ENERGY-HEALTH NEXUS

SDG7 for Primary Healthcare Infrastructure

SELCO FOUNDATION
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Contents

Preface

The crisis caused by COVID-19 is representative of a larger problem that will only worsen with climate change and environmental degradation caused by human activity. Rapid demographic, environmental, social, technological changes will likely accelerate the spread of several infectious diseases[1]. Combined with the health impacts of extremes in temperature, and in climatic and weather events, they have the potential to cause a severe strain on the health care system, particularly in growing economies with adverse implications for the poor[2].

On the one hand, the poor are disproportionately affected by the economic impacts of the pandemic, and on the other, they are reliant on a primary healthcare system, which in developing contexts today, lacks the resources and facilities required to provide adequate, affordable and quality care for basic health needs. Alongside combating climate change to mitigate the adverse health impacts, it is important to also strengthen systems on the ground to better deal with these adverse conditions.

Last mile energy delivery models play a vital role in strengthening the health sector and equipping skilled personnel to work with local communities. The evidence captured here, reflects the work that SELCO Foundation and its partners have done over the last 3 years and seeks to demonstrate the importance and value of key processes in enabling this last mile access:

1. Energy-health assessments bringing together stakeholders from both sectors to thoroughly understand needs and determine key gaps

2. Appropriate design that combines decentralized renewable energy systems, with appliance efficiency and optimized building design; illustrating the financial viability and energy savings on account of this design.

3. Procurement processes and installation guidelines that support energy efficiency drives and quality installations to ensure best services for communities

4. Financing and ownership options that unlock capital for energy-assets in healthcare and decentralize and democratize delivery models, making them more sustainable in the long run.

By scaling up the approach and processes outlined here, more than 40,081 centers at the primary level of health provision can be directly impacted, and more than 240 million individuals can have more reliable and affordable access to basic healthcare services at the last mile. This impact would be far greater if similar improvements were extended to facilities with unreliable power supply. It is important to note that these processes are not merely ways to power health facilities, but play a larger role in optimizing the design and delivery of energy-health systems.

[1] https://www.who.int/globalchange/climate/en/chapter6.pdf

[2] https://www.who.int/globalchange/climate/summary/en/index5.html

Context

Overview of Healthcare & Energy Access

The World Health Organization (WHO) defines Primary health care as "a whole-of-society approach to health and well-being centered on the needs and preferences of individuals, families and communities. It addresses the broader determinants of health and focuses on the comprehensive and interrelated aspects of physical, mental and social health and wellbeing".[1]

Stronger primary health care systems are essential to achieving Sustainable Development Goal 3 (SDG3) which aims to ensure healthy lives and promote wellbeing for all of all ages, including through universal health coverage. The health of the population as conceived under SDG3 is key to the attainment of many other goals beyond health including those on poverty, education, gender equality, clean water and sanitation, work and economic growth and so on.

When viewed regionally, South East Asia and Africa perform worse than the global average on aspects of Under-5 mortality and Maternal Mortality, with Sub Saharan Africa seeing 86% of global maternal deaths in 2017 [2 3]. Based on data from 2018, India's Maternal Mortality Ratio (MMR) is 113 per 1,00,000 lives for 2016-18, while the Infant Mortality Rate (IMR) is at 32 per 1000 live births under one year of age [4 5]. The United Nations target is to achieve an MMR of 70 (or less) per 100,000 live births.

[1] WHO Primary Healthcare
[2] WHO Maternal Mortality
[3] WHO 2020 Summary
[4] Sample Registration Survey 2019
[5] Sample Registration Survey 2019
[6] IPHS Guidelines, 2012, National Health Mission

This shows that **despite the progress in these indicators over the last decade, there is still a lot to do in making primary health care more effective and accessible to people particularly in developing country contexts.** In the Indian scenario, among the challenges faced in effectively providing primary health care, some of the important ones include: (a) inaccessibility and inadequate physical infrastructure and facilities and (b) non-availability of doctors or the inability to retain doctors who are posted, possibly on account of poor access to facilities.

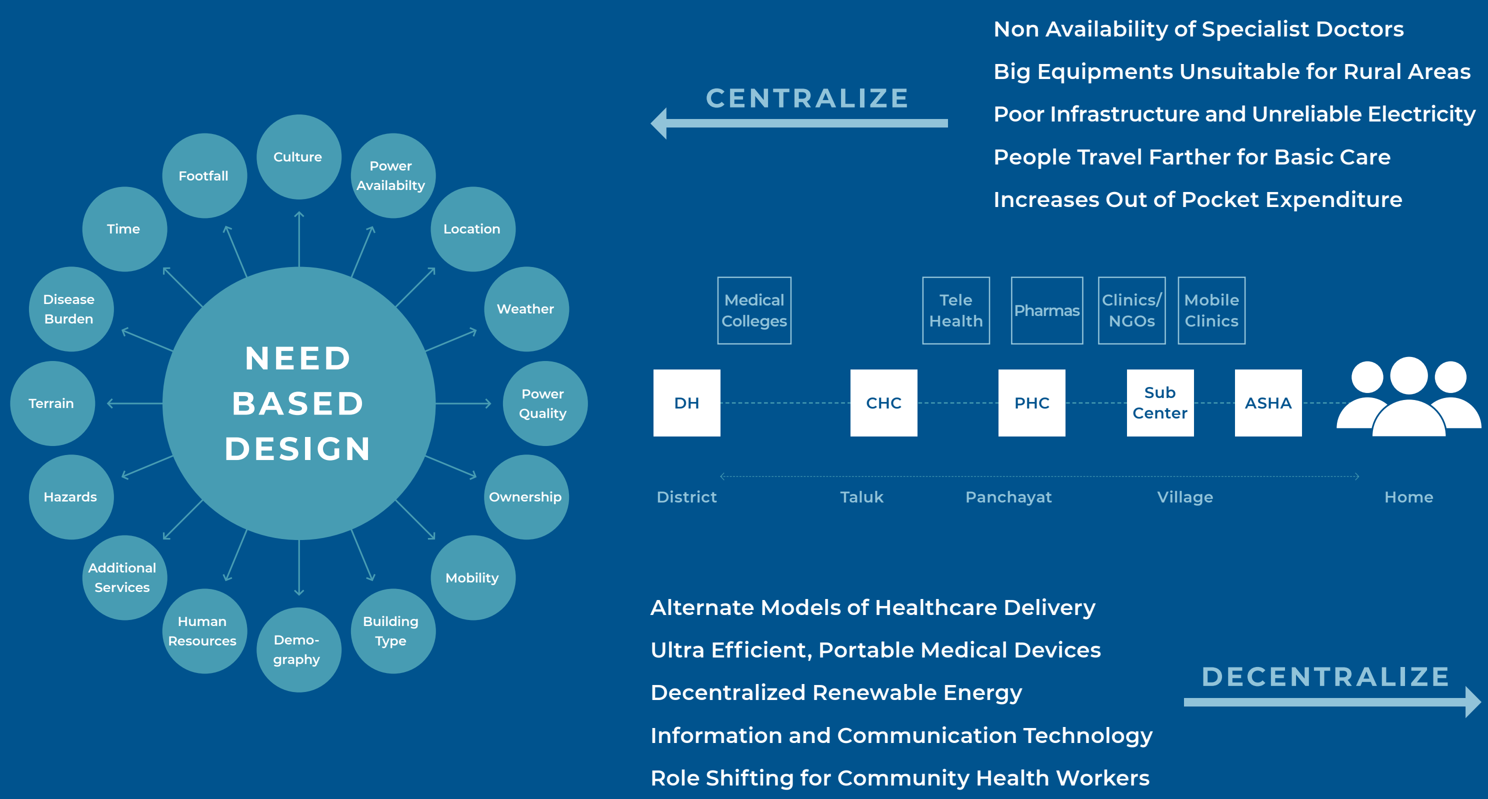
Relevance of Energy Access

The lack of infrastructure and the absence of appropriate delivery models for last mile communities particularly in difficult terrains and remote regions hinders the provision of better healthcare services. While SDG3 has focused the world's attention on the need for expanded access to skilled care, essential medicines and medical technologies for priority diseases and health conditions, comparatively less attention, however, has been given to the value of modern, affordable and sustainable energy access (or SDG7) in delivering good healthcare.

Unreliable, unaffordable access to energy and the lack of appropriate appliances reduce the efficacy and impact of healthcare services. It is critical to the proper storage of vaccines, uninterrupted use of essential medical equipment and diagnostic devices including vaccine cold chain equipment, baby warmers, Maternal Kits (for Antenatal checkups), NCD kits (to diagnose and screen Non Communicable Diseases) and access customized lighting and communications for a variety of medical services including maternal delivery and emergency procedures.

However, simply powering inefficient health infrastructure will not improve delivery. The efficiency of appliances, physical structures and the models for delivery are also critical in ensuring that services are available for the last mile in a timely and efficient manner.

Building on the approaches and solutions developed by SELCO Foundation and its partners for the health-energy nexus over the last 3 years, this paper seeks to outline the impact that SDG7 can have on improving service delivery under SDG3 and the kinds of interventions and ecosystem needed to create this impact. It also functions as a strategy paper detailing out the processes that need to be scaled up through key stakeholders within the ecosystem to strengthen existing rural healthcare infrastructure as well as deploy innovative solutions to deliver last mile healthcare services.



Primary Healthcare and Role of Sustainable Energy

The National Health Mission (NHM), initiated in 2005, is India's flagship initiative on healthcare delivery aimed at providing a strong impetus to the effort of improving healthcare in India. It encompasses the National Rural Health Mission (NRHM) and the National Urban Health Mission (NUHM). The main programmatic aspects of the Mission include:

- Health System Strengthening
- Reproductive-Maternal- Neonatal-Child and Adolescent Health
- Communicable and Non-Communicable Diseases

The NHM envisages achievement of universal access to equitable, affordable & quality health care services that are accountable and responsive to people's needs. Under its aegis, a framework was developed to establish standards for the functioning of all healthcare facilities known as the Indian Public Health Standards (IPHS). The IPHS guidelines detail the expectations from infrastructure, manpower, service delivery at each level within the healthcare system.

The Indian healthcare system is organised into primary, secondary, and tertiary levels. At the primary level are Sub Centers (SCs) and Primary Health Centers (PHCs). At the secondary level there are Community Health Centers (CHCs) and smaller Sub-District hospitals. Finally, at the tertiary level, there are District hospitals and Medical colleges. While there has been an increase in the number of PHCs, CHCs, Sub Centers, and District Hospitals over the past 5-6 years not all of them are up to the standards established by the IPHS guidelines. An overview of the healthcare system, the facilities at each level and their current status is presented in figure below.

