Future-Ready Jharkhand

RE-Powering Health Sector in Jharkhand

July 2022

About JREDA

The Jharkhand Renewable Energy Development Agency (JREDA) is incorporated as a society act in the year 2001 under the administrative control of the Department of Energy, Govt. of Jharkhand for promoting the use of renewable energy sources in the state. JREDA is a state nodal agency for the implementation of renewable energy projects using financial incentives made available by the Ministry of New and Renewable Energy (MNRE), Govt. of India, and Government of Jharkhand and State Designated Agency (SDA) for the implementation of Energy Efficiency projects using financial incentives made available by Bureau of Energy Efficiency (BEE).

About CEED

The Center for Environment and Energy Development (CEED), an environment and energy expert group, is involved in creating a sustainable solution to maintain a healthy, rich and diverse environment. CEED primarily works towards clean energy, clean air, clean water, and zero waste solutions by creating an enabling ecosystem to scale up investments in low carbon development pathways, climate mitigation, and adaptation. CEED engages with government agencies, industries, think tanks, stakeholders, and the public to create environmentally responsible and socially just solutions.

About Power for All

Power for All is a global coalition of more than 200 organizations (companies, civil society organizations, research institutes, trade associations, and financial bodies) campaigning to accelerate the deployment of distributed renewable energy (DRE) solutions as the fastest, lowest cost, most sustainable path to achieving universal electricity access (Sustainable Development Goal 7)before 2030. Power for All promotes decentralized renewable energy (DRE) solutions to accelerate the end of energy poverty. Power for All challenges business-as-usual (BAU) approaches to energy service delivery to provide reliable, universal access through market engagement, advocacy, and awareness development.

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Jharkhand Renewable Energy Development Agency
(State Govt. Agency Under Department of Energy, Jharkhand)

Foreword

Jharkhand has immense scope to embark on a new development pathway with giving more impetus to the cleaner and greener energy solutions in every spheres of the economy. The State Solar Policy of 2022 is similarly committed to promote wider usage of solar energy in the state.

The report "Future-Ready Jharkhand: Re-Powering Health in Jharkhand" jointly prepared by the JREDA, the Center for Environment and Energy Development (CEED) and the Power for All is a timely and commendable initiative to empower a range of stakeholders, including the policy makers.

To improve the effectiveness of health centres and medical institutions in the state, this report promotes the integration of health and energy using solar-based decentralised models. Decentralized Renewable Energy (DRE) options can be tailored in creative ways to fit the varied topography and hamlets of sparsely populated ecosystems in Jharkhand, where they are well suited for the development of the health sector. I am pleased to see that the roadmap discusses the function of the solarization process in enhancing health services and building health infrastructure through creative solutions.

This report will definitely assist us in identifying new initiatives and programmes as we move toward a widespread use of renewable energy in the state to promote the general welfare of the populace.

My heartfelt thanks to CEED and Power for All for joining hands with us for this report and I am hopeful that this roadmap will encourage new discussion in bringing the path breaking solutions on the ground and enlighten all key stakeholders with new learnings.

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Abbreviations

ANM	Auxiliary Nurse Midwife
APHC	Additional Primary health centers
ASHA	Accredited Social Health activists
AWW	Anganwadi Worker
BHM	Block Health Manager
CHC	Community Health Center
COVID	Corona Virus Disease
DH	District Hospitals
DHM	District Health Mission
DLHS	District level health Society
DRE	Decentralized Renewable Energy
GDP	Gross Domestic Product
HDI	Human Development Index
HEOC	Health Emergency Operation Center
HWC	Health and Wellness Centers
ICU	Intensive Care Unit
ILR	Ice- Lined Refrigerator
IMR	Infant Mortality Rate
IMR	Infant Mortality Rate
IPHS	Indian Public Health Standards
KVA	Kilovolt Ampere
kWh	Kilowatt Ampere
MCH	Mother and Child Health
MMU	Mobile Medical Unit
MNRE	Ministry of Renewable Energy
MO	Medical officer
MOHFW	Ministry Of Health And Family Welfare
MW	Mega Watt
NCCMIS	National Cold Chain Management Information System
NFHS	National Family Health Survey
NHM	National Health Mission
NRHM	National Rural Health Mission
NSSO	National Sample Survey Office
NUHM	National Urban Health Mission
PHC	Primary Health Center
PV	Photo Voltaic
RCH	Reproductive and Child Health
RH	Referral Hospital
RHS	Rural Health Statistics
SDG	Sustainable Development Goals
SDH	Sub- District Hospitals
SHC	Sub Health Center
SRS	Sample Registration System
UDHR	Universal Declaration OF Human Rights
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

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Key Highlights

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44% of the health centers surveyed were un-electrified

44% of the electrified health centers reported the issue of fluctuating power supply

75% of the health centers did not have an alternate arrangement of power supply

78% of the health facilities were willing to adopt DRE

175 MW Potentioal demand in the Health Sector

250 Cr INR investment potential through DRE

559 Cr INR savings for the health sector through DRE

0.8 million tons of carbon emission be avoided through DRE

Executive Summary

Energy is an enabler of socio-economic change and transitioning to clean energy can positively impact our overall well-being. The Health-Energy nexus plays a crucial role in attaining sustainable development goals and it is rightly interlinked with other global targets including opportunities for quality education, eradication of poverty, and achieving gender equity, which holistically shapes the quality of human life in general. The challenges of global climate change and pandemics can be converted into opportunities to create a low carbon and robust health infrastructure which in the long run can tackle the unforeseeable threats of health emergencies.

Jharkhand Renewable Energy Development Agency (JREDA) in association with the Center for Environment & Energy Development (CEED) and Power for All brings together a comprehensive report which highlights the current situation in the Healthcare system in Jharkhand. The state is largely regarded as under-developed and is the second bottom performer in Niti Ayog's SDG Index. Amid the imminent decline in coal-based power in the next two-three decades, the energy crisis in the state has been severely affecting healthcare interventions as well as the well-being of individuals and communities. This report extensively explores the status of the health care services in the state of Jharkhand and also identifies the lacunas in affordable healthcare in India.

The report aims to establish two primary objectives namely assessing the DRE potential in the health sector of Jharkhand and creating an enabling framework for extending the use of DRE as a sustainable energy source in Jharkhand's health institutions. The research findings provide insights into the current state of the health care and delivery system. It showcases the on-ground challenges faced by the health centers and thus highlights the existing gaps in public health infrastructure in Jharkhand.

The survey was conducted across 607 Health care centers (namely Primary Health Center, Sub-Center, Community Health Center, District and Sub-District Hospital) covering Ranchi, Gumla, West Singhbhum, Sahibganj, Dumka & Palamu districts using a combination of primary and secondary research methods. The survey findings highlight that 44 percent of the health care centers lack access to electricity. Besides this, of those electrified, over half (55.9%) of them experienced fluctuating power supply and 89 percent faced power outage issues up to more than 8 hours a day daily thus severely impacting a substantial rural and tribal population in the region. Most of the surveyed health centers were directly dependent on traditional grid connectivity and lacked any alternative sources of power supply.

Due to unreliable power sources, the majority of health facilities (78.3%) also expressed their willingness to use solar as an alternate source of energy in their region to improve health services. The findings from the research underline the major challenges faced by health centers such as unreliable power sources, causing disruptions in the provision of quality health services across the regions.

By identifying the challenges the report builds upon a clear picture of the existing health infrastructure in the state. This report examines and explores the demands and potential ways of strengthening the health institutions in Jharkhand using Decentralized Renewable Energy (DRE) systems.

The report calls attention to the trends in projected demands in the state health sector and thereby assesses the energy prospects in the health sector. The report projects that power demand in the health sector is expected to reach 175 MW. Further, it gives us a clear picture of how the integration of DRE into the energy transition plan can help facilitate change. DRE solutions can address the problems of rising power demand, to provide reliable and quality power supply throughout the state.

The final sections of the report focus on how the infusion of DRE through solarizing health centers can be cost-effective and save about 227 crores and 559 crores over the plant's lifetime in the BAU and optimistic scenario respectively. It can bolster the cold chain infrastructure for better vaccine supply, management, and prevention of wastage. It has been estimated that in the optimistic scenario DRE can contribute to sustainable energy transition and save nearly 0.8 million tonnes of CO2 over a period of 25 years in Jharkhand which is equivalent to carbon stored by 11,339,214 tree seedlings over a period of ten years.

The report showcases the need for a DRE roadmap for strengthening health services in Jharkhand. It envisages how we can create an enabling ecosystem for strengthening health infrastructure. Prime factors such as establishing a strong policy framework for health-energy integration, overcoming investment gaps, capacity building, and technology integration will play a major role in defining success in health care infrastructure.

The report gives us key recommendations which can accelerate the deployment of DRE to empower the public health infrastructure in the state. Strengthening health care services, especially in developing countries with diverse ethnic communities is of significant importance as a lack of resources can underpin the development of healthcare infrastructure in the country. The greatest challenge lies in providing affordable, quality universal health care access without suffering financial hardship.

Therefore, this report emphasizes convergent efforts, formulation of farsighted plans and policy with the health and energy integration as the starting points, procuring financing support from a variety of public and private routes, and engaging multiple stakeholders such as DRE developers, think-tanks, civil society organizations to realize a better and effective health delivery system in the regions of Jharkhand.

Introduction

1. Introduction

Energy is a fundamental part of our daily lives and is a prerequisite for socio-economic development. An effective health network can serve as a connecting thread for the study projects considering the whole globe grapples with the effects of COVID-19, and the health sector has been in the spotlight, putting pressure on it to prepare itself for the emerging challenges. Several service-related structural weaknesses have been uncovered as a result of the outbreak, particularly in terms of providing health care to the rural poor. The need to improve public health infrastructure has never been more pressing.

