification plans cannot solely depend on anticipated government funding that has not yet been fully implemented or proven.
- Innovative financing grants such as performance-based financing and counterpart funding have recorded some success in the PHC system in Nigeria including the $500 million World Bank program-for-results (P4R) Saving One Million Lives (SOML) initiative and the Routine Immunization and PHC innovative financing MOUs with donors and selected states.

Investment considerations and recommendations

- With approximately 3,433 functional Type 2 PHCs readily available for electrification in the short term, an estimated $180 million ($103m CAPEX and $77m OPEX cost) is required to provide 17.2MW installed solar PV systems (at 5kWp per PHC, $6/kWP CAPEX and 5% of CAPEX as OPEX estimate).
- In the medium-term, an additional 6,567 PHCs would require $345 million ($197m in CAPEX and $148m in OPEX) to provide 32.8MW and achieve NPHCDA's overall target of 10,000 functional and electrified PHCs.
- Work towards mitigating financial risks by providing blended financing options including performance-based grants, subsidies, equity and debt financing for private sector energy services companies.
- Explore funding opportunities with the BHCPF and community-based funding models to supplement O&M costs in some settings, if implemented successfully.
- Donor grants and subsidies can facilitate purchase of energy efficient appliances and retrofits for health facilities, cover a portion of CAPEX expenses for private ESCOs and fund indicated capacity building programs.
- Long-term concessionary loans from impact investors are required to encourage private sector energy service companies to participate in health facilities electrification.

Delivery Models and Funding Mechanisms

Overview

3
Appropriate delivery models analysed

1
Comparison table

3
SWOT analyses and schematics

5
Delivery model challenges and possible solutions

Three delivery models emerged as relevant for HFE in Nigeria

Delivery model	Description	Application
Traditional equipment ownership model	Describes a model where a donor agency either directly provides grant funding and commissions an NGO or private sector actor, or grants a public agency funding to commission an NGO or private sector actor to design, purchase and install solar PV systems at a public institution e.g. health facility. The asset is owned by the public institution or agency. This has been the predominant model for most HFE interventions implemented in Nigeria	The traditional model is well suited for Type 1 health clinics and health posts, since they require smaller-sized SHS systems with minimal O&M requirements
Service-based model	Describes a model where a public agency selects a service provider (private sector or NGO) to provide electricity services (design, procure, install, operate and maintain solar PV systems) to public institutions e.g. health facility, typically over a 10- to 15-year period. The service provider raises investment capital (debt or equity) from investors and may also get subsidies and guarantees from donors. The service provider ensures that service levels are met for the contract period. The government pays the provider on a regular basis, as it would with other utilities directly or through a financial institution once a 3rd party verifies that the services have been rendered accordingly.	Secondary level Type 3 general hospitals are more suited to the commercial service-based model as the majority are privately owned, with good management capacity as well as ability and willingness to pay for electricity services from a private developer. The service-based model is suitable in instances where public sector financial management, compliance management and procurement management capacities are strong, with effective regulatory frameworks
Hybrid model	This combines elements of the traditional equipment ownership model and the service-based model. Given compliance management and procurement management capacity challenges in most settings, it however proposes a Programme Management Unit (PMU) or Compliance Management Entity through which service contracts and repayments for energy services are managed with the private sector ESCO. The role of donors in this model could be to provide grant funds for aggregated procurement of energy efficiency upgrades for the PHCs supply side subsidies to cover portions of system CAPEX. The private sector ESCO raises concessional funding through impact investors, DFIs, corporates or philanthropies.	Hybrid model is proposed for Type 2 PHCs and Type 4 Tertiary level teaching hospitals