As illustrated in the figure, more than 39,000 SCs and nearly 800 PHCs still operate without any access to electricity. It is estimated that tens of thousands of health centers across low- and

middle-income countries either have no grid or one that supplies unreliable electricity. For example, one in every two primary health centers in India are either un-electrified or suffer from irregular primary supply. Many health facilities depend on expensive, polluting and inadequate alternatives such as diesel generators or kerosene lamps. A similar number of hospitals suffer from frequent and debilitating blackouts. This helps explain why infrastructure—including electricity—is the main driver behind the additional USD 274 billion in spending needed per year by 2030 to make progress towards Sustainable Development Goal 3 (Health) globally. And yet closing this health access gap by 2030 will not be possible through existing electrification targets. [7]

SUB CENTERS	**PHCs**	**CHCs**
The most peripheral point of contact between primary health care system & the local community; Manned by a female health worker/ANM and a male health worker.	A referral unit for 6 Sub Centers; With 4-6 beds; Manned by a Medical Officer In charge and 12-13 paramedical and administrative staff.	A Hospital/Referral Unit for 4 PHCs with Specialized services; With 30 beds
Population to be Served *As per IPHS Norms* **3,000–5,000**	Population to be Served *As per IPHS Norms* **20,000–30,000**	Population to be Served *As per IPHS Norms* **80,000–120,000**
Average Rural Population Covered Typically *In Practice* **5,616**	Average Rural Population Covered Typically *In Practice* **35,567**	Average Rural Population Covered Typically *In Practice* **165,702**
Total no. of Health Facilities Required in Rural Areas **189,765**	Total no. of Health Facilities Required in Rural Areas **31,074**	Total no. of Health Facilities Required in Rural Areas **7,756**
Total Functioning in Rural Areas **157,411**	Total Functioning in Rural Areas **24,855**	Total Functioning in Rural Areas **5,335**
Gap / Shortfall in no. of Health Facilities in Rural Areas **43,736 (23%)**	Gap / Shortfall in no. of Health Facilities in Rural Areas **8,764 (28%)**	Gap / Shortfall in no. of Health Facilities in Rural Areas **2,865 (37%)**
Total no. of Health Facilities without Electricity Access in Rural Areas *Excluding HWC* **39,286 (26.3%)**	Total no. of Health Facilities without Electricity Access in Rural Areas *Excluding HWC* **795 (4.8%)**	

Source: Compiled based on data from Indian Rural Health Statistics, 2018-19, other sources?

Primary Health Care Service

MEDICAL CARE & BASIC DIAGNOSTIC SERVICES

Including 24 hours emergency services, OPD and in-patient services, laboratory and diagnostic services.

Critical Services Dependent on Reliable Energy

Medical procedures, monitoring community health and disease prevention, including customized lighting for operations, autoclave sterilizers for instruments, microscopes, centrifuge, Non-Communicable Diseases kits.

Space cooling and heating, through energy efficiency and green building designs.

Other general needs including lights, fans, computers, mobile charging stations, water pumping and purification systems.

Primary Health Care Service

MATERNAL AND CHILD HEALTH CARE

Including Family Planning and Immunization: Antenatal Care, Intra-natal care: (24-hour delivery services both normal and assisted), Postnatal Care, Newborn Care, Nutrition and immunization services, Medical Termination of Pregnancies, sexual health

Critical Services Dependent on Reliable Energy

Maternal and child health care needs such as baby warmers, suction machines for deliveries, phototherapy etc.

Immunization and cold storage, which includes deep freezers and refrigeration to store drugs, blood, vaccines and medicines

Fig: The figure above shows the main services at the primary health care level [8] and highlights the activities that get hampered due to inadequacy of energy availability. In addition to the services highlighted above, the primary healthcare services also include awareness and prevention activities, ie Health Education and Behaviour Change Communication, Promotion of Safe Drinking Water and Basic Sanitation, Prevention and control of locally endemic diseases like malaria, Japanese Encephalitis etc. It also functions as a nodal point for the provision of services under a variety of government programmes aiming to tackle diseases such as Cancer, Diabetes, Tuberculosis, AIDS and providing support on aspects of Mental Health.

There is an opportunity to plug the existing health infrastructure gaps by building on innovations in energy delivery models and efficient medical appliances. The gap has resulted in high transaction costs for the poor, thus leaving millions around the world without reliable health services.

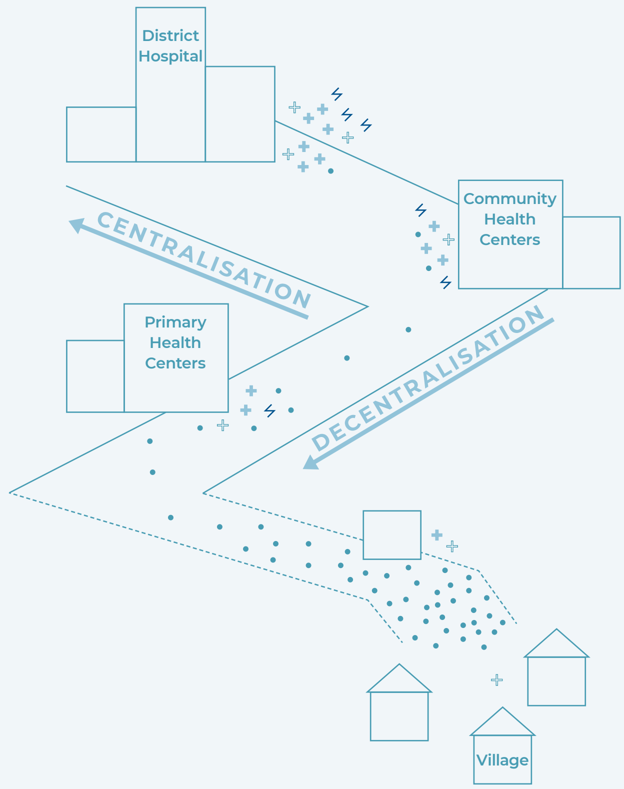
Nearly 86% of all the medical visits in India are made by rural populations with majority still travelling more than 100 km to avail health care facility of which 70-80% is born out of pocket landing them in poverty. [9]

Convergence Between Energy & Health Actors

Across countries, health is typically a service with significant government involvement—often extending all the way from creation of guidelines and frameworks to actual implementation and operating, managing the facilities/centers. Health departments at national and sub-national level are actively involved in determining how facilities will function.

The powering of health infrastructure has, however, been the purview of energy departments/ ministries. Even with private and non-government actors, traditionally, there has been little engagement between those in the energy access space and those working on health issues. An absence in understanding of health needs and health systems affects the creation of customized design solutions that can take note of key aspects around appliance efficiency, appliance and space usage and bring about significant reductions in costs and improve utilization of energy solutions for healthcare.

These challenges clearly outline the need for a more integrated systems approach and a comprehensive process to assess, design, implement and manage energy solutions for healthcare.



- Individuals Accessing Healthcare Services
- Doctors Present for Treatment
- Community Health Workers / Medical Assistants
- Availability of Reliable Power

> ***"It's not only an electrification agenda, it's a broader developmental agenda. There is a missing link between institutions working on electrification of health centres and those working on health (service delivery)."***
>
> *Salvatore da Vinci, Advisor, Sustainable Energy at WHO (Representation of IRENA) at the [Decentralised Healthcare and Sustainable Energy Conference, 2018](#)*

[7] Heather Adair-Rohani, WHO and Jessica Lewis, WHO (2018). A Deep Dive Workshop: The Importance of Sustainable Energy to Delivering Quality Health Services.

[8] Based on IPHS Guidelines

[9] Kumar R. Academic Institutionalization of Community Health Services: Way Ahead in Medical Education Reforms. J Family Med Prim Care. 2012

Solutions & Approach

Addressing energy issues for decentralisation of healthcare in an effective and impactful manner requires an integrated approach. It is imperative that we break away from siloes and requires both health and sustainable energy stakeholders to bring in a nuanced understanding of their sectors and a willingness to work closely to bridge knowledge and skill gaps. The value of this nexus approach is articulated in the figure below.

> ***"Health and Energy nexus is a landmark in the field of sustainable development- leading to decentralization, sustainability and afford-ability milestones in both health and energy."***
>
> *Dr. H. Sudarshan, Founder, Karuna Trust at the Decentralised Healthcare and Sustainable Energy Conference, 2018*

Health Sector	Health-Energy Nexus	Energy Sector
× Lack of awareness of sustainable energy solutions for healthcare. × Limited capacity to implement sustainable energy solutions. × Limited awareness of the use of energy efficient devices / technologies / green building guidelines with relation to health.	✓ Critically understanding the healthcare access gaps and energy needs that hamper the delivery of healthcare. ✓ Conduct joint audits and optimize energy solutions parallel to health gaps which will help to improve the quantity as well as quality of health services offered.	× Lack of awareness and understanding of how to develop customized, optimized and efficient sustainable energy solutions for healthcare settings. × Lack of prioritization of energy projects in the health sector as well as lack of active collaboration with healthcare centric organizations & bodies.
Final Goal: Universal Access to Healthcare	**Final Goal: Sustainable Delivery of Health**	**Final Goal: Access to Sustainable Energy**

Ecosystem for Energy-Health Systems

Building the ecosystem has been integral to strengthening the processes for design, delivery and management of energy-health solutions and ensuring they are sustainable in the long term. They are customized depending on the geographical context, type of community, available infrastructure/ physical set-up and so on. Based on a mapping of facilities along the healthcare value chain, energy-health gaps have been identified and solutions developed for each level starting from a Sub Center to the Primary Health Center and the Community Health Center.