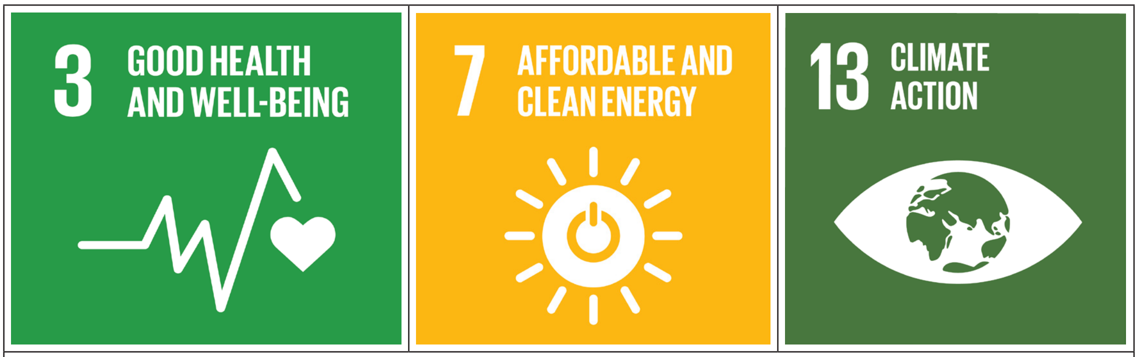


Figure 1. Sustainable Development Goals

Access to electricity is critical to health care delivery and the overarching goal of universal health coverage, as well as the Sustainable Development Goals (SDGs)[1], which include powering health facilities with clean sources of energy (SDG 7) to positively reinforce people's attainment of health and well-being (SDG 3), thereby integrating climate change mitigation and adaptation, and sustainable natural resource management into national development strategies (Figure 1).

1.1. Health Scenario in Jharkhand: A Brief Profile

Jharkhand is India's 14th largest state, with a population of 3.2 million people. Jharkhand was carved out as a separate state from Bihar and came into being as the 28th state of India in 2000. As per the Census-2011, the state is predominantly rural and is the second poorest state in the country; with 48% of the general population being malnourished. Jharkhand performs poorly across the board when it comes to healthcare. Jharkhand is placed last in terms of progress toward UN goals, with a score of 56 on the NITI Aayog's SDG Index. Jharkhand has poor health indicators, with high infant mortality due to low childhood immunization rates and high maternal mortality due to inadequate institutional delivery and limited access to health care across time. Though it has progressed on many parameters still a long way to go.

Rural healthcare facilities in Jharkhand are plagued by a shortage of medical service providers, and also of functional infrastructure (Ref: Table 1). The healthcare centers in the state are often non-operational after sundown. Equipment in operation theaters frequently does not work during the day due to the lack of a consistent, reliable supply of electricity. The ongoing Covid-19 pandemic has brought to light several structural deficiencies, particularly in the rural region. Inadequate healthcare infrastructure is one of the key lacunae in the healthcare system (Ref: Table 2).

In the past, Jharkhand has repeatedly underinvested in its healthcare system. On the Human Development Index (HDI) ranking-2018, it was ranked in the bottom three among 36 Indian states and union territories.[2] Jharkhand also ranks 19 on Health Systems Resilience Index as per an analysis made by Observer Research Foundation.[3]

Table 1: Health Indicators in Jharkhand

Health Indicators	NFHS-4 (2015-16)	NFHS-5 (2019-2020)		
		Urban	Rural	Total
Sex ratio of the total population (females per 1,000 males)	989	781	1070	1050
Infant mortality rate (IMR)	43.8	28	23	27
Under-five mortality rate (U5MR)	54.3	27.3	41.1	37.9
Institutional births (%)	61.9	89.1	73.1	61.9
Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2)14 (%)	31.5	17.3	29.2	26.2
Men whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)	23.8	12.1	18.9	17.1
Total fertility rate (children per woman)	2.6	1.6	2.5	2.3
Source: National Family Health Survey - 5 (2019-21)				

Table 2: Numbers of Sub-Centers, PHCs, CHCs Functioning in Rural and Urban Areas

Sub-centers		PHCs		CHCs	
Rural	Urban	Rural	Urban	Rural	Urban
3848	0	291	59	171	5
Source: Rural health statistics 2020-21					

1.2. Challenges of Health Sector in Jharkhand

Jharkhand's healthcare system is a patchwork of various environments. On one end of the scale are the gleaming steel and glass institutions that provide high-tech medicine to the well-heeled, mostly metropolitan Indians. The shabby outposts in the furthest reaches of the "other India," eager to live up to their image as health subcenters, are on the other end of the spectrum, waiting to be converted into a hub of health and wellbeing, a story we will witness develop. With the majority of the population living in remote rural areas, health facilities are limited, despite the government's efforts to establish a health care delivery system that includes primary, secondary, and tertiary healthcare, as well as mother and childcare at every level, resulting in a health crisis across the state. However, the key challenges in the Jharkhand Health sector are as mentioned below:

A. **Unreliable supply of electricity:** While there are significant government commitments to expand power availability, demand far outstrips available capacity necessitating the urgent addition of new generation capacity. And even when energy is accessible, it is not always reliable—a problem that affects schools, health institutions, and households in both urban and rural locations. According to rural health statistics, over 13% of state Health Sub-Centers (HSCs) and Public Health Centers (PHCs) are not electrified, in addition to the fact that the state is already dealing with variable voltages and unplanned power outages, which makes it difficult for the healthcare system to function correctly (Ref: Table 3). However, according to a CEEW assessment[4], only 41.82 percent of health centers had regular electricity, while 34.55 percent had no access to electricity at all.

Table 3: Infrastructure facilities available at sub-center in rural areas-II

Health Center	Total	Without Regular Water Supply		Without Electric Supply		Without All-Weather Motorable Approach Road	
Category	Number	Number	%	Number	%	Number	%
Sub-center	3848	828	21.5	518	13.5	-	-
PHCs	291	17	5.8	39	13.4	40	13.7
	Source: Rural health statistics 2020-21						

Table 4: Building position for community health centers in rural & tribal Areas (Nos.)

Category of Health Centers	Area	Total functional CHCs	Health Centers functioning in			
			Govt. Buildings	Rented Building	Rent free panchayat/ Vol. society building	Buildings to be constructed
CHC	Rural	171	171	0	0	0
	Tribal	100	100	0	0	0
PHC	Rural	291	232	9	50	59
	Tribal	159	126	3	30	33
HSC	Rural	3838	2422	1219	207	1426
	Tribal	2465	1492	372	601	973
Source: Rural health statistics 2020-21						

B. **Lack of Health Infrastructure:** The ongoing COVID-19 issue has brought to light several structural deficiencies. One of them is a lack of proper healthcare infrastructure (Table 4) in the rural region. In rural areas, primary health care is provided through a network of PHCs and SHCs, which act as people's last-mile delivery. However, due to a lack of electricity availability or a supply of quality and reliable electricity, health clinics lack appropriate functional equipment (like a cold chain, delivery, and newborn care equipment). More than a third of PHCs, for example, lack fully working cold chain equipment (deep freezers and ice-lined refrigerators), and half lack the infrastructure required to provide baby care. Utility services such as electricity and water, on the other hand, are needed for the operation of a health facility and are major determinants of the effective delivery of vital health services.

C. **Unmanageable patient load:** According to World Health Organization studies, India's ability to provide health care has been limited by a lack of qualified health workers. A dearth of health personnel impeded the country's first COVID-19 reaction, which had major implications for health access. According to the Ministry of Health and Family Welfare, India has one doctor for every 1,404 people and 1.7 nurses per 1,000 people, much less than the WHO's recommended ratio of one doctor and three nurses per 1,000 people. Jharkhand has 18,518 individuals served by one government doctor (Bihar has one doctor out of 28,391 and UP has 19,962 people). However, according to statistics on rural health, the average rural population served by a PHC and sub-center is higher than the national average, overstraining the facilities and making it difficult to manage each patient. (Figure 2, 3, and Table 5.)