Traditional equipment ownership approach – illustration

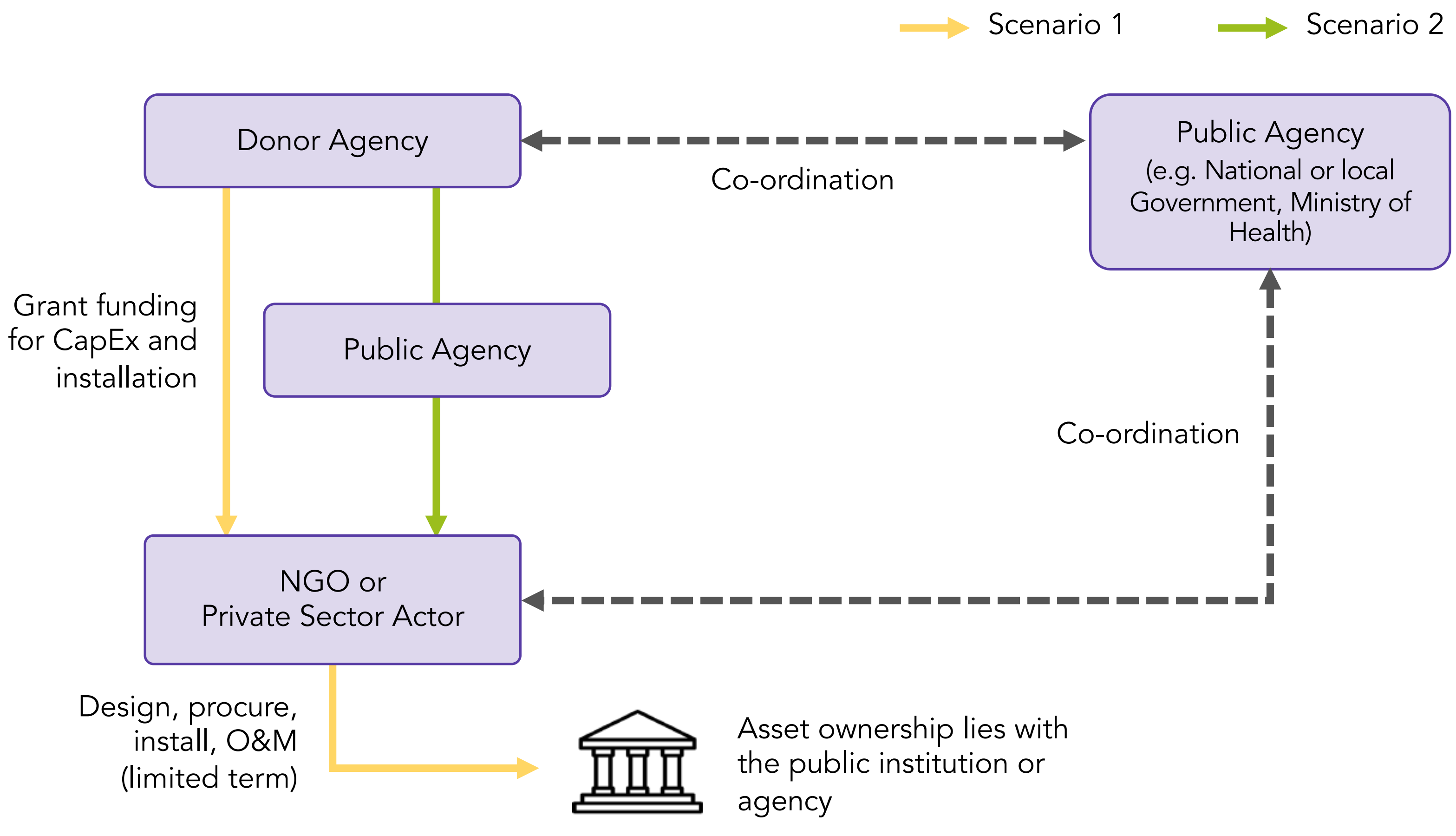
Scenario 1

A donor agency directly provides grant funding and commissions an NGO or private sector developer to design, purchase and install RE systems at a HF.

Scenario 2

A donor agency provides grant funding directly to an implementing public agency who commissions an NGO or Private sector developer to design, procure and install RE systems to a HF.

In both instances, a public agency plays a coordination role, and the asset is owned by the public institution or agency



Note: Illustration from SEforALL, WB, ESMAP (2021) 'From Procurement to Performance'.

Traditional equipment ownership approach – SWOT

Strengths

- Targeted funds making it easier for quick deployment.
- Removes or lessens burden of raising finance for public and private stakeholders.