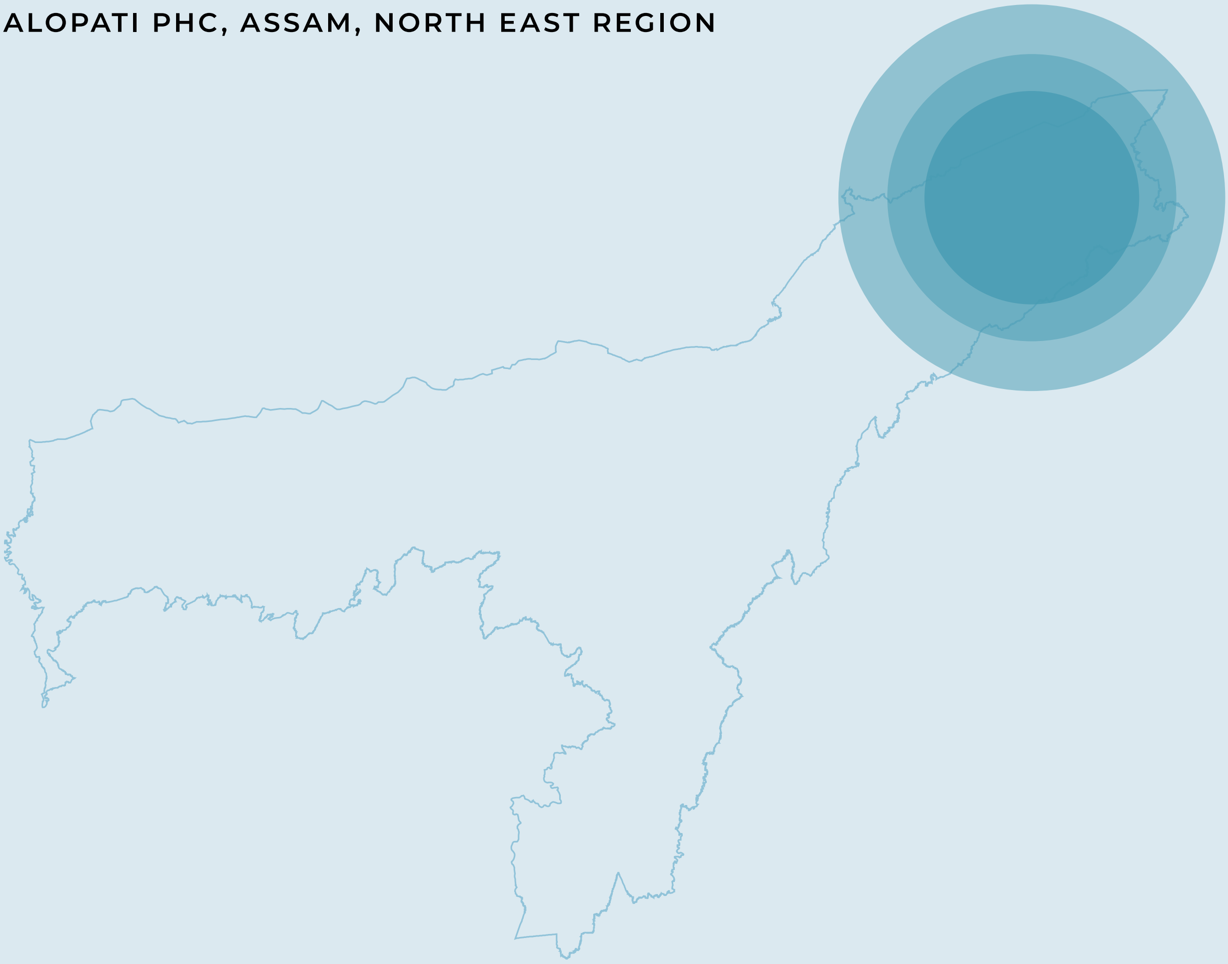
Efforts have also been undertaken to identify the various models for service delivery including options that are mobile (such as the Boat clinic for the riverine belt) and portable (Maternal kits and kits for diagnosis of Non-Communicable diseases).

The figure below captures the types of interventions and key stakeholders across the key ecosystem components of technology and innovation, training and capacity building, service and delivery, finance and ownership, and policy.

	INTERVENTIONS	STAKEHOLDERS
TECHNOLOGY & DESIGN	Identification, testing, gathering feedback and piloting tech and design solutions for: → Energy efficient appliances. → Customized sustainable energy systems to power these appliances. → Efficient and green building design to optimize space utilization, cooling and heating.	→ **Manufacturers, Vendors, Suppliers** → **Clean Energy Enterprises** → **Architects, Masons, Contractors, Civil Engineers, etc.**
TRAINING & SKILLS	→ Capacity building on health-energy audit, technical assessment for energy systems and green construction. → Modules on usage and maintenance of innovative and efficient appliances. → Local capacity to support installation and maintenance of energy systems.	→ **Health staff, medical officers at healthcare facility/ service point** → **Training and incubation centers for clean Energy Enterprises and local technicians** → **Trainers for public building constructions**
SERVICE & DELIVERY	Work with partners to: → Improve and support staff at the facility, including in the process of recruitment, training, staff health and safety. → Improve service provision including cold chain, laboratory testing etc. → Prolong opening hours, better manage-ment of records and communication.	→ **Public healthcare points,** → **NGOs involved in last mile delivery,** → **Private healthcare providers,** → **Public private partnerships**
FINANCE & OWNERSHIP	→ Cost benchmarks- energy savings and benefits → Loan structures and financial modeling for long-term asset based financing → Modelling of financial benefit of green building design → Identification and access of locally available funds for maintenance	→ **National and state level health departments,** → **Public works department** → **Hospital management committees**
POLICY	→ Policy guidelines on powering health at different points in the value chain; Guidelines on green building design and benefits → Procurement guidelines, Government certification → Incentives to encourage energy efficiency in health technology/ appliance design and manufacturing	→ **• National and State health departments** → **• Multilateral and bilateral health agencies**

Case Study 1

ALOPATI PHC, ASSAM, NORTH EAST REGION



Background

Alopati Majarchar PHC (In Barpeta District of Assam) was designed to cater to a population of roughly 25,000 people. But in the absence of other health facilities in the area, it serves a population of nearly 100,000—well over its capacity. The PHC also provides maternal and newborn care services, conducting upto 60-70 deliveries a month. This is significantly higher than the recommended IPHS guidelines of 20-25 deliveries per month for a PHC, all this while being unelectrified and unconnected to the grid. In the absence of electricity, the PHC was dependent on small solar powered lights and a diesel generator to meet their critical power needs. The scenario was particularly challenging to work in:

- Doctors and nurses were forced to conduct deliveries in extremely stressful conditions
- Usage of equipment such as baby warmer and cold chain solutions for vaccine storage were often affected by the shortage of fuel
- High operating costs of running the center using diesel generators, where the expenditure was INR. 3000 to INR. 3500 ($40 - $47) per month. During the rainy seasons, the center often spent nearly INR. 1500 to INR. 1800 ($20- $25) more on travelling to the nearest petrol station to procure the fuel because of limited supply
- Lack of proper access to electricity and infrastructure and the inability to use critical appliances affected the motivation and well-being of staff members.

Solution

The center was identified for energy-health interventions by Doctors For You (DFY), a pan India humanitarian organization, that works in disaster and conflict hit areas on providing medical care and emergency medical aid to the vulnerable communities during crisis and non-crisis situations. The DRE solution for this PHC was implemented in February 2020.

Technology Solution: The PHC was provided with two DRE systems of 3.96 kWp each and energy efficient equipment including a baby warmer, phototherapy, suction machine and spot lights. Electrical loads such as lights and fans were replaced with efficient appliances. The system includes 2 inverters so in the event that one fails, the other is always available to support critical loads. In a remote region with no other source of power, this is important to factor in.

Financial Model: The total energy system cost is INR 925,000 ($12,460). Given the dire need in the region, the capital cost for this intervention was grant funded. For operations and maintenance, based on the learnings from other facilities, the Health center has been advised to enter into an agreement with the energy enterprise where untied funds of the RKS (Health center management committee) will be used to cover the 1-2% annual maintenance cost.

Impact

Savings on diesel fuel of more than INR. 3000 ($40) per month.

Timely immunization for children and pregnant women using a well-functioning cold chain system.

Safer deliveries and better conditions for doctors and nurses to treat patients.

Improved working conditions and increased convenience for staff in the health facilities.

Key Processes & Strategies for Scale

The design, implementation and management of energy solutions for healthcare delivery are guided by certain key processes. These processes are integral in ensuring efficiency, efficacy and sustainability of solutions developed and deployed under the health-energy nexus. These processes are designed to enable convergence of expertise from the health and energy sectors. Within each process, there is a role for stakeholders from each of the sectors. These stakeholders may be government, private sector, NGOs or end-users. Within each of the processes, the level of responsibility, accountability and involvement of different stakeholders has also been outlined to lay the foundation for better engagement and achievement of outcomes.

A brief overview of the processes are provided in figure below. More details about each process, its relevance and importance in ensuring affordable, reliable and quality solutions and the key stakeholders involved are outlined in the following sections. The interlinkages and the role of the ecosystem components in scaling up each of the key processes are also discussed.

STAGE 1

IN-DEPTH ENERGY-HEALTH ASSESSMENT

- Energy-Health audits for assessments of needs and gaps
- Participatory consultations with key staff and patients

STAGE 2

APPROPRIATE DESIGN

Efficient appliances

+ Decentralized Renewable Energy system

+ Green and efficient built environment

STAGE 3

PROCUREMENT & INSTALLATION

- Installation and servicing guidelines
- Vendor/ supplier guidelines
- Pricing and procurement

STAGE 4

FINANCING, OWNERSHIP & MAINTENANCE

- Training for health staff on usage
- Financial and ownership models (including MOU)

IPHS guidelines recommend that PHCs move towards the provision of 24*7 services, which would require 24*7 availability of electricity. However a 'one size fits all' approach of determining the kilowatt capacity for a health facility and installing such an energy system would fail to note the nuances in equipment efficiency, equipment usage or special needs owing to the health conditions in a particular region. A simple energy audit alone would not reveal the health priorities and existing challenges in delivering health services for a particular region- which are important to design an optimal and useful energy solution.

Convergence in understanding and assessing priorities for energy access and healthcare can provide key insights towards improving system design and consequently healthcare delivery and its outcomes. For example, it was only through the Health-energy audit that the critical need for a sickle cell anemia testing facility with appropriate equipment for a PHC in Madhya Pradesh (Central India) became apparent and was then included in designing the energy system. In the same region, the assessment revealed that there was a significantly high number of home deliveries since the nearest sub-center was not adequately equipped, resulting in the upgradation of this sub-center to a delivery point to include additional staff and appropriate equipment. A basic energy assessment of what exists would not have brought out these insights that have been critical in improving healthcare delivery.

The following sections provide a summary of the assessment, the skills required, key outcomes and the strategies to scale this process.

Overview of In-Depth Health-Energy Assessments

Outcomes of the Audit: The health-energy assessment is a participatory exercise carried out with the support of a toolkit to assess the existing health services, including the gaps and future service needs in last mile health care facilities. The tools help in gathering information about the facility and its patients' needs systematically and scientifically in consultation with the health staff and subsequently, aid in designing a detailed plan for improving the services available at the facility.

By helping understand the pattern of energy consumption, the assessment also supports the team in suggesting actions to rationalise energy use and reduce power demand which influences system design and enables customization (as discussed in the next section of the process). Overall, this exercise helps in:

- Identifying and categorizing services and appliances in terms of critical and non-critical energy loads

- Recommending energy efficient health-care appliances (for essential and desirable services) and designing optimized decentralised energy systems
- Designing energy efficient structures and built environment
- Determining additional services that could be delivered through the center with new appliances
- Determining manpower requirements to manage the energy system and appliances, and
- Planning financial or budgetary requirements to carry out all of the above.