Figure 2: Average rural area covered by a health center

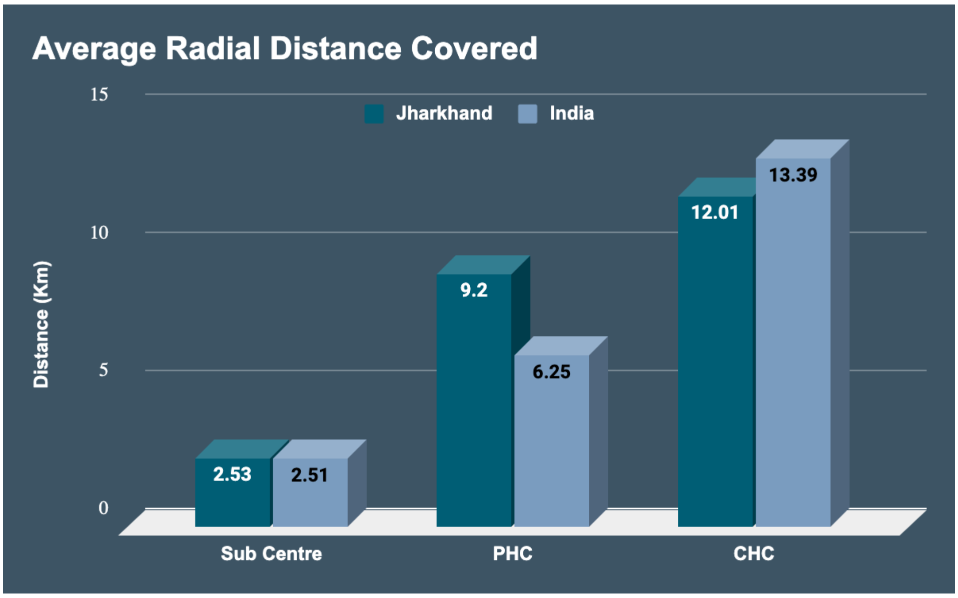


Figure 3: Average radial distance covered by a health center

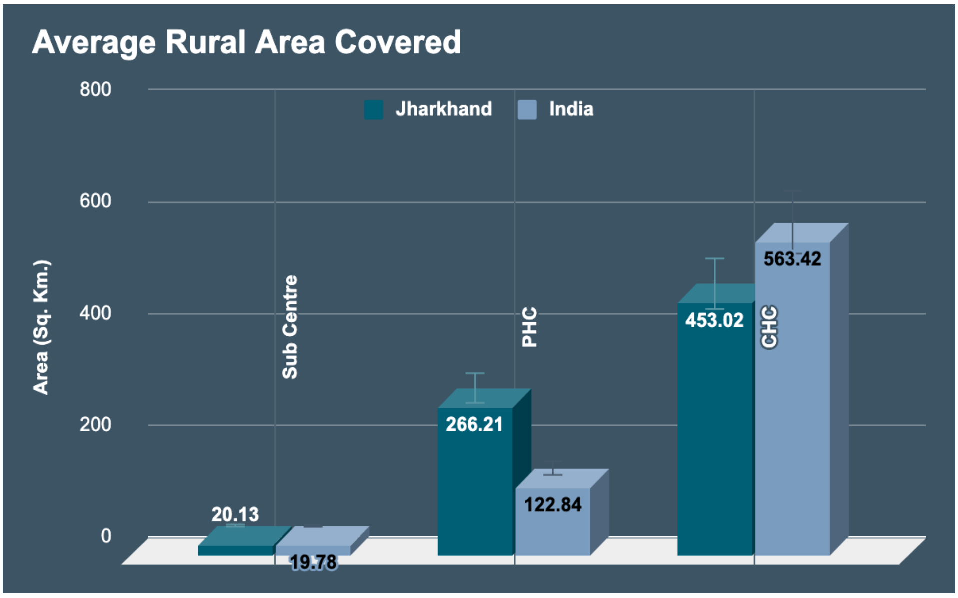


Table 5: Average rural population covered by a health center

Categories	Average Rural Population Covered (Jharkhand)	Average Rural Population Covered (India)
PHC	98399	35602
CHC	167450	163298
Sub-center	7441	5734
		Source: Rural health statistics 2020-21

D. **Inadequate Outlay for Health:** The pandemic has wreaked havoc on the country's healthcare system, exposing flaws in the service delivery process. To combat the pandemic and alleviate its effects, the governments (both central and state) have been forced to raise public healthcare spending, albeit to varying degrees depending on available finances. Following the Covid-19 outbreak, India's health expenditure increased to 2.1% of GDP in FY 2021-22 for the first time, approaching the government's planned goal[5], against 1.3 percent in the previous fiscal (as per the Economic Survey 2021-22). The government of Jharkhand has increased its funding for the health sector in the 2022–23 budget by 27% in response to Covid-19's revelation of flaws in the state's health infrastructure. This increase is intended to modernize healthcare facilities in rural areas and launch new initiatives to enhance healthcare for the general public. However, Jharkhand has only set aside 5.2 percent of its overall spending on healthcare, which is slightly less than the average state allocation (5.5 percent)[6].

Aim, Objectives, and Methodology

2. Aim, Objectives, and Methodology

2.1 Aim

The overall goal of this study is to provide an insight into the current state of the health care and delivery system, examine existing gaps in public health infrastructure, and explore the demands and potential ways of revitalizing health institutions in Jharkhand using DRE.

In Jharkhand, barely a few research studies have been conducted on the importance of health and energy. Therefore, conducting a comprehensive health-energy assessment of public health facilities is crucial to discovering the true energy and health gaps in rural and urban areas. This report aims to bridge that gap by concentrating on a greener energy transition in public health infrastructure to increase the effectiveness and reliability of the health service delivery systems to those in need.

2.2 Objectives

The purpose of this report is to aid various stakeholders, such as policymakers, regulators, developers, and investors, in determining the degree of consistency between the current state of the DRE and Jharkhand's clean energy ambitions, as well as identifying the course correction measures required to achieve universal healthcare. From this perspective, the report's objectives are as follows:

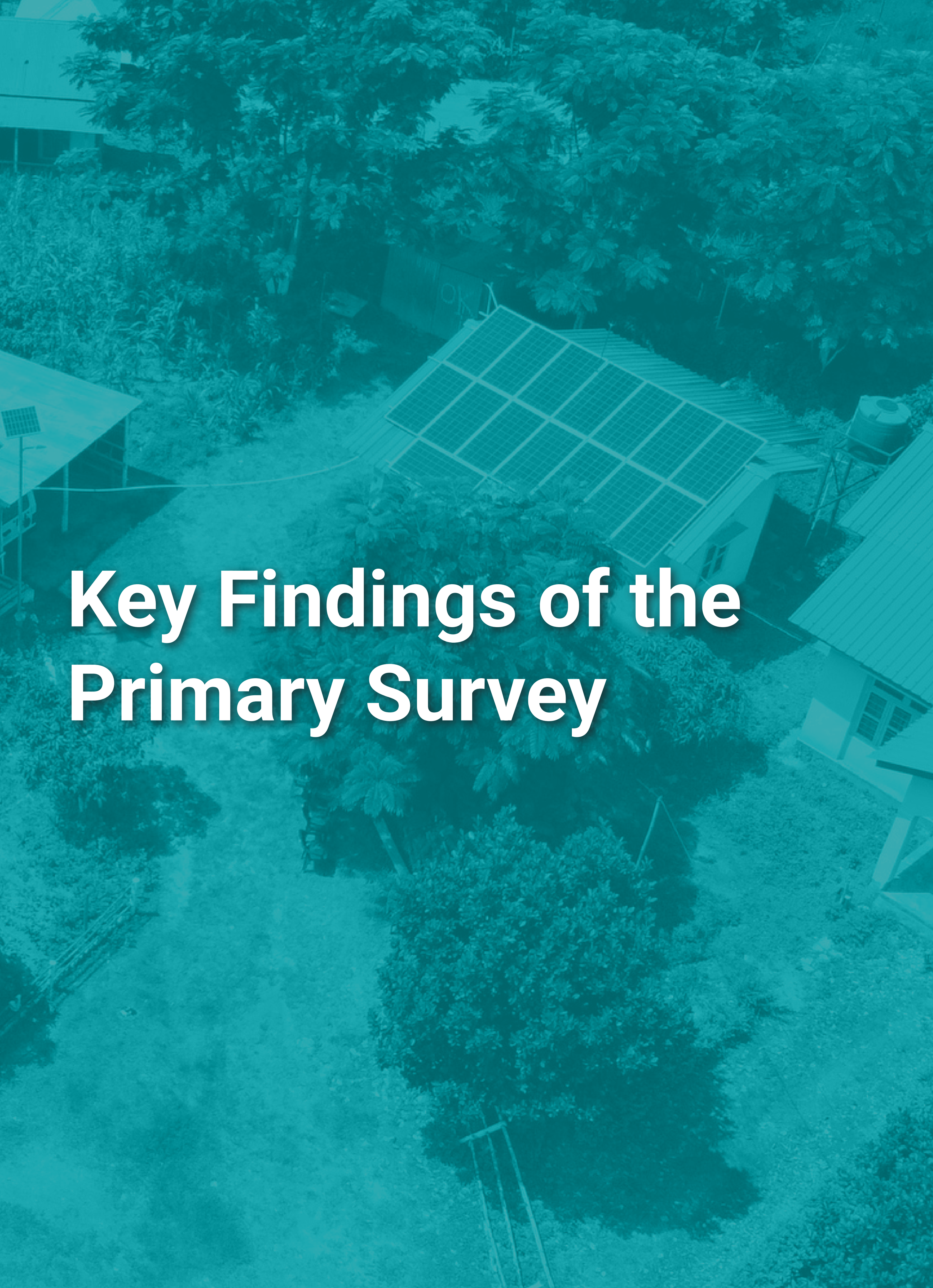
- To assess the DRE potential in the health sector of Jharkhand
- To propose ways to create an enabling framework for extending the use of DRE as a sustainable energy source in Jharkhand's health institutions

2.3. Methodology

A combination of primary and secondary research methods, including semi-structured questionnaire surveys, in-depth interviews, and formal and informal interactions with various stakeholders in the government, private sector, and non-government organizations has been used to gain a better understanding of the ground reality of the DRE specific to healthcare facilities and its potential infusion into the public health infrastructure. In this regard, Energy Collective, a multi-stakeholder platform and network served as a connecting thread for the study project.

A secondary literature review of previous works and reports from reputable organizations such as the Ministry of Health and Family Welfare (MOHFW), Rural Health Statistics, National Family Health Survey (NFHS), Indian Public Health Standards, Niti Ayog, Power for All, Shakti Sustainable Energy Foundation (SSEF), World Bank, Council on Environment, Energy and Water (CEEW), etc. was conducted to establish the context. A series of interactions were held with various health professionals and health workers, including District Program Managers (DPM), Block Program Managers (BPM), Medical Officers (MO), and Auxiliary Midwife Nurses (ANM), as well as child nutrition workers, such as Anganwadi Workers (AWW), at various Public health centers and Anganwadi centers.

Key Findings of the Primary Survey



3. Key Findings of the Primary Survey

Figure 4 : A Community Health center in Dumka

To gain a better understanding of the ground reality of the DRE sector-specific to healthcare facilities and its potential infusion into the public health infrastructure, a primary survey was conducted with health professionals such as block and district health managers, medical officers, ANM, and AWW working at PHCs, CHCs, HSCs, Referral hospitals, and District hospitals.

A total of 607 health centers were surveyed in 6 districts of Jharkhand namely Ranchi, Gumla, West Singhbhum, Sahibganj, Dumka & Palamu. (Ref: centers Figure 5) In collaboration with JREDA and the state's health department, the districts were chosen while taking into account the rural, tribal, industrial, and urban belts.