Weaknesses

- Short-term scope (< 5 years).
- Limited term for O&M.
- Limited provision for replacements or repairs.
- Institutional capacity to manage and maintain systems limited.

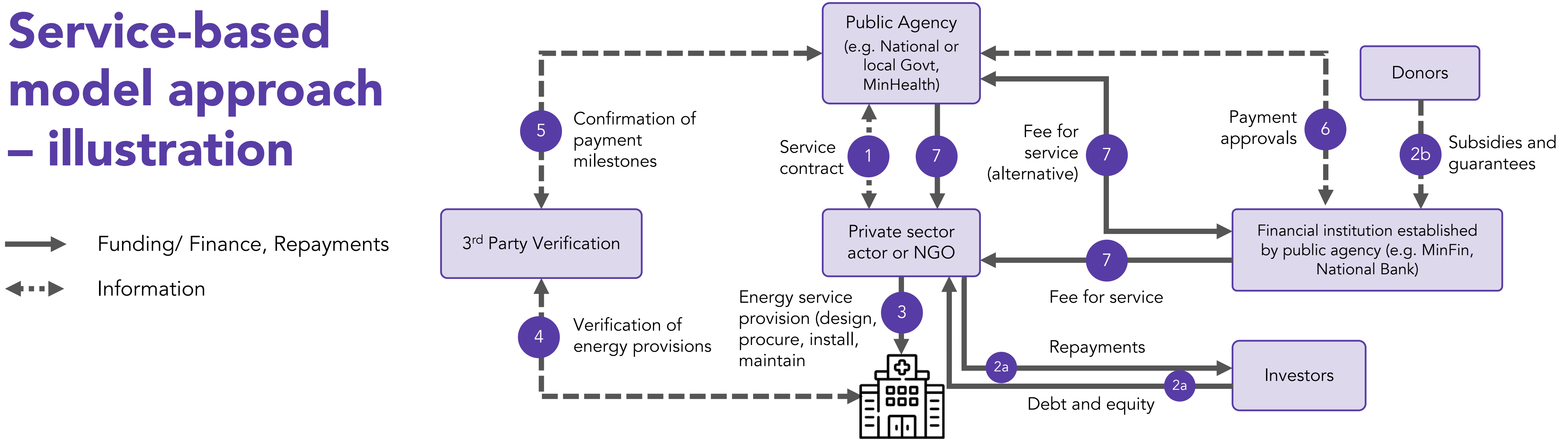
Opportunities

- Aggregation of procurement and implementation.

Threats

- Free donations tend to be viewed as 'nobody's property'; limited sense of community ownership.

Service-based model approach – illustration



01 A service contract is signed between the service provider and the public agency

2a The service provider raises capital from investors; direct grants to the investors (for e.g., RBF) are not included in this figure

2b Subsidies and guarantees are deployed; these are in addition to existing funds and finance going to public health, public education, etc.

03 An energy solution is deployed, and the end user starts using power as a service

04 A third party verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency

06 The public agency sends payment approval to the financial institution

07 The financial institution (e.g., fund manager) issues payment in accordance with the contract and the service delivered

7 alt The financial institution releases funds, which the public agency uses to pay the service provider. Note: these funds can be provided up front.

Service-based model approach – SWOT

- In the service-based model, the government or development partner selects a service provider to provide electricity services (installing and operating the solar photovoltaic (PV) systems) to public institutions, typically over a 10- to 15-year period.
- The service provider raises investment capital and ensures that key performance indicators (KPIs) are met during the contract period.
- The government pays the provider on a regular basis, as it would with other utilities

Strengths

- Technical capacity to manage systems post-implementation.
- Generation assets can be subsidized.
- Revenue generation from service provision, O&M.
- Ownership and responsibilities clearly defined.

Weaknesses

- High risk of non-repayment for electricity by public institutions.
- Not enough incentive exist to make PHCs entry points/anchors for community electrification.