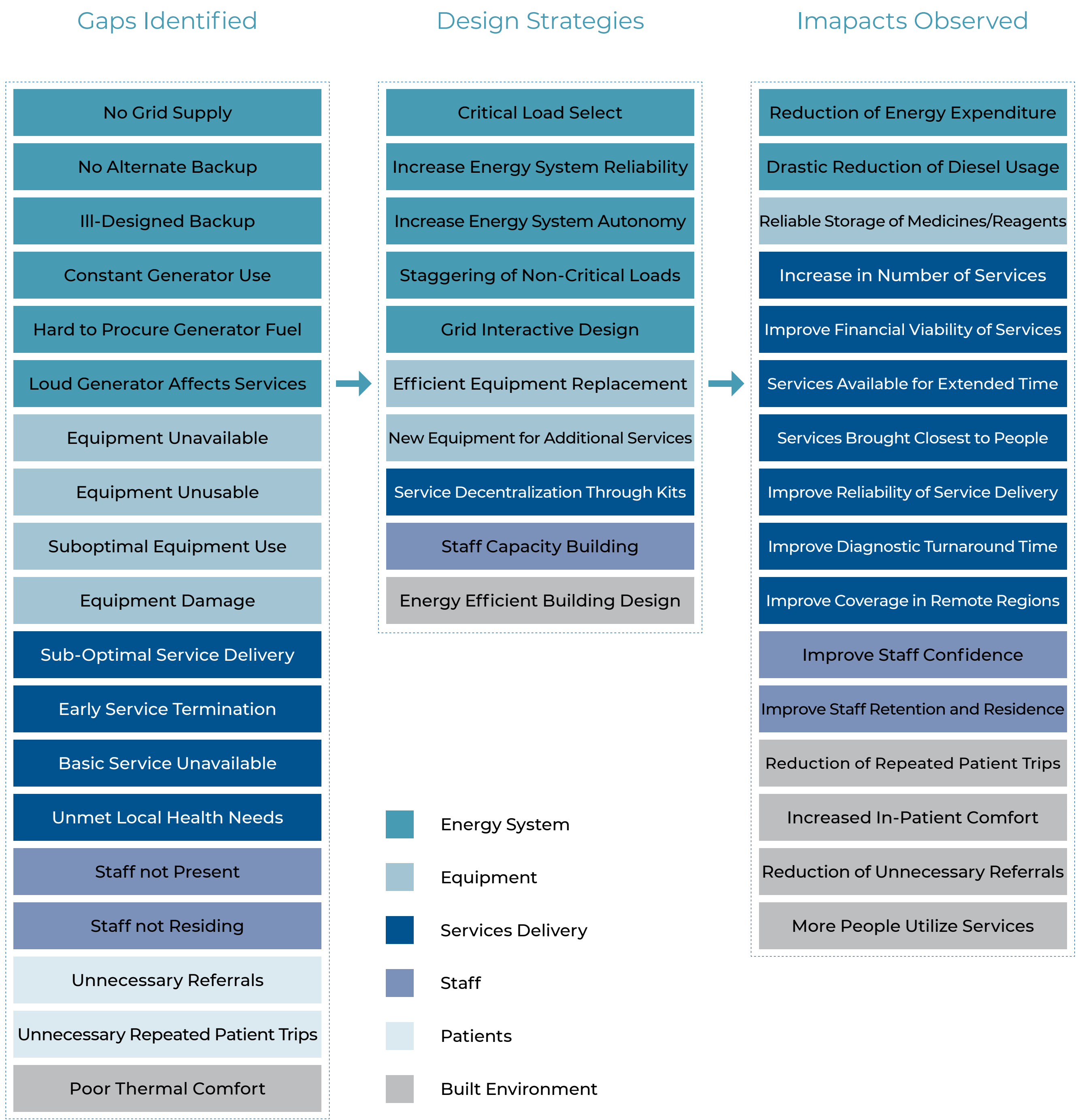
Toolkit Components / Methodology: The toolkit for this audit includes a combination of interviews with staff at the healthcenter, recording data on healthcare appliances, their power consumption and usage patterns using energy meters, data loggers and registers, observations about built environment structures as well as checklists and photographs to enable design of energy systems. The figure below provides a summary of the kinds of information sources used in the audit.

Skills and Expertise: The ideal auditing team consists of an administrator or medical officer of the health center and a knowledgeable technician from a local Clean Energy Enterprise (CEE). In addition to merely addressing the energy gaps, such a joint participatory assessment process can also open up opportunities to expand health services being delivered at the center with increased access to reliable electricity.

So far, the health-energy audit has been deployed in over 50 diverse health centers delivering primary and secondary care in India. The various gaps identified within the energy-health system through this approach has allowed institutions to develop and implement customized design strategies to address these gaps, resulting in a range of impacts observed in different parts of the health system. A summarized overview of these gaps, strategies and impacts is presented in the figure below (after audit summary).

Summary of Audit & Assessment with Sources of Information

	Sub-themes	Q&A (directed to health staff/ management)	Tangible Data Sources (energy meters*, data logging, bills reciepts, registers etc)	Observation/ Checklists (benchmarking against actual on-site capacities & specs or IPHS Guidelines)	Photographs
TYPE OF CENTRE	Sub center, Primary Health Center, CHC, District Hospital	✓			✓
	Service Hours	✓			
COMMUNITY AND AREA PROFILE	Demographic details of the health centre	✓	✓		
	Amount of sunlight + seasonal variation of weather or disaster risk typology	✓			
	Remoteness and access to maintainence services	✓			✓
HEALTH SERVICES	Health services offered and implementation status - clinical and diagnostic service, other community services	✓		✓	
	OPD attendance and bed occupancy	✓	✓	✓	
	Diagnostic services carried out	✓		✓	
	Number of tests done	✓	✓	✓	
LOCAL ILLNESSES	List of various local diseases	✓	✓		
	Steps taken by health centre to counter these diseases	✓	✓	✓	
HUMAN RESOURCE	Medical OfÞcer(s) and other health centre staff sanctioned and working	✓	✓		
	Training and capacity building of staff	✓		✓	
BUDGETING	Arogya Raksha Samiti - Financial allocations for the centre	✓	✓		
BUILDING	Building dimensions and materials, shading, roof type, existing wiring infrastructure(baseload/heating load), earthing quality		✓	✓	✓
EQUIPMENT	Utilisation of various amenities and equipments, and availability of equipments	✓	✓		✓
POWER QUANTITY, QUALITY & COST	Electricity situation, power cuts, existing back ups/ alternate sources, existing loads/ appliances (including pumping and heating requirments) - list capturing appliance type, specs, brand, wattage, duration of use etc	✓	✓		✓
	Voltage fluctuations		✓		
	Capital and recurring cost of existing energy sources (Diesel gen set, UPS, grid electricity)	✓	✓		

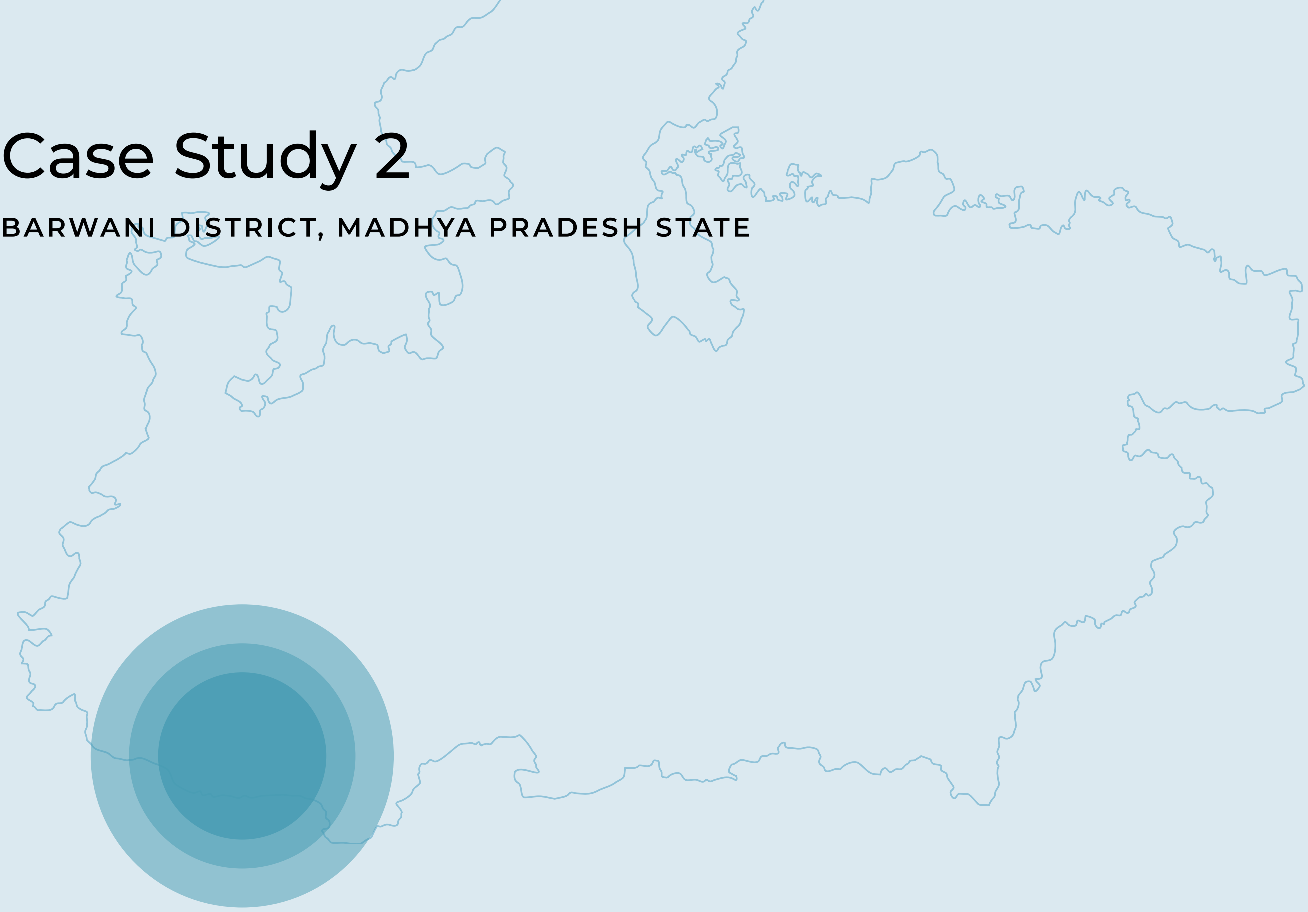


Typologies of gaps identified, design strategies and impacts observed across health system components.

Source: SELCO Foundation analysis of energy-health audit results.

Case Study 2

BARWANI DISTRICT, MADHYA PRADESH STATE



Background

Barwani district of Madhya Pradesh has a tribal population of more than 70% and is prone to extremely high temperatures of more than 42 degrees in the summer and extremely cold temperatures of less than 10 degrees in the winters. Improving the quality of primary healthcare facilities and identifying needs of local communities was important to manage the health problems affecting the poor in tribal areas while also bringing down the cost of healthcare provision and relieving the district hospitals from being overloaded.