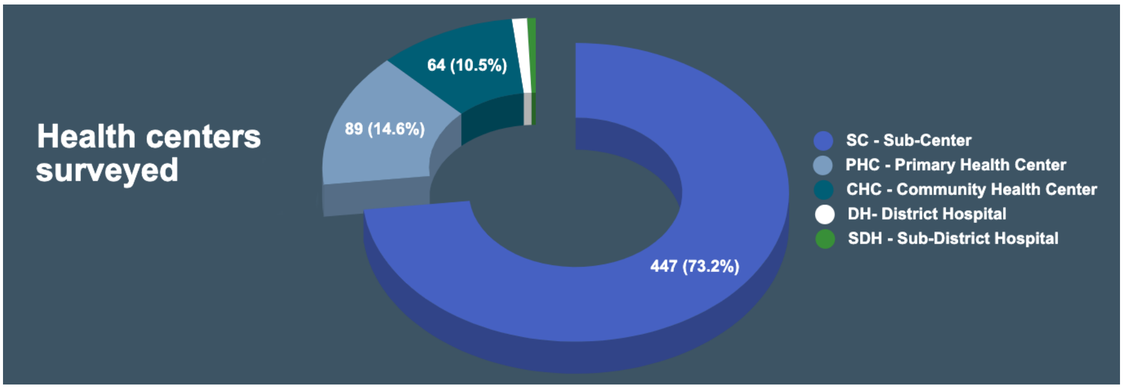


Figure 5: Classification of the health centers surveyed

According to the most recent rural health statistics for 2020–21, over 500 health facilities in Jharkhand are still without electricity, which is a significant improvement from the previous years when over 1900 health centers lacked electricity. However, our survey showed that over 56 percent of the health facilities assessed were linked to the grid, while 44 percent were not. The situation in rural health sub-centers (HSCs/SCs) was much bleaker as compared to PHCs. Over half of the health sub-centers were discovered to be unelectrified, relying solely on natural light for their daily operations (Ref: Figure 6). It was also found that several health clinics had installed electric poles and cables, but it had been a while since they had been electrified or charged. Additionally, a few health facilities either lacked an operational power meter or obtained their electricity by illicit means, owing to the necessity for electricity to run the medical facilities (Ref: Figure 7). Power outages are common and can continue for four to sixteen hours, which makes it difficult for rural populations to rely on the provision of electricity. The lack of stable and constant power sources in rural health facilities is confirmed by our survey findings.

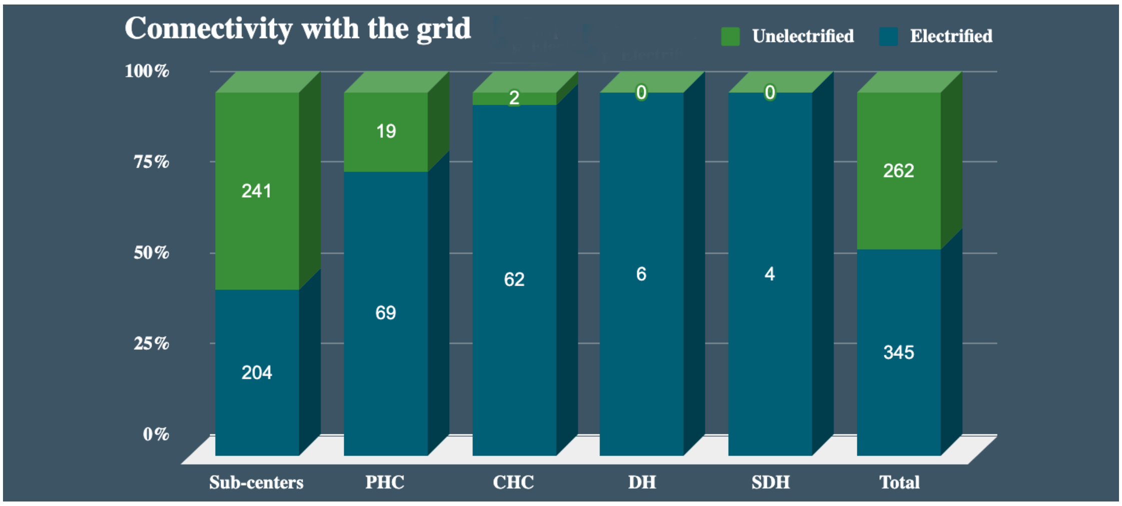


Figure 6: Electrification status of the health centers surveyed

Figure 7: Un-electrified Health Center

Over 89 percent of electrified health centers have outages that last longer than eight hours each day daily (Ref: Figures 8).

Over 44% of the electrified health centers reported the issue of fluctuating power supply. A quality power supply is necessary for the effective operation of the health centers and their equipment. (Ref: Figure 9)

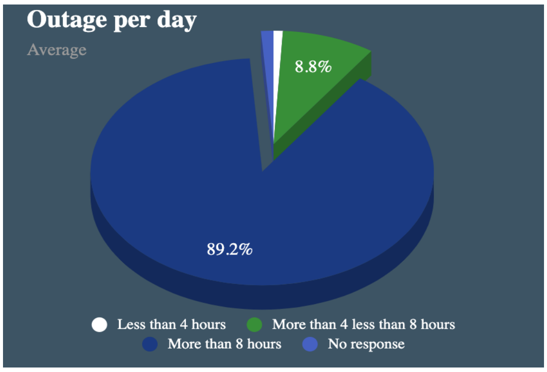


Figure 8: Power disruption at the health centers surveyed

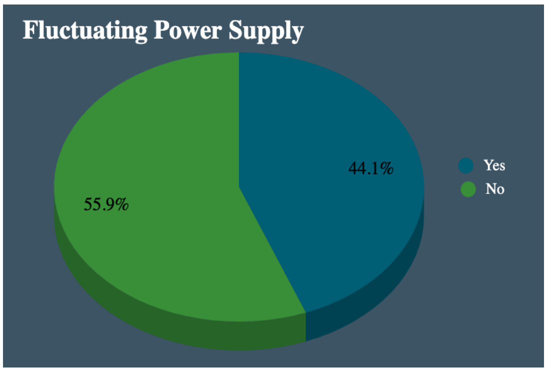


Figure 9. Issue of fluctuating power supply at the health centers

Even though coal-based power plants provide the majority of Jharkhand's energy needs, the state's electrical supply remains unstable. An aging infrastructure and inadequate transmission and distribution networks within the state are the main causes of this.

Another major cause of concern identified in the survey was that the majority of health centers lacked an alternate source of electricity, causing disruptions in the provision of quality health services to the residents. Only 5% of the health centers surveyed were operating with a Diesel Generator set, whereas over 15% of the health centers were solarized as additional backup power for their day-to-day operations. (Ref: Figure 10)

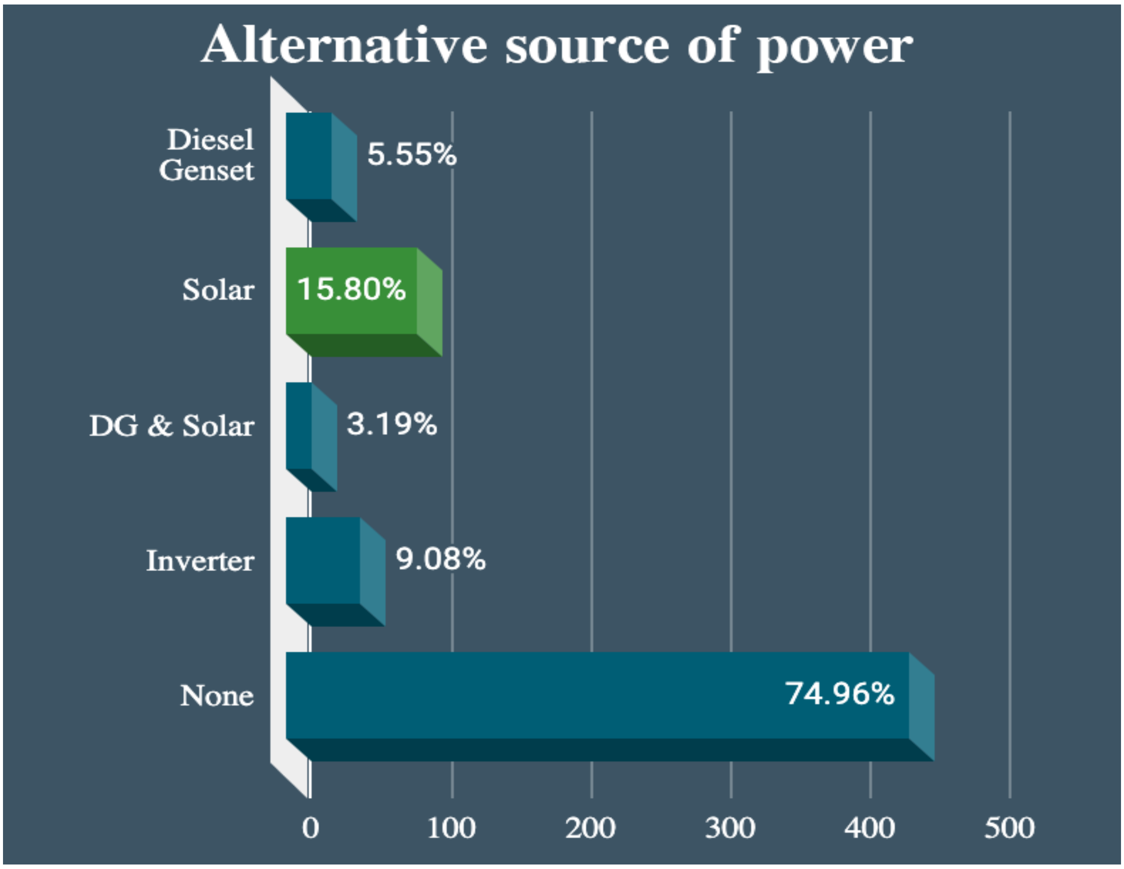


Figure 10. Alternate power sources at the health centers

As the discoms attempt to enhance their grid network, they are constrained by the challenging geographic terrain, heavily forested areas, and isolated locations of hamlets. Grid power is expensive because of the increased investment requirements and cost overruns caused by historical delays in the execution of major distribution projects.