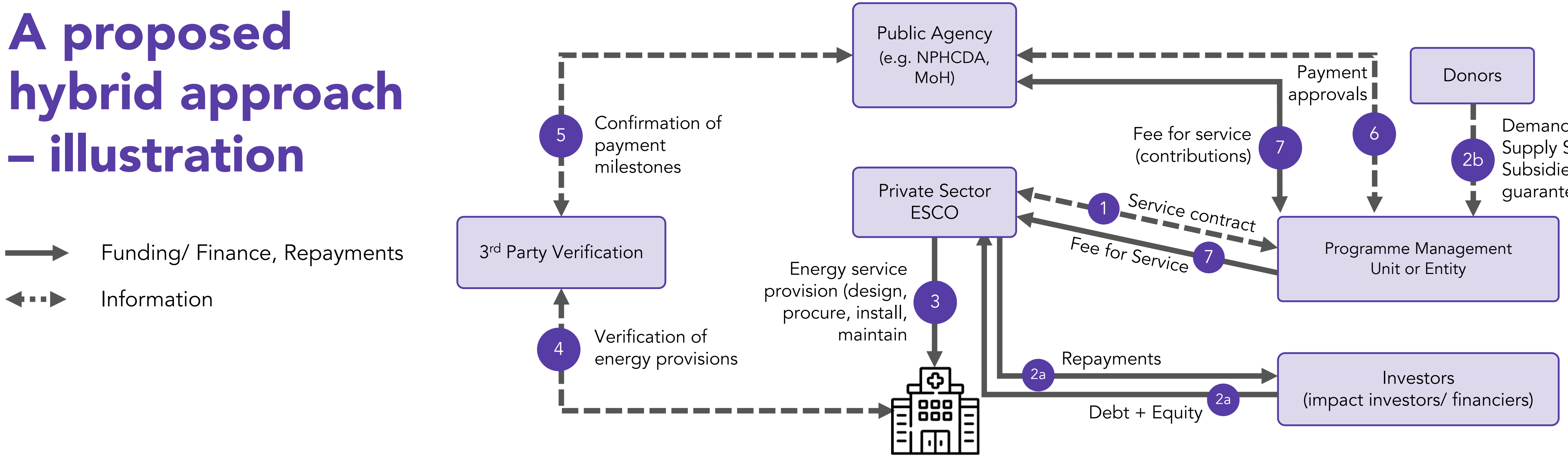
Opportunities

- Entry point to communities to provide other energy-related services.
- Opportunity for aggregation of clusters.

Threats

- For standalone SHS, may become irrelevant when mini-grids or grid arrive.
- Highly dependent on long-term agreements with government agencies.

A proposed hybrid approach – illustration



01 A service contract is signed between the service provider (ESCO) and the PMU/Entity

2a The ESCO raises capital from investors

2b Subsidies and guarantees are deployed through the PMU/Entity to be further disbursed to private ESCO

03 An energy solution is deployed for SHS, while connection is made for mini-grid, and the end user starts using power as a service

04 A third party verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency

06 The public agency sends payment approval to the PMU/entity

07 The PMU/entity (non-financial institution) receives contributions from public agency, combined with 2b, issues upfront payment in accordance with the contract and the service delivered to private ESCO

A proposed hybrid approach – SWOT

Strengths

- Private sector ESCO dependence on contracts with public agency limited, reduced risk of failed contracts in case of change of administration.
- Funds and repayments managed and disbursed by dedicated PMU/entity.
- PMU/entity can function independently.

Weaknesses

- Applies mostly for SHS type interventions, less capital intensive for expected repayments.

Opportunities

- Aggregation of locations by geo-political zones.
- Aggregation and procurement of energy efficient upgrades/retrofits as part of demand side interventions.
- Opportunities for bundled services provision (e.g. productive uses).

Threats

- PMU/Entity needs to be established.
- Consistency of contributions from public agency required for sustainability and building confidence of private sector ESCOs and investors.

Technology:

- Large SHS and mini-grid serving Tier 3-5.

Preconditions:

- Independent non-financial PMU/Entity to manage programme implementation, funding and repayments disbursements to private ESCOs.
- Buy-in from government and donor stakeholders to operate through a PMU or entity (e.g. WB-REA through NEP PMU).
- Strong commitment from government to follow through with contributions to payments for electricity services provided. Must be prioritized appropriately in the budget planning for the health sector.