Solution & Key Facets

With champions for energy access in the State health Department and at the district level, and the assurance of adequate personnel and equipment for the centers, DRE solutions were implemented in 1 Sub-center (Danodi), 2 PHCs (Julwania and Upla towns) and 1 CHC (Rajpur town).

Detailed Health - Energy Assessments were carried out with the active participation from the Medical Officer (MO) and other staff members in all health facilities.

- Energy efficiency drive including replacement of all medical equipment in SC and PHCs
- Upgradation of Sub-Center to a delivery point with appropriate equipment and power to reduce the number of home deliveries in the region
- Identification of the need for and implementation of sickle cell anemia testing facility at one PHC (using untied funds available at the center)
- Design and implementation of customised energy systems for critical needs in each center, which alongside energy efficiency drive, reduces energy system costs

TRAINING & CAPACITY BUILDING

KEY STRATEGIES TO SCALE ASSESSMENT PROCESS

Energy Sector Stakeholders:

- Develop modules and undertake capacity building of local energy enterprises, technicians and technical partners of state energy departments to visit facilities and lead health-energy assessments.
- Accredit/ empanel energy enterprises at a district level (by State energy departments), based on local presence, past performance on installation and after-sales servicing; Annual review of accreditation.
- Organize refresher trainings for energy enterprises on energy-health needs, critical loads, new efficient equipment etc.

Health Sector Stakeholders

- Undertake training and involve at least one key staff from each Health facility in the assessment process.
- Share insights and advocate within the health sector about the need for the process.
- Through engagement in successive audits, help energy departments to build training modules , organize sessions and disseminate learnings.
- Build in-house capacity for energy-health assessments, provide feedback on the energy aspects, and create stronger ownership and maintenance models for DRE systems on the field post implementation (linked to Key process on Financing, Ownership and maintenance).

POLICY

KEY STRATEGIES TO SCALE ASSESSMENT PROCESS

- Engage with and get buy-in from District administration, specifically District Commissioners (DC), District Health Officials (DHO) and Chief District Medical Officers (CDMO) to kickstart process and ensure active engagement from health facilities on the ground
- Equip district administration and representatives with key information:
  — Relevance of Health-Energy Nexus and broad process to be followed
  — Types of interventions
  — Value addition of these interventions- specifically in terms of quality and reliability of service delivery, cost implications in short term and long term in comparison to current alternatives
- Endorsement of energy-health assessments/ audits and the participatory consultation processes by National Health Mission and its affiliated institutions, to accelerate adoption by States and Districts.

STAKEHOLDERS INVOLVED*	ROLES & RESONSIBILITIES
State Representative National Health Mission (MD & SPMU)	Accountable
State Energy Department/ State Nodal Agency of MNRE/ (through Local accredited energy enterprises)	Responsible
District Administration (DC, DHO, CDMO)	Accountable
Rogi Kalyan Samiti (Health center managment committee).	Consulted
Local NGOs, CBOs	Responsible
Staff at health centers	Consulted
Patients at health centers / Local community	Consulted

*Key for roles and responsibilities of Stakeholders:

- Responsible: Undertakes the work to achieve or complete the task
- Accountable: Ultimately accountable for correct and thorough completion of task- may oversee other actors
- Consulted: Provides information, inputs and feedback to be taken into consideration
- Informed: Kept informed of progress

Appropriate Design

Clean Energy Systems with Efficient Appliances and Built Environment Solutions

Holistic energy-health interventions that combine sustainable energy systems with efficient appliances and sustainable built environment designs seek to respond to specific challenges faced by public health facilities including:

a. Inefficient electrical and medical device usage resulting in higher energy requirements and higher operational costs of running critical care services that overburden public health centres

b. Critical load identification and prioritization to determine the type of solar energy system design (combination of DC or AC back-up) and cost implications of the same

c. Inefficient building design, leading to increased usage of lighting during the day and active cooling measures (such as fan, coolers, air conditioners) for thermal comfort particularly in heat stress regions which further increases energy consumption at the facility; Poor climate responsive built spaces also affect recovery capacity among patients and reduce wellbeing and productivity of the medical practitioners working in the facilities.

Energy Efficient Appliances and Appropriate Solar Energy Systems

Decentralized, renewable energy solutions, coupled with energy efficiency measures, have great potential to expand health facility access to cost-effective, reliable electricity in many low-income settings where the grid is unreliable or non-existent. As illustrated in the figures below, today there are more efficient options for each appliance required at the level of Primary healthcare- be it basic energy, cold chain and refrigeration or maternal and newborn care.

The differences in appliance efficiency significantly change the sizing of the decentralized solar energy system- both PV panel and battery capacities- which in turn change the cost of powering the system and the future cost of maintenance. Case study 3 on Meghalaya sub centers illustrates how the cost of powering a center with all existing loads compares to one where efficient appliances are powered to provide the same set of services. The cost of powering a center with inefficient appliances is 3 times more than the cost of powering one with efficient appliances. Including the cost of appliances would still mean the inefficient appliance center is 35% more expensive than the one with efficient appliances.

Comparison of wattage of efficient and inefficient appliances; Implications on energy system sizing and design.in Primary Healthcare Centers and Sub-Centers in India

Primary Healthcare Centers

ENERGY CONSUMED BY AN EFFICIENT SYSTEM
13 UNITS PER DAY

ENERGY CONSUMED BY AN INEFFICIENT SYSTEM
24 UNITS PER DAY

PERCENTAGE OF ENERGY SAVED
45%

SOLAR PANEL CAPACITY
56.25% Savings

INEFFICIENT
14.4 kWp

EFFICIENT
6.3 kWp

COST OF SYSTEM
55% Savings

INEFFICIENT
₹14,80,000

EFFICIENT
₹6,65,000

Sub Centers

ENERGY CONSUMED BY AN EFFICIENT SYSTEM
1.4 UNITS PER DAY

ENERGY CONSUMED BY AN INEFFICIENT SYSTEM
3.1 UNITS PER DAY

PERCENTAGE OF ENERGY SAVED
55%

SOLAR PANEL CAPACITY
40% Savings

INEFFICIENT
1.5 kWp

EFFICIENT
900 Wp

COST OF SYSTEM
58% Savings

INEFFICIENT
₹1,80,000

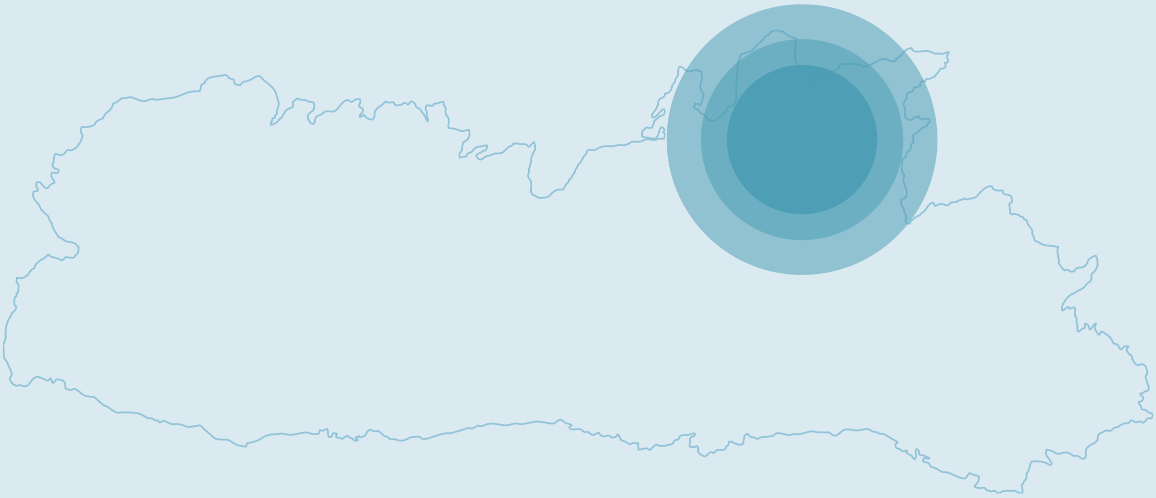
EFFICIENT
₹75,000

Through assessments, design and interventions across multiple health facilities, there is an improved understanding of efficient appliances required for specific services, critical vs. non-critical loads for service delivery in that facility and system designs allowing for incremental additions. In this process, a set of design options with cost implications have been developed for each level of healthcare facility (SCs, PHCs, CHCs). These design options provide decision makers with the information required for them to choose what is best suited for their regions or contexts based on power availability, reliability, remoteness, critical services to be provided and additional services that may be needed based on community profile or local health concerns.

Click here for an example of the solution options developed for Sub Centers. The next Case study discusses how these options were used in the context of planning energy interventions for Sub-Centers in Meghalaya.

Case Study 3

MEGHALAYA STATE, NORTH EAST REGION



Background

The state of Meghalaya has 477 functional Sub Centers in rural areas, of which 157 (35%) do not have electricity. Based on discussions with key government actors within the state, unreliability of electricity is also a challenge in a large percentage of these sub-centers. The state has recorded an MMR of 187 per 100,000 live births and an IMR of 34 per 1000 live births. Both of these are worse than the national average of 113 per 100,000 live births (MMR) and 32 per 1000 live births (IMR). In the absence of well-functioning labour rooms and unreliable access to electricity to run key appliances, the risks associated with maternal and child care are exacerbated.

Solution

While the hilly terrain, low population density and climatic conditions in the state are a challenge to the provision of reliable grid-based electricity, they create an immense opportunity for using decentralized energy solutions to power public health facilities across the state. Through engagement with the Managing Director of the National Health Mission in Meghalaya (MD-NHM) and other representatives of the State Health Department, a plan was presented to improve energy access across all Sub-Centers, starting with 100 centers where there is an unmet demand for critical services such as maternal and newborn care, or areas that are particularly remote with limited access to higher tiers of healthcare services (such as PHCs, CHCs or district hospitals). Solution options presented were similar to those provided in figure x.

The chosen solution option includes efficient appliances and solar energy systems for basic energy needs, vaccine storage, labour room, and staff quarter energy needs with a power requirement of 1.02 KW, and a budgetary implication of approximately INR. 7.4 lakhs ($10,000) per center or INR 7.4 crore (approximately $ 1 million) for all 100 Sub Centers; 50% of this will be contributed by the State NHM.

Importance of Energy Efficiency Drive

- In the absence of energy efficient appliances, energy system cost would be 3 times higher and the total cost including efficient appliances would be 35% more expensive.
- Assuming battery replacement after every 5 years, over a 20 year period, the total savings on the system powering efficient loads would be more than 60% compared to a larger system with inefficient appliances.
- For each center, this would mean a savings of more than INR. 11 lakhs ($14,822) over a 20 year period. Across the 100 SCs, the savings would mean that at today's value more than a 150 SCs can be powered.