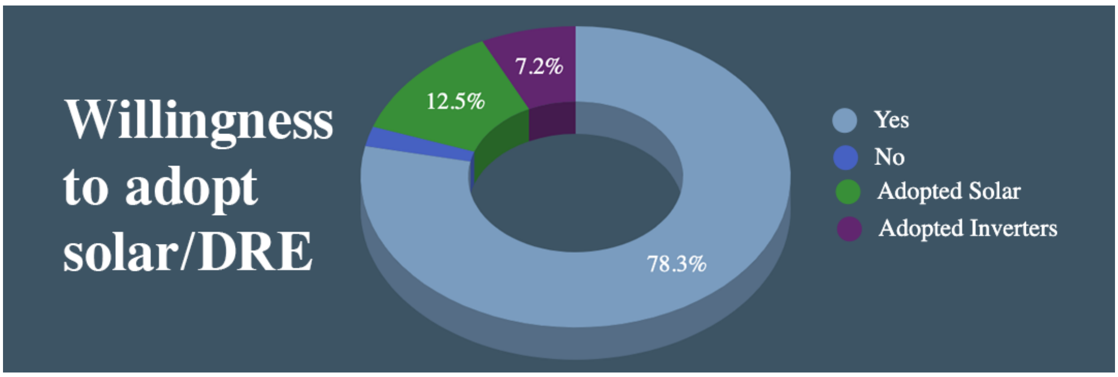


Figure 11. Willingness to adopt DRE as an alternative power source

The silver lining to the whole situation was that the majority of health facilities genuinely cared and expressed a readiness to use solar as an alternate source of energy to improve health services in their region of operation (Ref: Figure 11). The institutional sector offers a greater opportunity for rooftop solar PV projects. The state's energy security will be ensured, local manufacturing facilities will be supported, and job levels will rise as a result, all of which will assist foster a favorable environment for implementation.

The results of our survey show that while many solarized health centers appreciated the efforts made by JREDA to solarize the state's health centers and communicated the reduction in their electricity bills and reduced use of diesel as a result of having solar plants at their facilities, a small number of solarized health centers also expressed dissatisfaction with the operation and maintenance services provided by the developers. For long-term operations, solar PV plants must be operated and maintained regularly so that downtime is reduced, and trust in the DRE is maintained as the best option for electricity demand, and it is adopted by all health centers, bringing the energy transition to the health sector as well. It is also

Figure 12. Solarized Community Health Center in Sahebganj

essential that the staff at the health centers be trained to handle basic operations and troubleshooting to decrease the downtime of the solar plants and make them more effective there, giving the powers in the hands of the owners. A sense of ownership is important for the proper functioning of the plant.

Figure 13. Representative images of survey at health centers

Strengthening the Health Sector through DRE

4. DRE as a Health Sector Enabler

The availability of power in healthcare facilities is a significant determinant of the efficacy of healthcare delivery. Transportation, immunization stockpiling, clean water supply, emergency services, and staff retention are all dependent on it. Electricity backup is also essential for keeping medical equipment operational in the event of a power outage in a health center.

Health Sub-Centers are among the least electrified health institutions in rural areas (Ref: Figure 14), serving as the community's first point of contact. According to the Indian Public Health Standards Guidelines, they are responsible for rendering services such as vaccination, working toilets, residential quarters for Auxiliary Nurse Midwives (ANMs), autoclaving and sterilization equipment, and so on. However, to function they all require a consistent source of electricity.

Road networks are typically required infrastructure for obtaining energy services; they also impact how easily facilities can be serviced to keep their power infrastructure operational. While public facilities are supposed to be the community's primary service delivery units, it is vital to be aware of their accessibility.

Furthermore, having a consistent energy supply in healthcare facilities can significantly improve the quality of care, take for instance:

» Many life-saving operations, as well as critical medical devices and appliances for prevention, diagnosis, and treatment, are energy-dependent.

» Health care facilities have varying energy requirements depending on the services they provide and the loads they must support. Vaccine refrigeration, illumination, medical equipment, and surgical care are only a few of the essential services available. Communication, water pumping and heating, and space heating and cooling are examples of additional services. (Figure 14)

» Electricity access in health facilities can boost the number of successful childbirth deliveries, especially at night; also it enables mobile-health applications and makes public health education and information more accessible.

» Thermal energy is also needed to heat space and water, sterilize medical equipment, and securely incinerate medical waste (WHO and World Bank 2015).

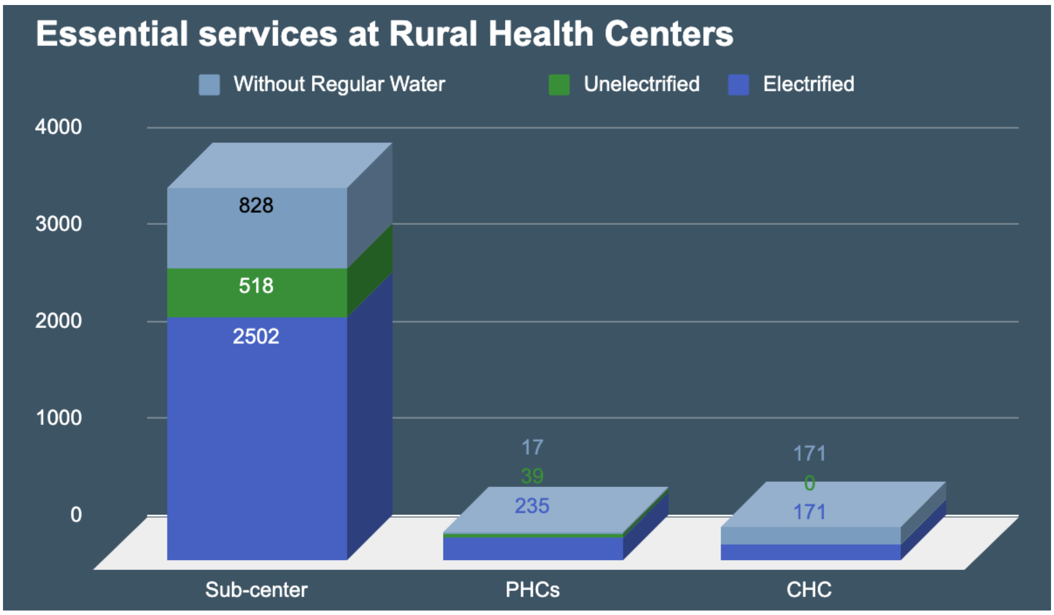


Figure 14. Essential infrastructure services at the rural health centers

Some Excerpts from the IPHS Guidelines:

DH[7] :

1. The National Health Policy, 2017 recommends two beds per 1000 population. It is therefore proposed that the provision of one bed per 1000 population is an 'Essential' norm for every district while two beds per 1000 is a target they should aspire towards 'Desirable'
2. Districts with less than 5 lakh populations with a functional DH do not need a Sub District hospital. Districts with populations between 5-10 lakh can have one SDH. Thereafter, one SDH for every 10 lakh population can be considered for the provision of comprehensive secondary care health services.
3. Approximately 450 to 500 liters of water per bed (including daycare, emergency, dialysis, and LDR beds) per day is required for a district hospital.

CHC[8]:

1. Non-FRU CHCs will have 30 essential beds. For FRU CHCs in rural areas, 30 beds, maternity, and surgical services will be essential while in a 50 bedded FRU CHC, additional ophthalmic, orthopedic, and ENT services will be desirable. Similarly, for FRU UCHCs with 50 beds, maternity and surgical services will be essential in all the cities.
2. Appropriate power backup/inverter should be in place to ensure there is no disruption of services and the cold chain for vaccine and diagnostics must be properly maintained.
3. Shadow-less lights in the operation theatre and delivery rooms should be provided. Emergency portable light units should be provided in the wards and departments.
4. An arrangement should be made for a round-the-clock piped water supply along with an overhead water storage tank with the provision to store at least three days of water requirement. Approximately 340-450 liters of water per bed per day is required for a CHC.
5. Adequate powers back up with another source such as DG, Photovoltaic, etc., should be there in synchronization with the first source.

PHC[9]:

1. There should be two essential and four desirable beds in a PHC while six essential and four desirable beds in a 24x7 PHC/UPHC. UPHC and multi-specialty polyclinic will have two essential and four desirable daycare beds to provide care to patients requiring stabilization, observation, and/or monitoring.
2. UPHCs are not expected to provide in-patient care. However, such UPHCs that continue to provide delivery services, need to provide infrastructure as per 24x7 PHC.
3. All the essential medical staff and allied health professionals should be provided with residential accommodation to ensure their availability round the clock at 24 x 7 PHCs/UPHCs.

SC[10]:

1. Wherever facility exists, uninterrupted power supply has to be ensured for which inverter facility/ solar power facility is to be provided
2. Sub-centers should be developed as a delivery facility and should also cater to adjacent Type A sub-center areas for delivery purposes. Type B Sub-center will provide all recommended services including facilities for conducting deliveries at the Sub-center itself. They will be expected to conduct around 20 deliveries in a month.