Funding mechanisms:

- Donor grants, subsidies, concessional loans.
- Donor and government guarantees.
- Debt and equity from impact investors.

Comparison of three model approaches

	Traditional equipment ownership approach	Hybrid approach	Service-based approach
Description	Government or donors provide capital/ installation cost of power system which is constructed by private sector EPC or NGO.	Private sector ESCO funds capital expenditure/installation of standalone solar or mini-grid and charges a service fee/tariff to independent PMU for the provision of power and ongoing maintenance to health facility. Less dependence on public agency or public agency established financial institution.	Same as hybrid approach with strong dependence on public agency and public agency established financial institution.
Ownership	Public agency, health facility	Private ESCO	Private ESCO, public agency
Financing mechanism	Grants	• Blended financing, concessional debt and equity, grants, subsidies. • Potential for other instruments to be leveraged upon.	Commercial debt and equity, subsidies, guarantees

Technology

- Standalone system, solar PV-battery or solar-PV-battery-diesel generator
- Mini-grid, solar PV-battery or solar PV-battery-diesel generator

Challenges for all models and possible solutions

Key factors	Challenges	Possible solutions
Affordability and ability to pay	• Government budgetary constraints, adverse creditworthiness and lack of trust in public institutions can deter private sector from providing services.	• Additional funding needed for public agencies to cover monthly service costs or address risk of repayment. • To reduce credit risk, deploy de-risking instruments, focusing particularly on payment and termination risks.
Private sector willingness/ability to raise capital	• Unwillingness/inability of private sector to raise capital due to difficulty in creating bankable projects, or limited absorption capacity of off-grid companies.	• Create enabling policy framework such as long-term electrification targets and strategies, clear and transparent contract templates, and policies that include clear 'grid arrival' clauses.
Transaction costs	• Underserved public health providers are one part of the overall off-grid solar market. • Public facilities are dispersed and can result in small ticket sizes and high transaction costs.	• Aggregation of projects could help to reduce financing cost and make projects more attractive to investors and energy service providers.
Risk of grid extension	• The risk of grid extension exists for standalone systems and the traditional equipment-ownership model.	• Select facilities that are likely to use a stand-alone system long enough for firms to recoup their investment.
Continuation of grant-based model	• Given that donors continue to support with grants, government agencies may not have the incentives to promote service-based model that encourages private-sector participation and sustainability.	• Advocacy and sector-wide buy-in of the importance of sustainability and service-based model. • Source of funding for government from development partners should be structured to promote sustainability.

Contextual challenges across different stakeholder groups

Government PHCs

- Budgetary provision for health sector service priorities too low to further accommodate RE electrification CAPEX or OPEX.
- Lack of consistency and availability of funds to operate HFs services optimally and pay for utility costs such as electricity.
- High upfront cost of capital for RE generation assets.
- Limited technical capacity for oversight, performance monitoring and maintenance of RE systems.
- Maintenance costs for RE systems, replacement costs too high for PHCs to manage on their own.
- Varying levels of commitment across different states on prioritizing healthcare provision and HFE, therefore coordination between State Government and private sector slow process.
- Reactionary uptake of support rather than strategic based on long-term institutional and national development plans.

Private sector/developers

- Health facilities lack consistent and adequate funding streams to repay service charges to profit-driven organization, therefore default approach is social good service provision.
- Risks of non-repayments for services rendered is high, especially where institutions and agreements are weak.
- Economics of commercial cost of capital is not feasible for social good provision such as HF electrification on a fully commercial basis, making access to finance difficult.
- Provision for spare parts or replacements of RE components not prioritized due to nature of past delivery models, e.g. donor-funded and EPC model.