Increased Reliability and Life of the System

- System design based on weather conditions: Average annual sunshine falls from 3.91 kWh/m2/day to 2.37 kWh/m2/ in the months of June, July and August, requiring more days of autonomy. In this scenario, the system design has been divided such that loads like luminaries and fans are part of a DC solar off-grid system with 3 days of autonomy while the AC system for critical loads functions with 2 day of autonomy. To overcome the risk of an inverter failure shutting down the entire operation, instead of a single AC inverter based system for all loads, the energy system is split into two allowing for continued use of certain loads. In remote areas, while designing a 100% AC system, a standby-inverter is recommended to increase the reliability.
- Use of vaccine and ice pack storage powered using stand-alone solar systems and direct drives, without batteries, that function for 12 days without backup once fully charged. This stand-alone vaccine storage system is recommended because the ice line refrigerator not only requires a significant initial investment but also requires proper input voltage which is difficult to guarantee in rural areas.
- Design of labour room with stand-alone solar system so this critical service is not affected by energy consumption in other services of the PHCs. Typically, energy system in a labour room is designed to include an energy efficient baby warmer, a suction apparatus and spotlight with an average of 3 hours back-up per day and 2 days of autonomy.

This collaborative intervention creates a framework that can be replicated and scaled in other parts of the North East to build more resilient health facilities on the ground.

> ***"Sub Centres along with Primary Health Centres form the nervous system of our Health Infrastructure. However, they are also the most neglected. It becomes easier to establish a state of the art diagnostic machine in one of the Civil Hospitals but, however any small infrastructure work in hundreds of Sub Centres is a herculean task. Meghalaya in collaboration with SELCO foundation has embarked upon one such journey to make 100 remote sub centres fully electrified through Solar Power along with energy efficient equipments."***
>
> *Mr. Ram Kumar, Mission Director - NHM, Meghalaya*

Efficient Building Designs

There is growing evidence to demonstrate that energy efficient building designs, layered with efficient appliances powered by clean energy sources can lead to a drastic reduction of energy consumption and lower the carbon footprint at these centres. For example, a well-designed building with high natural ventilation reduces the requirement of fans in the building. This coupled with efficient appliances, and solar powered cooling and lighting technologies could make the health facilities highly resilient, energy efficient and even energy independent.

Good participative design is key to ensuring that the building design ultimately improves the ability of patients (and health workers) to access (and provide) healthcare comfortably and safely.

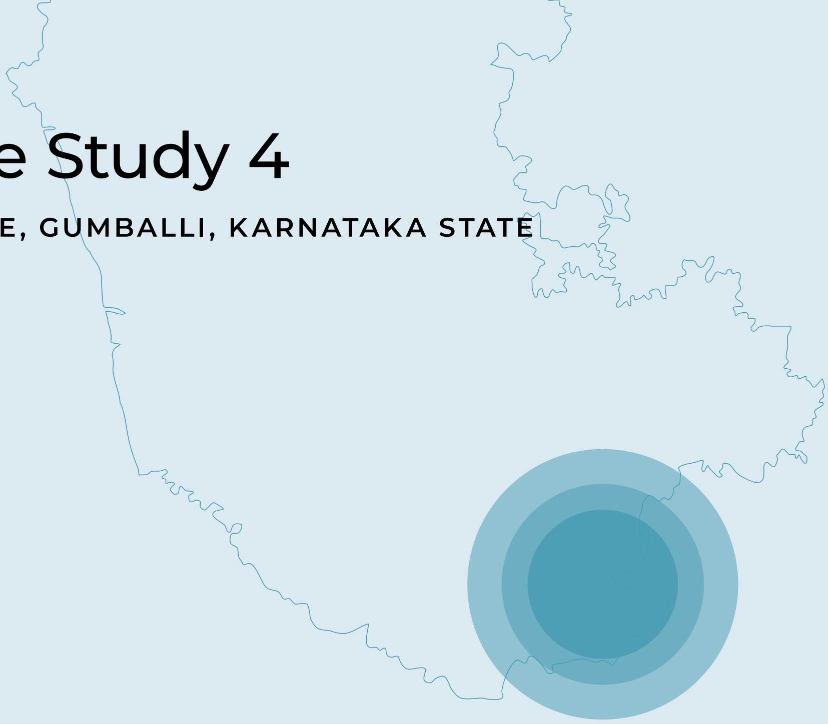
Given below is a comparative assessment of systems (a) designed with efficient appliances and green building designs (b) designed with inefficient appliances but with green building designs and (c) with both inefficient appliances and typical building designs. This is based on the design of a COVID care hospital, Vistex in the Masarhi block of Patna district in Bihar, and clearly illustrates the savings in energy usage by incorporating efficient appliances and green building designs.

TOTAL LOAD CONNECTED	TOTAL UNITS REQUIRED	SOLAR PANEL CAPACITY	% OF SAVINGS *ENERGY*
Efficient Appliances with Green Building Design **4290 W**	Efficient Appliances with Green Building Design **21.8 Units**	Efficient Appliances with Green Building Design **12 kWp**	Solution without Energy Efficient Appliance and with Green Building Design **28.82%**
In-Efficient Appliances with Green Building Design **5749 W**	In-Efficient Appliances with Green Building Design **30.63 Units**	In-Efficient Appliances with Green Building Design **16.2 kWp**	Savings with Both—Energy Efficiency and Green Building Design **58.34%**
In-Efficient Appliances with Standard Typical Building Design **5749 W**	In-Efficient Appliances with Standard Typical Building Design **52.34 Units**	In-Efficient Appliances with Standard Typical Building Design **26 kWp**	

Another example of the importance of built environment is illustrated in this partnership with Karuna Trust, where interventions were undertaken on building and energy system design in the heat stressed region of YK Mole in Gumballi, South Karnataka.

Case Study 4

YK MOLE, GUMBALLI, KARNATAKA STATE



Background

The land was allocated by the panchayat with discussions held with various stakeholders including the ANM Bhagya, who is from a tribal community in a nearby village- BR Hills. To avoid the long travel from her village to the Sub Center, she had rented a small room in a village close to YK Mole which was fraught with frequent power cuts and had no safety measures. During the summers, the Auxiliary Nurse-Midwife (ANM) and the patients who visited other Sub Centers for vaccinations and regular check-ups found it extremely uncomfortable to sit indoors as power outages were frequent and the structure would heat up considerably.

Solution

An energy audit comparison of this center against 3 government sub-centres on the basis of appliances, energy consumption, electricity bills, CO_2 emissions and Energy Performance Index (EPI) acted as the backbone for improving the building design to increase efficiency with solar-powered energy efficient equipment.

Energy Consumption SELCO vs. Govt. Built Sub Centers

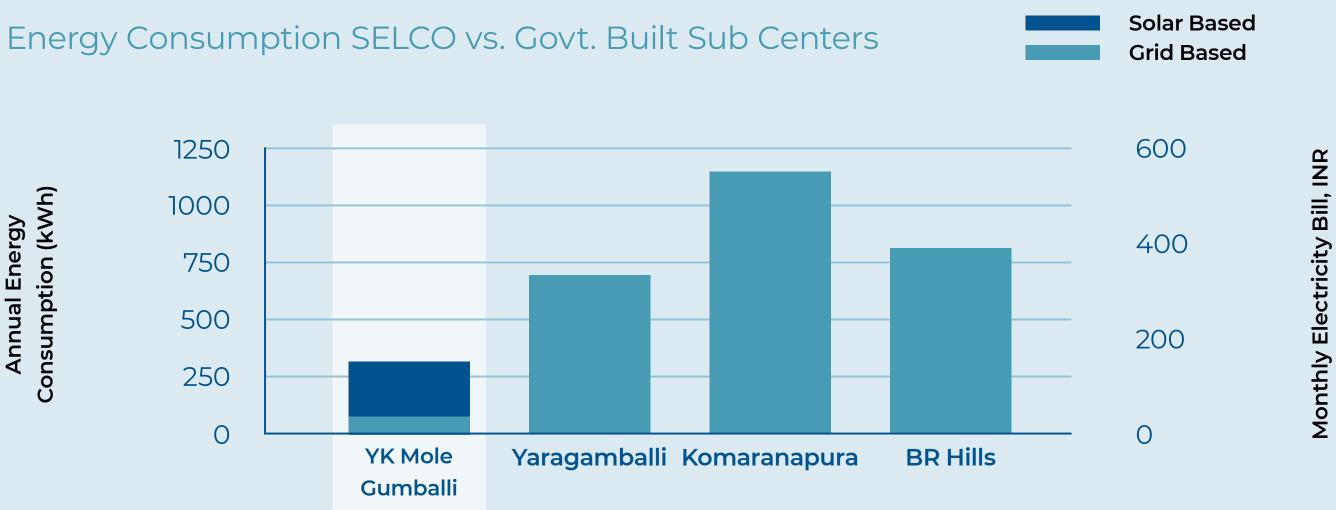


Figure: Comparative Analysis of energy consumption, energy source and monthly electricity bills across 4 centers- Gumballi Sub Center (with interventions) vs Govt Sub Centers (Yaragamballi, Komaranapura, BR Hills sub centres) | Source: SELCO Foundation analysis, 2019.

Improvements to reduce indoor temperature and increase natural lighting and ventilation; Incorporating energy efficiency principles in building design with the right orientation and shorter facades to lower indoor temperature during heat stress.

Designing for natural light and ventilation reduced dependency on active cooling measures.

YK Mole Sub Centre designed to ensure thermal comfort for the patients and the health care staff, and reduce energy consumption; ANM Bhagya administering a patient at the YK Mole sub-centre, Gumballi, Karnataka.

> ***"The clinic is very comfortable and cool at all times and I remain unaffected by power cuts at odd hours due to having a solar connection."***
>
> *Bhagya, Auxiliary Nurse Midwife, YK Mole Subcentre (If the subcenter did not have comfortable living conditions, Bhagya would have had to live in a nearby village instead- and cover over 20kms by foot every day to cover the same number of villages she is able to cater to now. Currently, she covers 6km every day, and is also able to keep the clinic open till late night, especially during peak season or during emergency cases)*

Window to Wall Ratio (WWR) was maintained up to 25%, resulting in natural lighting for 75% of indoor space saving on electricity requirements during much of the day, and increased ventilation by keeping windows open.

Double roofing to delay heat gain, improved insulation and keeping doors and windows open, allowing patients to sit comfortably inside and in the veranda area during the day.

In comparison to other government facilities with similar layouts, traditional structures and inefficient appliances, the power consumption in the SC was 91% lower on account of improved natural lighting and appliance efficiency.