4.1. Multidimensional Aspect of Energy Access through DRE

Figure 15: Representative image of sub-center in rural area

Access to electricity at healthcare facilities is essential for deliveries, vaccine storage, emergency services, clean water supply, the retention of qualified staff; which is required for deliveries, vaccine storage, emergency services, and retention of qualified employees. The World Bank framework calls for a comprehensive understanding of electricity access that goes beyond mere connectivity and includes quality, reliability, and affordability of health services (Figure 15 and Table 6). Deliveries in a labor room, for example, demand a specific set of lighting equipment. After the baby is born, power is still required to keep vital newborn equipment like radiant warmers and incubators running. Power is required to run deep freezers and ILRs, which are used to preserve immunizations at the right temperature, in addition to delivery and newborn care. As a result, providing good healthcare without consistent access to electricity is difficult, if not impossible. Diagnostic and treatment capacities may be severely reduced due to a lack of enthusiasm, and staff may become unavailable due to discontent.

Health sub-centers (HSCs) are the backbone of India's rural healthcare system. Even though having access to electricity improves the quality of healthcare, in India, one out of every two health centers is either un-electrified or faces an intermittent power supply. Due to the state's terrain geography, which makes grid extension difficult, the majority of centers lacked a consistent supply of power. There are various instances when women were giving birth in the dark, and healthcare workers brought candles in case of power failures, making it difficult for healthcare facilities to provide care at night.

At the most basic level, power is required for the operation of critical medical equipment. Apart from in-patient and out-patient treatments, the two most significant services provided by these health centers (especially PHCs and CHCs) that require a continuous and stable supply of power are maternity deliveries and vaccination. Deliveries, especially those that take place at night, require a light source and fans for the mother's comfort. Radiant warmers are also necessary for a newborn baby's health. Most immunizations must be kept at 4 degrees Celsius, which demands a steady supply of electricity to the ice-lined refrigerator and deep freezer. For example, autoclaves are required for the sterilization of equipment and other items. As a result, an improved electrical supply may be thought to have a positive impact on the delivery of these services.

DRE-powered health centers such as solar PV systems could be a potential solution for energizing rural healthcare, given the topographic fragility of many of these rural and remote places. These systems could either offer full power or serve as a backup (perhaps in conjunction with storage) to provide a steady power supply, particularly during peak hours. PHCs often use diesel generators as backup power sources. Having a solar PV system as a backup, on the other hand, has various advantages in terms of cost, environmental impact, and health. Diesel generators are less expensive than solar PV systems with battery backup, but their operational expenses are higher.

The annual operating cost of a diesel generator for a 5 kW system would range from INR 200,000 to INR 400,000, assuming a fuel delivery cost of INR 26-27 per kWh while using solar with battery costs around INR 12–14 per kWh[11]. Off-grid solar arrays can thus provide the energy requirements of sub-centers, PHCs, and CHCs in rural and remote areas where electricity is scarce. Before completing a solar installation, however, each center must be assessed to fully account for its energy usage and to determine whether an installation for the entire load or a backup installation is required. Based on the electricity needs of these institutions, the government has taken steps to power them with stand-alone solar systems with battery backup or grid-interactive solar PV-only systems.

Energy-efficient/innovative appliances and mobile healthcare facilities that are customized for rural requirements and can work even during outages (such as Godrej's Surechill vaccine and blood bank refrigerator) are required in addition to standalone solar systems providing electricity to health facilities.

Figure 16. Multidimensional Aspects of Electricity Access

The ongoing Covid-19 crisis has exposed several fundamental service flaws, notably in the rural areas where mostly the poor find it difficult to access sufficient healthcare facilities. It is estimated that about 230 million people are served by 39,000 sub-centers (the first point of contact between the primary healthcare system and the community) in rural India. With an initial capital commitment of less than $30 per person, Decentralized Renewable Energy (DRE) can assist in tackling this problem quickly and affordably. Solar, on the other hand, is a low-cost, low-emission alternative that benefits society as well as the healthcare system.

Table 6: Various aspects of multidimensionality

Aspects of multidimensionality	Descriptions
Capacity	The peak load that can be applied to a specific electricity connection is referred to as capacity. It establishes the scope of services available to a health center. Although the capacity varies depending on the services supplied by the health center, a typical PHC's capacity ranges from 3 to 10 kW and for CHC in the range of 10-25 kW, whereas for sub centers it lies around 500W-2 kW.
Duration & Availability	According to IPHS recommendations, all Health Centers should strive to provide services 24 hours a day, seven days a week. A PHC that runs 24 hours a day, seven days a week would require a 24 hour power supply. Even if a Health Center is not open 24 hours a day, the minimal need is that it has access to power during its operating hours.
Reliability	The term "reliability" refers to the assurance of a Health Center's power supply at any given time. The facility's staff can make informed judgments about power backup and anticipate any impact on services with a predictable power supply.
Quality	Voltage fluctuation is caused by the quality of the power source. Voltage fluctuation would be absent or low in a high-quality power supply. This becomes important when considering the potential for device damage due to voltage fluctuations.
Affordability	Whether it's a family or a public institution, the final cost of electricity should be affordable to the customer. Furthermore, backup options should be as economical if the grid fails to provide the necessary power. Affordability can be determined by comparing the per-unit cost of power from various sources or by calculating the proportion of the monthly budget spent on satisfying electricity needs.
Legality	Users with legal connections can demand improved electrical services. This has significant ramifications for the power generation system's overall supply and dependability. A formal connection will not only provide a health center with permanent access to electricity, but it will also have a substantial impact on the supply's quality and reliability.
Convenience	Electricity should be easy to get and utilize, whether it comes from the grid or from a backup generator.
Health & Safety	The source of energy has an effect on the user's health as well as the environment in general. Given growing worries about rapid climate change and rising air pollution, a move to cleaner and healthier forms of electricity generation is required.
	Source: CEED Analysis adapted from World Bank/ESMAP, 2014/16

4.1.1 **Learnings from Health center solarization in Chhattisgarh [12] :** The Chhattisgarh State Health Department collaborated with Chhattisgarh Renewable Energy Development Agency (CREDA) on an initiative to provide solar energy to all primary health centers. The solar electricity of 900 health centers and district hospitals has assisted approximately 80,000 individuals per day. The centers can give therapy 24 hours a day, allowing them to serve a larger number of patients. Reliable water supply, safe vaccine refrigeration, and powered theatre equipment, fans, and baby warmers have all been made possible thanks to regular electricity. Health-care workers have reported a fourfold increase in the number of newborns delivered at their facilities now that women can safely give birth at night. Another benefit of reliable power is the ability to digitize patient services and significantly boost operational efficiency. Patients can use new smart-card services to register for free medical treatment, and drugs can be ordered online utilizing reliable Internet connectivity. When compared to the grid or backup diesel, solar systems have resulted in an 80 percent reduction in energy costs, while also helping the patients with quality health services.

Electricity access entails not just having a physical connection to the grid, but also having access to electricity when you need it and having electricity of acceptable quality. Recognizing the multidimensional nature of electricity, energy access is crucial to ensuring that every rupee spent on electricity services has the greatest societal impact possible. This implies that if electrical service and supplies are reliable, there is a greater likelihood of receiving high-quality health care.

4.1.2 Solarizing Health Sector in Jharkhand

Around 7 MWp Solar PV added through solarization of 423 health centers by JREDA

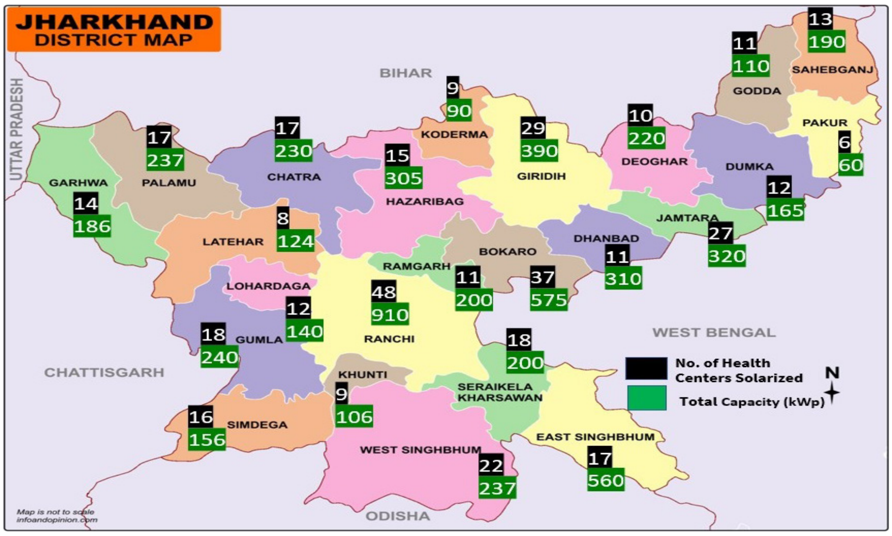


Figure 17. Solarized Health Centers in Jharkhand (Source: JREDA

With the rising power demand, the Jharkhand Government needs to shift gears to provide reliable and quality power supply throughout the state. Although the state's power supply has improved, it still does not provide quality electricity to all. The state has over 13% of health sub-centers and PHCs are unelectrified and many suffer from variable voltage supply and power outages. To augment the electricity supply at the health centers, the Jharkhand Renewable Energy Development Agency (JREDA), in collaboration with the Jharkhand Health Department, installed over 423 solar photovoltaic (PV) systems across the state starting in 2015 with a cumulative capacity of about 7 MWp (Ref: Figure 17).

4.2. Stories of DRE for Healthcare and Covid Management

Several systemic service gaps have been highlighted by the ongoing COVID-19 crisis and one of them is insufficient healthcare facilities. The COVID-19 pandemic calls for revamping Jharkhand's rural health care system beginning with enhancing access to reliable electricity. DRE is an exciting opportunity to support the health care system in India and this can be seen in two case studies from the health sector in Jharkhand that present enormous possibilities DRE can bring for saving lives.