Donors

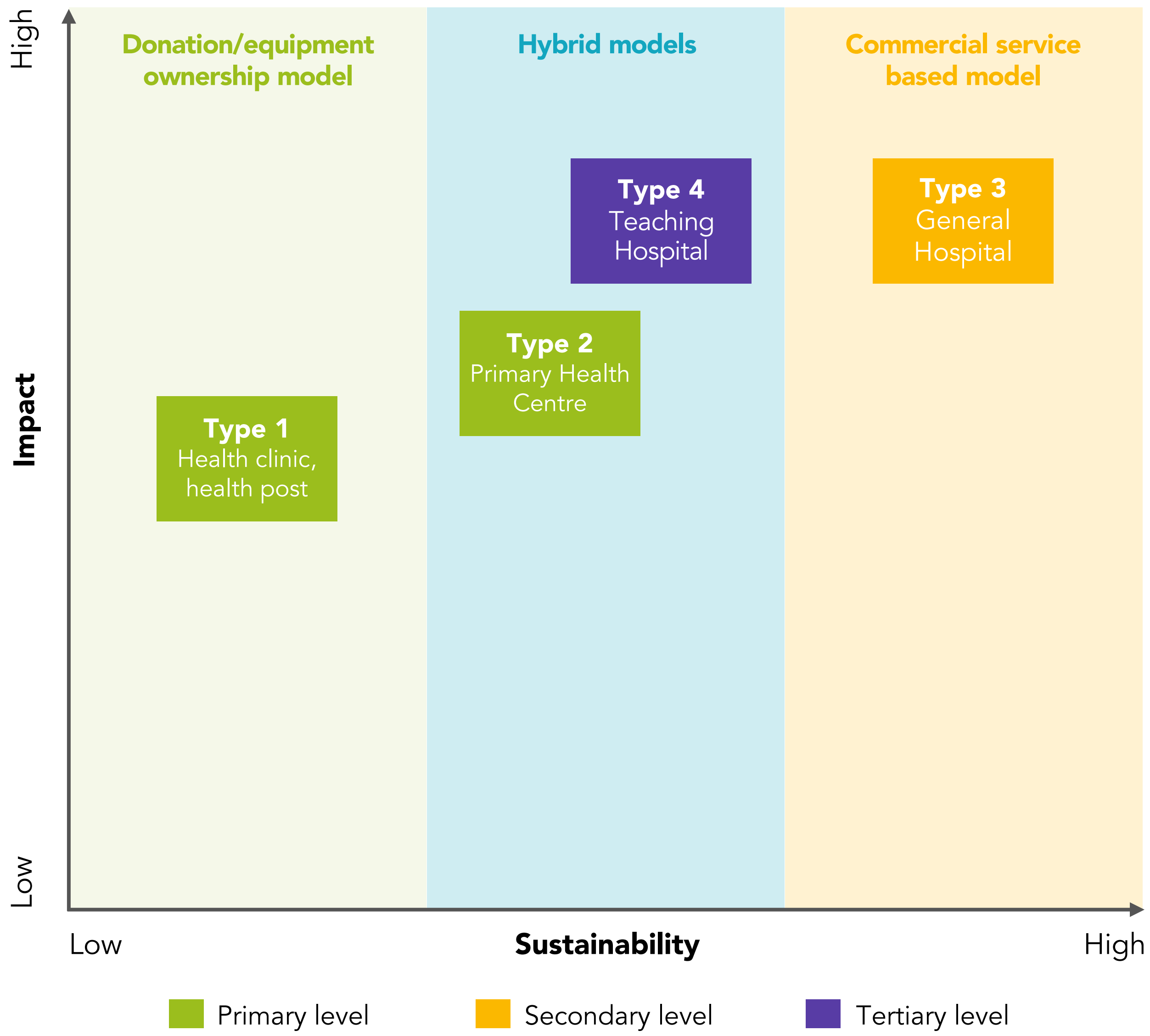
- Quick wins focused due to transient nature of programmatic interventions, therefore most implement equipment procurement models or EPC models.
- Challenge of balancing impacts and value for money.
- Framework for O&M and component replacement beyond warranty period often lacking.
- Low incentive to end user for system upkeep and performance.
- Reliance on government for OPEX could prove challenging.

Long-term sustainability profiles of delivery models

Type 1 PHCs and health posts are better suited for interventions that deliver electrification on a donation/ equipment ownership delivery model basis because they have a very low ability to pay. They offer health services that can typically be covered by low power plug-play kits (e.g., fans, light bulbs, vaccination fridges). Due to their remote locations, more complex cases are ideally to be referred to PHCs for which a higher tiered power solution is being recommended.