- Energy efficiency achieved due to improved air circulation is 87%.
- Many ANMs who were posted here earlier had asked to be transferred due to uncomfortable and improper living conditions. A staff quarters with living space, bedroom and toilet was built for the ANM separately next to the sub centre, reducing the daily travel and creating more comfortable living conditions for the ANM. In the absence of the staff quarters, the ANM would have had to live in the nearby village and cover over 20 kms on foot every day to cater to the villages in her jurisdiction. She now covers roughly 6 kms a day and is also able to keep the clinic open late into the night for emergency needs.

Key Strategies to Scale Up Design of Energy Systems and Built Environment

TECHNOLOGY & INNOVATION

KEY STRATEGIES TO SCALE DESIGN PROCESS

- Design energy systems options for essential and desirable services, with efficient appliances for facilities at each level within the health value chain.
- Undertake/ enable appliance innovations for low resource settings- including improvements in appliance efficiency for requirements within primary healthcare delivery.
- Innovate and design built environment interventions for new structures and for incremental innovations for health facilities in low resource settings across different geographies (eg: forested, dry and arid, disaster prone, rainy and humid and so on.)

TRAINING & CAPACITY BUILDING

KEY STRATEGIES TO SCALE DESIGN PROCESS

Energy Systems

Develop modules and train Clean Energy Enterprises in the local area (ideally through the State Energy department and State Nodal agency) on:

- Identification and design of systems for critical and non-critical loads
- Determining system back-up and battery design (or autonomy) based on load types, solar irradiance in the region etc.
- Design components that are standardized vs. customized based on regional conditions

Efficient Building Design

Train Identify and build the capacity of Public Works Department (PWD) Engineers who design and certify for the construction of government and public buildings on aspects of energy efficient materials and construction methodologies.

POLICY

KEY STRATEGIES TO SCALE DESIGN PROCESS

Energy Systems and Efficient Appliances

- Create stronger incentives for the manufacture and distribution of efficient healthcare appliances in rural settings through entities such as the Bureau of Energy Efficiency and existing industry bodies.
- Recognize (as part of IPHS) the relevance and need for DRE as the main power source, not just as a backup source for the grid; especially for critical loads in remote geographies including disaster prone regions, forests, hilly regions etc. (to avoid challenges associated with breakdown of grid and system downtime).

Energy Efficient Building Design

- Incorporate efficient building design recommendations as part of IPHS for construction of health facilities- covering aspects of orientation for specific climatic zones, measures for ventilation and natural lighting and so on.

STAKEHOLDERS INVOLVED*	APPROPRIATE DESIGN
State Energy Department/ State Nodal Agency of MNRE/ (through Local accredited energy enterprises)	Accountable / Responsible
Rogi Kalyan Samiti (Health center management committee)	Consulted
Local NGOs, CBOs	Consulted
Staff at health centers	Consulted
Patients at health centers / Local community	Informed

*Key for roles and responsibilities of Stakeholders:

- Responsible: Undertakes the work to achieve or complete the task
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Procurement policies and guidelines often come down to a basic metric of costs where the lowest bidder or the lowest price are chosen without adequate attention to other aspects critical to the quality and sustainability of the project or intervention. Procurement that provides adequate weightage to factors such as the transaction costs of operating in certain terrains, quality of installations and reliability of after-sales servicing would result in projects that are more sustainable in the long term, providing good quality services to local communities.

Broadly, procurement for energy-health interventions would include the technical specifications of system and components to be used, the criteria for selection of vendors / suppliers and the installation and servicing guidelines.

a. **Technical Specifications:** The energy system design and components determine the technical specifications within the procurement process. As discussed in the previous section on design, they need to incorporate efficient appliances, customized system size and autonomy based on appliance wattage, load types, local weather conditions etc. Based on the intervention itself (energy or built environment), the warranty of the solution and its components need to be clearly outlined. These guarantee and warranty periods may differ. For example, in the case of an energy system, there is a basic expectation that components such as the battery will have a minimum warranty of 5 years, while panels would come with a 15-20 year warranty.

b. **Criteria for Vendor / Supplier Selection:** The implementers of the energy-health solutions-whether they are local energy enterprises, local construction agencies or contractors-are extremely important to the functioning of a system. In the past, limited accountability of project implementers and their lack of response post implementation resulted in solar energy installations becoming obsolete within a short period. Neglecting simple aspects of maintenance (for example—replacement of batteries, or provision of spare parts) because of the remoteness of these locations have resulted in whole systems remaining unutilized and sunk costs for government agencies seeking to promote rural electrification.

In order to overcome this, adequate weightage must be given to factors such as:

- Local presence of the vendor and their ability to provide timely, quality service in the project area.

- Past performance of the vendor, especially on similar decentralized rural energy projects.
- Composition of the organization with adequate local representation that allows for an understanding of the context in the project area etc.

c. **Installation and Servicing Guidelines:** This would include having clear standards on the maximum time frame before a complaint or service interruption is attended to (typically 48-72 hours), providing after-sales service for a minimum of 1 year post installation and the frequency of this servicing (once every 6 months, for example), followed by the provision for creating Annual Maintenance Contracts for regular visits and maintenance.

In the case of built environment interventions, before the finishing stage of construction, energy efficiency measures outlined in a checklist should be adhered to along with the snagging [10] process.

[10] Snagging is the process of checking a building for faults and damages.

Once the guidelines are clearly established, they can be adapted to different contexts and customized for geographies. This sets the minimum expectations from vendors or suppliers and provides clarity on roles and responsibilities for staff and management at the health facility.

Post installation, there needs to be a clear handover process from the accredited local energy enterprise (who implemented the project) to the staff/ management at the health center. This is particularly important to ensure proper usage and maintenance of the appliances and energy system and formalizing the handover to the entity responsible for energy system management going forward.

Key Strategies to Scale Up Procurement and Installation Guidelines

TECHNOLOGY & INNOVATION

KEY STRATEGIES TO SCALE PROCUREMENT & INSTALLATION

- Clear technical specifications based on energy system design
- Installation and servicing guidelines, including specifications for energy efficiency measures in buildings
- Criteria for vendor selection

TRAINING & CAPACITY BUILDING

KEY STRATEGIES TO SCALE PROCUREMENT & INSTALLATION

Accredited Energy Enterprise
Based on procedures validated by State Energy department or nodal agency

- Create checklist and handover documents for staff at health center on proper usage of the energy system and appliances
- Train health center management team and staff on basic maintenance and troubleshooting

Accredited Built Environment Contractors and Vendors

- Identify and build the capacity of local vendors, contractors and masons empaneled or accredited to construct government and public buildings on energy efficient construction methodologies and materials
- Provide O&M manual to health center management that includes the structural report, energy efficient materials vendor list, relevant drawings and layouts

POLICY

KEY STRATEGIES TO SCALE PROCUREMENT & INSTALLATION

Energy Efficient Appliances Through National Health Systems Resource Center
Established under the NHM, with a mandate to support development of policies, strategies, and action plans for health technologies, specifically for medical devices

- Establish guidelines on energy efficiency drives, including identification, benchmarking and procurement of appropriate appliances, that can be reviewed and adopted by relevant agencies responsible for procurement at the state level for adoption
- Alternatively, enforce guidelines for wider uptake of energy efficiency at each state, thereby increasing long term savings for each health facility and collectively for the health system

Energy Systems Through State Energy Department

- Share standards for components of the DRE system, including warranties to be used by relevant stakeholders for procurement.
- Develop clear criteria for choosing vendors/ clean energy enterprises/ technology suppliers, (beyond lowest price/ bid) to provide weightage to MSMEs, local presence, past performance in the local region-district/ state etc.

Efficient building materials through the Building Materials and Technology Promotion Council (BMTPC)

- Certify energy efficient technologies including insulation materials, alternate timbers and agri-waste panels as part of the Schedule of Rates for procurement through the Public Works Department (PWD).

STAKEHOLDERS INVOLVED*	APPROPRIATE DESIGN
State Representative National Health Mission (MD & SPMU, State Health Dept)	Accountable
State Energy Department/ State Nodal Agency of MNRE/ (through Local accredited energy enterprises)	Responsible
District Administration (DC, DHO, CDMO)	Accountable / Responsible
Rogi Kalyan Samiti (Health center management committee)	Accountable / Consulted use funds for energy efficiency
Local NGOs, CBOs	Consulted
Staff at health centers	Informed
Patients at health centers / Local community	Informed

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The financing and ownership models are integral to the longer term sustainability of the energy-health intervention and to enabling the scale up and replication of these interventions. Here, the Rogi Kalyan Samiti (RKS) in the Indian healthcare context plays a vital role. Formally introduced under the umbrella of the National Rural Health Mission (NRHM) in 2005, it is essentially the health facility management committee and exists at every PHC and CHC. Post installation, the role of the RKS or health facility management committee goes from consultation and participation to complete oversight and accountability.

The objective of the formation of RKS was to increase people's role and participation in the functioning, management and service delivery of healthcare facilities. It seeks to include members from Panchayati Raj Institutions (PRIs), legislative bodies, government medical staff and civil society. The central government allocates untied funds annually to each RKS for health centre management. The allocation and disbursement of funds is done at the discretion of the committee.

a. **Ownership:** Leveraging its field presence, composition and role in managing the center, the RKS can play a strong role in owning and managing the energy systems and interventions. Much like with any other medical equipment or physical infrastructure at the health center, the ownership of the energy interventions needs to lie squarely with the RKS and the health center management.

The untied funds available at the health center can play an important role in financing the opex and contributing to certain aspects of the capex of these energy-health interventions. There is, however, a need for committed budgetary allocations to enable infrastructure development that is energy efficient and sustainable for new facilities and existing ones.

b. **Capital Expenses:** Typically, the main source of funding for an SC or PHC is the annual allocation from the state NHM. The allocation is made depending on the need for upgradation, new equipment as well as regular operational expenses of the facility such as supply of medicines and drugs etc.

The capital costs for sustainable energy-health interventions have largely been covered through ad hoc funding from State Renewable Energy Nodal Agencies and philanthropic organizations, with some supplementary contributions from government health department funds at state or district level. In scaling up these interventions, it is imperative for the National Health Mission at Central and State levels to begin actively allocating funds for sustainable capital infrastructure and allowing existing annual budgets to be used for upgradation—be it through decentralized renewable energy systems, purchase of efficient equipment or energy efficient built environment modifications.

In addition, other funding sources that could be explored for energy-health interventions through government include:

- Climate Funds—aimed at demonstrating or scaling up interventions that have the potential to increase climate resilience at the local level.

- Funds available from State RE Nodal Agencies —aimed at supporting the deployment of RE interventions at the state level.
- District Mineral Funds, DC Innovation fund, MP Local Area Development Funds, Chief Minister Funds etc. aimed at local area development.
- MGNREGA funds for built environment interventions—typically aimed at local level employment generation through infrastructure development.