CASE Study-1 (CEED analysis):

Figure 18. A 50 kWp Solar PV Power Plant installed at Angada CHC, Ranchi

Solar powered community health center at Angada, Ranchi

A total of 112,759 people live in 84 villages in the Ranchi district's Angada block. The Angada community health centre is well-equipped and nearly complete in terms of its infrastructure. The Jharkhand Renewable Energy Development Authority (JREDA) provided support for Angada CHC's plan to acquire solar-powered systems to meet its energy requirements and benefit the society through improves health access. A 50 kWp SPV power plant was established at the CHC which supports 8–10 hours of energy requirements of the health centre.

Key impacts:

- Reduced electricity bills
- Effective management of health programmes
- Efficient and accurate quantification and distribution of medications & patient tracking
- Better monitoring of overall health system parameters round the clock
- Efficient utilisation of rooftop, making the roof cooler

Case Study 1

CASE Study-2 (CEED analysis):

Figure 19. A 10 kWp Solar PV Power Plant installed at Getalsud PHC, Ranchi

Solar powered primary health center at Getalsud, Angada, Ranchi

PHC is the first point of interaction between the village community and the medical officer. The PHCs were intended to offer integrated curative and preventive health care to the rural population, with a focus on preventative and promotive components of health care. However, the Getalsud PHC's electricity situation was worrisome due to frequent power outages and voltage fluctuations. JREDA helped the PHC by installing a 10kWp solar plant thereby relieving the PHC with the power woes. The Primary Health Center has been using solar-powered electricity for over 6 hours each day. Solar energy has proven to be advantageous for the PHC in terms of lowering the cost of diesel, increasing the number of patients served, and developing a resilient health system at the centre.

Key impacts:

- More relaxed environment for the doctors thus more time for doctors consultation
- Greater acceptance of the in-patients and being treated
- Freedom from inefficient Diesel Generator (DG) thus decreased expense on power
- A sustainable alternative in case of frequent power cuts and unreliable power supply
- Increased number of persons served

Case Study 2

CASE Study-3 (CEED analysis):

Figure 20. A 50 kWp Solar PV Power Plant installed at female ward of RINPAS, Ranchi

Solar powered Female Ward of RINPAS, Ranchi

The Kanke block of Ranchi District in Jharkhand, India, is home to the Ranchi Institute of Neuro-Psychiatry & Allied Sciences (RINPAS), a medical college. It is a unique hospital for behavioural science research, social and occupational rehabilitation for mental patients, and diagnostic and therapeutic services for people with mental illnesses. In order to meet its energy needs and reap the benefits, RINPAS's intention to install 50 kWp solar-powered systems got support and assistance from the Jharkhand Renewable Energy Development Authority (JREDA). The health centre has been using the diesel generator set still but only as a backup power supply on cloudy days.

Key impacts:

- Financial savings of over fifty thousands per month due to decreased use of DG sets
- Better and enhanced medical services
- Better patient management and tracking,
- Precise medication quantification, and distribution to patients with mental illness

Case Study 3

CASE Study-4 [13]:

Figure 21 : Installation of a 15kWp solar PV system on the roof of a hospital (2017)

Solar Plant in Premjyoti Hospital

Premjyoti Hospital in Sahibganj, Jharkhand's north-eastern district, is the only medical institution with the staff and services to undertake surgery within a 200-kilometer radius. A group of ambitious doctors founded this hospital in 1996, more than two decades ago, to serve the region's primarily indigenous population. At the time, the district lacked power. When grid power was finally brought to this isolated location in subsequent years, power was only accessible for 6-8 hours per day, especially during the peak summer months, when temperatures reached 45 degrees Celsius. A 15-kilowatt 'peak' (kWp) off-grid rooftop solar photovoltaic (PV) system with battery backup was installed to enhance the health services.

Key Impacts:

- Better and improved health services to the patients
- Better sterilization and in house lab facilities
- Contributing to the nature as an eco-friendly model
- Reduces carbon footprint due to less dependency on diesel genset
- Enhance energy based health amenities in the hospital
- Reduction in electricity bill
- Digitize patients records and enhanced inventory management

Case Study 4

CASE Study-5 [14]:

Figure 22 : A 10kWp solar PV Power Plant installed at Nav Jivan Hospital (2017)

Solar powered COVID care center in Nav Jivan Hospital, Palamu

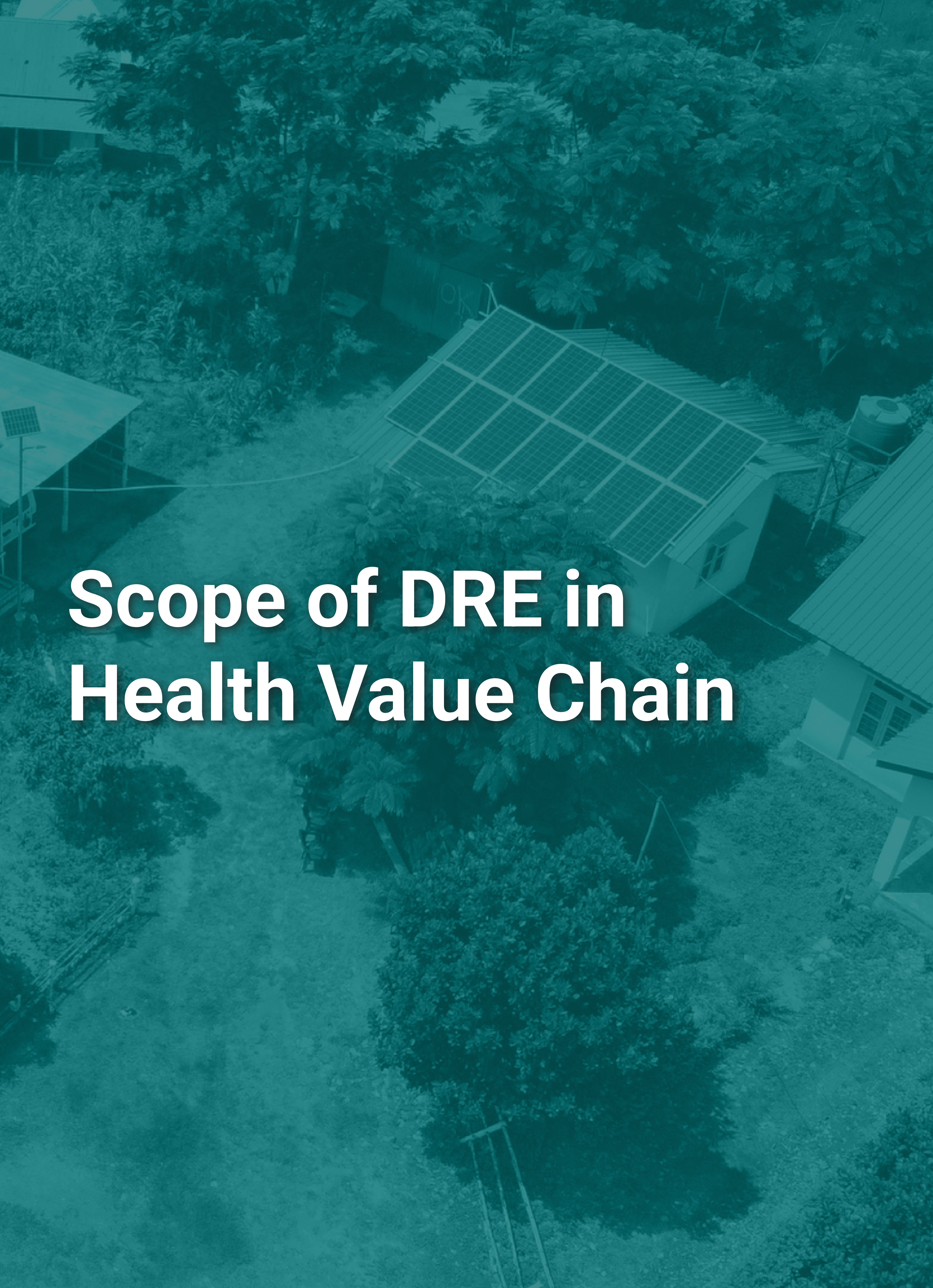
Nav Jivan's success and advancement in facilities did not happen immediately, but rather after years of careful preparation and forethought. Due to a lack of infrastructure, the hospital performed surgeries and child births with flashlights and petromax lamps for numerous years. When three-phase grid connections were installed, the situation significantly improved; still, frequent and protracted power outages, as well as voltage variations, continued to wreak havoc on operations. Furthermore, unavoidable damage to the electricity infrastructure during the monsoons would result in protracted power outages, requiring the hospital to rely on expensive (annual diesel fuel expenses of up to INR 10 lakh) and polluting diesel generators.

A 10kWp system was installed with the help of a doctor in the team which now meets some of the hospital's most pressing demands right now, serving as the principal source of power for equipment used to treat COVID-19 patients. The ICU ventilators are powered by solar energy, and additional ventilators obtained from the state can be used in an emergency.