Type 2 PHCs and Type 4 Tertiary health facilities can leverage interventions that deliver electrification based on hybrid models that combine donations and semi service-based models.

Type 3 Secondary health facilities are better suited for commercial service-based models as majority are private sector owned and are more likely to have a larger ability to pay.



Measures of impact and sustainability

Impact is gauged based on the number of HFs that can be electrified, the speed at which solutions can be deployed, the potential for improvement of health services, as well as the potential for the model to deliver value for all stakeholders involved, given the funding/financing options that are currently available or that can be implemented successfully.

Sustainability is gauged on the ability to operate, maintain and replace selected electricity supply systems as well as replicate models to scale in the long-term.

These sustainability/impact profiles do not prescribe a "best" delivery model for different facility type but highlights key preconditions that need to be considered by Federal and State governments as they design and implement their archetypes of fit for purpose delivery models.

03 | Roadmap

SUSTAINABLE ENERGY FOR ALL

POWER AFRICA
A U.S. GOVERNMENT-LED PARTNERSHIP

Implementation Phases

Sustainable electrification of all PHCs by 2030

	Phase 1: Structuring and feasibility 2022 – 2023	**Phase 2:** Development and demonstration 2023 – 2025	**Phase 2:** Scale up 2025 – 2029
Key activities	• Structure set-up. • Revalidation of functional PHCs and electricity status to update central dynamic data base. • Technical assistance and programmatic plans for joint energy audits and proof of concept facilities.	• Implementation plans and delivery models defined. • Funding sources identified and structured. • Investment plan developed for 3,433 PHCs, in partnership with relevant parties. • M&E – performance management framework operational.	• Scale-up plan developed, and funding partnership established. • Implementation plans and delivery models refined based on lessons from phase 2. • Investment plan developed for 6,567 PHCs, in partnership with relevant parties. • M&E – performance management framework operational.
Key outputs	• Joint energy audits, validation exercises and development of central dynamic database.	• Pilot and demonstration of different service-based/hybrid models. • 3,433 functional PHCs electrified.	• 6,567 functional PHCs electrified.

Next steps for phased implementation

Phase 1: Structuring and feasibility

- Engagement between Coalition, NPHCDA and REA to plan framework for coordination and support of HFE projects.
- Commit and provide funds for energy audits and establishing independent PMU led by donor support.
- Commence with revalidation of 10,000 functional HFs and energy audits led by REA and NPHCDA.
- Commence development of dynamic database.
- PMU commence led build out HFE programme plans to engage wider stakeholders such as private sector, government and investors and begin to provide technical assistance.

Phase 2: Development and demonstration

- Pilot HFE using different models and gather lessons learnt, donor led pilot funds.
- PMU to refine investment and aggregation of HFs plans, Monitoring, Evaluation and Learning plans (MEL).
- Launch programme and engage private sector energy service companies to activate electrification programme.
- Donor funding and financing mechanisms made available.
- Commence electrification of targeted 3,433 HFs led by private sector, supported by donors, DFIs and impact investors.
- Activate MEL data collection.

Phase 3: Scale up

- Elaborate on and refine plans from phase 2.
- Launch electrification scale up of targeted 6,567 HF.
- Initiate course corrections where necessary and continue MEL data collection.

Recommendations, Roles and Actions

Challenges	Recommendations	Proposed actions	Stakeholders
01 Data and digitalization	Invest in data gathering by conducting physical energy audits of health facilities to include functionality and electrification information, current expenditure on electricity, electrification status of facilities, current O&M regime and governance arrangements.	Commission comprehensive energy assessment and data gathering for functional health facilities.	HFE programme donors, NPHCDA, REA.
	Build a dynamic national database that aggregates, captures and presents information intervention map on HFE.	Upgrade NPHCDAs Health Facilities Registry or develop new database and link to NPHCDA HFR.	HFE programme donors, NPHCDA.
	Digitalization of HFs can support in record keeping, data collection, remote monitoring of deployed RE systems, monitoring and reporting of impacts.	Invest in computers and internet access across HFs.	HFE programmes, private sector, civil society.
02 Funding and financing mix	Mitigate financial risks for private sector energy services companies by providing blended financing options and instruments including performance-based grants, subsidies, guarantees, equity and debt financing.	Develop and pilot HFE projects with blended financing options and instruments targeted at HFE.	HFE programme donors, DFIs, investors.
	Long-term concessionary loans from impact investors are required to encourage private sector energy service companies to participate in health facilities electrification.	Provide access to concessionary loans to private sector.	DFIs, investors.
	Explore funding opportunities with the BHCPF and community-based funding models to supplement operational maintenance and retrofit costs.	Allocate percentage of BHCPF for HFE O&M.	Federal and State governments through NPHCDA.