There is a need to explore and outline the various funding sources available at a district or state level for health and well-being that could be used as part contribution towards capital and infrastructure costs.

c. **Operating Expenses:** The main operating expenses for energy-health interventions are (i) annual maintenance cost—typically about 1-2% of the total energy system cost and (ii) costs of replacing batteries after every 5-7 year period.

Currently, centers with unreliable or no access to power spend approximately INR 1,000–INR. 2,000 ($13.5–$27) per month on diesel for back-up generators.[11] This would mean an approximate annual expenditure of INR. 18,000 ($242) on diesel fuel alone. In comparison, the annual maintenance cost of a PHC powered by solar energy would be between INR. 5,000–INR. 10,000 ($67–$134) approximately, i.e. 1–2% of the solar system cost.

There is a clear case for the operating expenses of the energy interventions to be covered at the local level through funds available at the center. This would also bolster the sense of ownership amongst the health center management and staff.

The typical sources of funding available for each RKS include:

- Untied funds under the NHM provided by State or District health departments
- User fees for hospital services such as X-ray, Ultrasound scanning, laboratory services etc.

- Funds raised from donations, grants from government and loans from financial institutions.

The untied funds allocated per year for each Sub Center is INR. 20,000 ($ 270), and for each PHC is INR. 1.75 Lakhs ($ 2360).[12] The guidelines on the functioning of RKS suggest that untied funds can be used for a variety of capital and operating expenses including purchase of medical equipment, minor repairs and construction work on toilets or septic tanks, provision of clean drinking water, activities to support poor patients with medicines or accommodation and so on.[13] This opens up the opportunity to use these untied funds to cover the operating expenses for energy-health interventions as well as for efficiency improvements in building design.

[11] SELCO Foundation. (2020). Evaluations of DRE systems at Public Health Care Centres in India.

[12] Utilization of Untied Funds, Karnataka 2012

[13] Tripura Gov Guidelines

Case Study 5

HEALTH FACILITY MANAGEMENT THROUGH AROGYA RAKSHA SAMITHIS (ARS)[14], KARNATAKA

Background & Context

Health partners like Karuna Trust run PHCs through a Public Private Partnership (PPP) model, leveraging government infrastructure and providing healthcare at an affordable price of INR. 200 ($ 2.6) per person per year. This requires reducing costs and increasing efficiency and reliability of service delivery. Having bought into the energy-health interventions as outlined in the sections above, The Trust has solar powered 23 PHCs and 18 SCs with energy efficient equipment and in some cases built environment interventions.

Karuna Trust has also been a path-breaker in enhancing the role of the ARS (the term in Karnataka for the Rogi Kalyan Samithi or Health facility management committee) by ensuring greater ownership and involvement of the community and local representatives in the Operations & Maintenance (O&M) of these energy-health interventions.

Solution

- Involvement and participation from the ARS members and health staff in the planning and energy-health assessment and audit processes ensured a greater ownership and buy-in for identified solutions.
- Understanding of the substantial financial savings and other benefits to be gained from interventions, resulted in a willingness to allocate part of the untied funds towards Operations and Maintenance of these systems.
- Resolutions passed by the ARS to cover the cost of annual maintenance (after the first year of free servicing) and the replacement of batteries, ensured longer term commitment to the performance and efficacy of the energy system.
- Training provided to ARS members and health centre staff (post installation) facilitated proper handover and clarity on regular usage of equipment, monitoring of energy consumption, regular panel and battery maintenance and so on.

In most health centres, capital expenditure for energy interventions is currently being covered through grant funding from philanthropic organizations, CSR entities and so on. In some cases, this is supplemented by small allocations from State units of the National Health Mission or District health departments. But efforts are now underway to work with the ARS in allocating untied funds to share in the capital expenditure of the systems- including for purchase of energy efficient appliances.

The capacity building of the ARS and their participation at every step throughout the process has been integral in strengthening the ownership and willingness to commit funds towards energy-health interventions.

Key Strategies to Scale Up Models for Financing, Ownership & Maintenance

TRAINING & CAPACITY BUILDING

KEY STRATEGIES TO SCALE FINANCING & OWNERSHIP MODELS

- Outline financial case to be used in discussions with RKS, health departments, National Health Mission and NGOs in the health sector to get a buy-in on the need and value of energy interventions for primary healthcare delivery
- Build capacity of RKS and health center management across health centers on a regular basis on the possible uses of untied funds (for example- Energy efficiency drive, Annual maintenance, Replacement of batteries, efficient built environment improvements and so on)

POLICY

KEY STRATEGIES TO SCALE FINANCING & OWNERSHIP MODELS

- Include 'purchase of efficient medical equipment and contracts for annual maintenance of energy systems' and 'built environment upgradations' into the guidelines for RKS on suggested uses of untied funds.
- Allocate funds specifically for energy systems and efficient equipment as part of the core funding from the State health department and National Health Mission (typically available for infrastructure, upgradation and purchase of new medical equipment).

STAKEHOLDERS INVOLVED*	ROLES & RESONSIBILITIES
State Representative National Health Mission (MD & SPMU)	Accountable
State Energy Department/ State Nodal Agency of MNRE/ (through Local accredited energy enterprises)	Responsible Maintenance, Trainings on Usage
District Administration (DC, DHO, CDMO)	Consulted
Rogi Kalyan Samiti (Health center management committee)	Accountable
Local NGOs, CBOs	Responsible Trainings on Usage
Staff at health centers	Responsible Usage, Maintenance
Patients at health centers / Local community	Consulted

*Key for roles and responsibilities of Stakeholders:

- Responsible: Undertakes the work to achieve or complete the task
- Accountable: Ultimately accountable for correct and thorough completion of task- may oversee other actors
- Consulted: Provides information, inputs and feedback to be taken into consideration
- Informed: Kept informed of progress

05

Way Forward

In the context of the interventions undertaken so far, champions involved and the learnings gathered, there is a momentum now for both the health and energy sectors to take the next steps in strengthening convergence, involving a larger set of stakeholders- locally, nationally and internationally and clarifying roles and responsibilities to realize the financial, social and environmental benefits of energy-health interventions.

The table below summarizes the key stakeholders involved in the processes for scaling up energy-health interventions and their roles and responsibilities. The section then suggests some areas of work and potential opportunities that need more work but are crucial to the strategy to scale.

Stakeholders and Their Roles in Convergence

PROCESS	IN-DEPTH ASSESSMENT	CUSTOMIZED DESIGN	PROCUREMENT & INSTALLATION	FINANCING, OWNERSHIP & MAINTENNANCE
TYPES OF INTERVENTION	→ Energy-Health Audits → Participatory Consultations with Key Staff / Patients	**Efficient Appliances** + Solar Energy System + Built Environment	→ Design & Servicing Guidelines → Vendor Guidelines → Pricing and Procurement	→ Training for Health Staff on Usage → Financial and Ownership Models (including MOU)
STAKEHOLDERS INVOLVED				
State representatives National Health Mission (MD and SPMU)	**Accountable**		**Accountable**	**Accountable**
State Energy Department / State Nodal Agency of MNRE (through Local accredited energy enterprises)	**Responsible**	**Accountable / Responsible**	**Responsible**	**Responsible** *Maintenance, Trainings on Usage*
District Administration (DC, DHO, CDMO)	**Accountable**		**Accountable / Responsible**	**Consulted**
Rogi Kalyan Samithi (Hospital management committee)	**Consulted**	**Consulted**	**Accountable** *Use of Untied Funds* **Consulted**	**Accountable**
Local NGOs, CBOs	**Responsible**	**Consulted**	**Consulted**	**Responsible** *Trainings on Usage*
Staff at health centers	**Consulted**	**Consulted**	**Informed**	**Responsible** *Usage, Maintenance*
Patients at health centers / Local community	**Consulted**	**Informed**	**Informed**	**Consulted (?)**

*Key for roles and responsibilities of Stakeholders:

- Responsible: Undertakes the work to achieve or complete the task
- Accountable: Ultimately accountable for correct and thorough completion of task- may oversee other actors
- Consulted: Provides information, inputs and feedback to be taken into consideration
- Informed: Kept informed of progress

Infrastructure Financing and Viability

To expand access to primary health care equitably, investments in health infrastructure would need to be done in a manner that improves the efficiency of health delivery and reduces the cost for the end-user. In order to gain the support of governments and financial institutions and enable them to invest in sustainable energy infrastructure for healthcare, the financial viability of the investments need to be clearly articulated.

This would mean creating a framework for economic and financial analysis of health-energy nexus infrastructure, while focusing on energy efficiency, decentralized renewable energy and efficient building designs. Greater clarity and evidence of the economic opportunity (financial viability and business models) needs to be built using parameters like reduction in end-user transaction costs, cost savings for in-patient health care provision, comparison across alternative infrastructure investment costs (including energy inputs, grid extension and maintenance, inefficient vs efficient appliances etc). The financial, social and environmental case for investing in sustainable energy -health interventions for long term benefits needs to be highlighted, in order to move the needle with key investors including financial institutions and development banks.

Concerted Effort of Training and Capacity Building

On the value of the energy-health ecosystem and the key processes and strategies for scale with the following stakeholders:

- District administration and district health officials
- State Health departments and National Health Mission representatives at the state level, including those responsible for procurement processes
- Rogi Kalyan Samithis or Health facility management committees.
- State energy departments and state nodal agencies of the Ministry of New and Renewable Energy.
- NGOs and practitioners in both health and energy sectors

National Level Health-Energy Consortiums

That bring together champions, experts and ministries from both energy and health sectors to:

- Build evidence based on the interventions on the ground and advocate for better fund utilization towards appropriately and efficiently designed energy-health systems.
- Outline policy guidelines on the key processes for uptake by specific bodies involved in developing standards, deciding procurement, allocating funds and so on.
- Develop regional level roadmaps at a district or state level on how the processes can be scaled up and the solutions can be deployed across health facilities within the region.
- Engage with key manufacturers and industry bodies on facilitating improvements in appliance efficiency for medical devices required in low resource settings.

The ecosystem interventions, stakeholders and processes outlined here are relevant across health systems in developing country contexts. Building on the work at national and sub-national levels, multilateral organizations like the World Health Organization (WHO), International Renewable Energy Agency (IRENA), Sustainable Energy for All (SEforAll) would be well-positioned to champion these processes and interventions.

Responding to the crisis at hand and building a resilient health system requires the primary healthcare infrastructure to be well-equipped and well-functioning. The processes and case studies outlined above indicate how this can be done.

Acting together on the strategies to scale is the way forward in accelerating the provision of sustainable energy systems and energy efficient built environment solutions particularly to improve healthcare delivery amongst the poorest and most vulnerable communities.

Their well-being will be a testimony to the health and energy sector's performance in helping achieve SDG3 and SDG7.

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