Challenges	Recommendations	Proposed actions	Stakeholders
03 **Technology, standards and energy efficiency**	Technology choice of standalone solar PV systems (serving single user) or mini-grids (serving multiple users) should be guided by both functionality and least-cost burden for the type and level of HF.	Support standard high quality and appropriate technology choices.	HFE programmes, either donors or government-led, private sector.
	Factor in minimum standards for HFs in terms of critical and non-critical equipment, appliances and staff accommodation when sizing renewable energy systems.		
	Invest in use of energy efficient appliances and equipment for HFs.		
	Commit to adhering to existing standards and guidelines at programme level e.g. SON approved quality standards for solar PV components, NEMSA electrical installations guidelines and Ministry of Environment environmental guidelines throughout project lifecycle and especially for used battery disposal.		

Challenges	Recommendations	Proposed actions	Stakeholders
04 Sustainability and delivery approach	Strongly consider preconditions when selecting delivery models, such as organizational capacity, financial and technical robustness during design and implementation of 'fit for purpose' delivery models for various levels of HF electrification. Ownership, funds availability or sources, energy service delivery levels must be clearly and realistically defined.	Invest in pilots of outlined delivery models for the various types and level of HF.	HFE programmes, either donors or government-led.
	Leverage on sustainability guidelines being developed by REA-NPSP for similar health facilities interventions. The ability to operate, maintain, replace electricity supply systems is paramount to long-term sustainability and performance.	Adhere to sustainability guidelines.	HFE programmes, either donors or government-led, private sector, investors.
	Support and build capacity of existing efforts to create cluster networks and community champions e.g. REA-REUCS, to enhance community participation, physically monitor system performance and provide accountability for O&M requirements with private sector players.	Invest in technical capacity building programmes.	HFE programmes, either donors or government-led.

Challenges	Recommendations	Proposed actions	Stakeholders
05 Coordination and information exchange	Leverage existing coalition and relations between NPHCDA and REA to foster dialogue, information exchange, bridge gap between health and energy stakeholders and get buy-in from Federal, State and local governments and ministries in creating a policy framework conducive to project sustainability.	Strengthen role and structure of coalition to provide a framework for engagement.	HFE programme donors, NPHCDA, REA,
	Provide technical assistance at pre-implementation, implementation and post implementation stages.	Establish and invest in technical assistance through proposed HFE PMU.	HFE programme donors.
	Support capacity development of stronger technical, commercial, legal, institutional capacity for public agencies supporting HFE interventions.	Invest in technical capacity building programmes.	HFE programme, either donors or State government-led.
	Develop or align and implement healthcare electrification programs in consonance with existing health and energy sector plans e.g. NPHCDA 1 PHC per ward plan and existing integrated electrification plans such as REA programmes.	Adopt a phased approach to delivery in line with government's 1 PHC per ward priorities.	HFE programmes, either donors or State government-led, private sector, investors.

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About SEforALL

Sustainable Energy for All (SEforALL) is an international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action towards the achievement of Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate.

We work to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential.

About Power Africa

Power Africa is a U.S. government-led initiative that addresses one of the most pressing challenges to sustainable economic growth and development in Sub-Saharan Africa: access to electrical power. Power Africa provides coordinated support from the U.S. public and private sectors to add cleaner, more efficient electricity generation capacity, which benefits residents and businesses across the continent.

In support of Power Africa, USTDA provides critical early-stage planning to spur new power generation, and transmission and distribution infrastructure. These activities support a range of energy development and deployment from power generation to grid modernization, which increase efficiency and improve access.

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