Key impacts:

- Better and improved health services to the COVID-19 patients
- Better lighting facilities for health care workers in their residence
- Efficient roof space utilization
- Eco-friendly model positively contributing to the nature
- Reduces the carbon footprint
- Reduction in Electricity Bill
- Mitigation of carbon emission by diesel
- Safety of medical equipment

Case Study 5



Scope of DRE in Health Value Chain

5. Scope of DRE in Health Value Chain

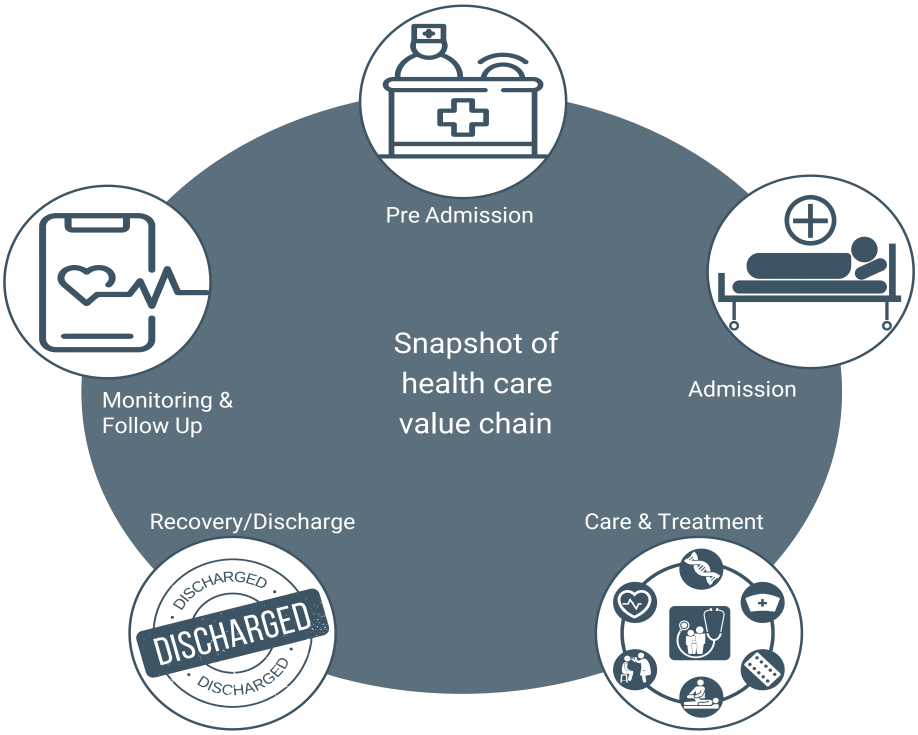


Figure 23. Health Value Chain

Better health services are more likely to be provided with a reliable and high-quality energy supply. Powering health facilities with renewable energy sources, in conjunction with energy efficiency programs, can reduce dependency on fossil fuels, cut carbon emissions, and lower operational costs. It could also help the health sector become more energy independent and resilient, especially if the energy grid or supply chain is disrupted. SDG-3 will not be achieved, and universal health coverage will not be realized unless health institutions that provide critical care have reliable electricity. Figure 23 depicts an outline of the existing health value chain, while Table 7 depicts the DRE element being infused into it.

Table 7: Scope of DRE in the health value chain

Health Value Chain	Services	Scope of DRE
Pre-Admission	• Diagnosis • Preliminary Consultations • Medicines/vaccines • Preventions & care • Referrals	• Cold chain/refrigeration unit • DRE based mobile test centers • DRE powered clinics • DRE powered pharmacy stores and delivery
Admissions	• Ambulance services • Emergency • Precautionary aid • Medical history • Diagnosis check up • Consultations with experts	• DRE powered Mobile Medical Units • Stand alone solar power plants • Cold chain/refrigeration unit • Lighting • Heating • Testing such as ultrasound and resuscitation ventilators • Sterilization • Drinking water supply • Sanitization • Mortuary

Care & Treatments	‣ Clinical examinations ‣ Diagnostic tests ‣ Treatment ‣ Amenities such as blood, oxygen etc./medical devices ‣ Medical supplies	‣ Diagnostic tests ‣ Cooling & heating ‣ Lighting ‣ Powering medical devices ‣ Communications ‣ Energy efficient vaccine refrigerator ‣ Non-communicable diseases screening kit (NCD Kit) ‣ Mobile NCD screening unit ‣ DRE powered labs
Recovery/Discharge	‣ Referrals to other facility ‣ Ambulance services ‣ Inpatient recovery	‣ DRE powered mobile medical units ‣ DRE powered isolation wards ‣ DRE powered Covid centers ‣ Back up supply
Monitoring & Follow-ups	‣ Monitoring compliance ‣ Monitoring and managing patient condition	‣ Communications ‣ DRE powered training centers ‣ Mobile vaccine storage containers ‣ Powering staff quarters

5.1 DRE in Healthcare Value Chain

Cold Chain for Vaccine Refrigeration and Storage: Cold chain equipment is essential for the storage of vaccines and drugs and their storage. Accessibility of health services at the PHC also guarantees safe delivery of infants and routine child immunization and vaccination cycles. Loss of vaccines and medications due to non-functional equipment in the cold chain dramatically contributes to the expense of public health, either due to lack of power or due to technological problems. Usually, vaccines are kept for as long as one month at district and rural health centers and they need the support of a steady temperature of 0°C (32 °F) to 8°C (46 °F). The potency of the vaccinations is permanently lost if administered at temperatures beyond this range. Here, DRE can play a key role in ensuring a steady temperature for the vaccines thus saving a lot of vaccines the cold chain maintains its potency and ensures a steady supply.

Electrical Appliances: Many appliances may be electrically operated 24 hours a day, seven days a week, and can work in solitude or on the go. Thanks to DRE solutions. The devices, which are rather costly, also require a reliable supply of electricity, which can be given by DRE solutions such as stand-alone power plants (Ref: Table 8.)

Table 8: Essential electrical appliances for enhancing services

Service Provided	Electrical equipments	Capacity(watt)
Maternal and child Health care	Radiant Warmer	600-700
	Sterilizer/ Autoclave	1200
	Suction Machine	200-230
	Phototherapy Unit	270
	Heat source for a new born (bulb)	200

Immunization	Refrigerator	100-120
	Ice- lined Refrigerator	115-370
	Deep freezer	120
	Room Heater	1000/150
Physical Medicine and Rehabilitation	Shot wave diathermy	500-1000
	Neuro muscular Stimulator	
	Infra red lamp (therapy)	
	Ultra sound therapy	800-1000
Dental Care	Dental Unit	800
OT	X- Ray view Box	20-90
	ECG Machine	30
Disease control	Nebulizer	50-60
General	Computer	120
	Tube lights	20
	fans	75
	Geyser	
	Light examination, mobile, 220-12 V	20
Laboratory	Centrifuge	242
	Incubator	400
	Hematology Mixer	28
	Hematology Analyzer	230

Communications: Healthcare administration would be substantially aided by communication and telephone connectivity in provincial health facilities. Routine service and administration responsibilities, such as logistical arrangements, illness, and immunization monitoring and reporting, disease diagnosis support, and other medical processes, all require effective communication.

Sterilization: It necessitates extremely high temperatures (about 120°C/250°F), for which thermal energy is preferable to electricity. A solar thermal collector can provide the desired temperature at a reduced cost, especially in places with high solar insolation.

Water Treatment & Hygiene: According to the World Health Organization water-borne infections are estimated to cause 50,000 fatalities every day. Clean drinking water is essential not only for patient rehabilitation but also for the health and hygiene of frontline health personnel. In the face of COVID, hygiene has emerged as one of the most important aspects of the preventive and cure phase, which may be addressed by ensuring a consistent supply of power through sustainable solutions such as the DRE Hot Water facility.

Powering & Lighting: Electricity backup is required for every health center not only for the provision of vital health services but also for the provision of electricity to staff quarters so that employees can stay in the facility late at night to provide emergency and delivery services. Alternative power can be supplied through DRE solutions in the event of the main grid outage.

Mobile Medical Unit: The Mobile Medical Unit's (MMU) major goal is to make public health care more accessible to those living in rural, underserved, and unreachable areas. This innovation aims to deliver healthcare to people's doorsteps, especially in rural and underserved areas. The MMU's programs are expected to meet the technology and service quality standards of a main health care center.

Baby Body-warmer: The body heater is a body warming system that provides heat to the body. This device aids in regulating the baby's body temperature and slowing down his or her metabolism. In some areas where the temperature is extremely cold, babies are placed on radiant heaters for a few hours after birth. This device can also be powered by solar energy.

5.2 Strengthening the Cold Chain at Health Centers

In Jharkhand, there are over 1.5 lakh health sub-centers (SCs), 25,000 primary health centers (PHCs), 5000 community health centers (CHCs), and over 20,000 health and wellness centers that ensure last-mile delivery of essential primary health care services like immunization at the block/tehsil and village levels, as well as for other remote areas. These healthcare facilities, which serve as the initial point of contact for millions of people in rural and peri-urban areas, will be significantly reliant on the distribution of vaccines to every hamlet in the country.

According to the Rural Health Statistics (RHS) for 2020-2021, 14 percent of rural sub-centers and 13 percent of rural PHCs in Jharkhand lack electricity, and those who do have it for a few hours are subjected to voltage fluctuations and frequent outages. With the support of 29,000 cold chain points, 240 walk-in coolers, 70 walk-in freezers, 45,000 ice-lined refrigerators, 41,000 deep freezers, and 300 solar refrigerators, India has launched the world's largest vaccination drive. The majority of PHCs and CHCs have cold chain facilities for storing vaccinations before they are used on the ground. They perform a critical function in ensuring that vaccines are kept at the proper temperature (2-8 degrees Celsius). However, while this infrastructure exists, unreliable power supply continues to be an issue.

According to the Ministry of Health and Family Welfare's Immunization Technical Support Unit (ITSU), approximately 25% of all vaccines delivered to health facilities are wasted during storage and transit. Poor cold-chain management, particularly exposure to temperature swings, is one of the reasons. Each year, damaged vaccinations cost millions of dollars because of weak links in the present cold chain in distant areas or places with inconsistent power supplies.

In the absence of a constant and dependable energy supply, this will be the case for COVID-19 vaccines or any other future viruses, which will require temperature-controlled management of cold storage to maintain the vaccine's optimum efficiency. Assessing present gaps, mending the cold chain, increasing energy efficiency, and improving rural Jharkhand's overall health outcomes are all urgent initiatives that must be addressed promptly.

Only a reliable power source, both at the transit stage and for last-mile distribution, can ensure that mass immunization is successful. Storage and transportation of these vaccinations at optimal temperatures will be a major difficulty in countries and regions with weak power supplies. COVID-19 has already changed the way important public services, particularly health care, are delivered. However, while vaccine development has received a lot of attention, and properly so, the scale and resilience of cold chain infrastructure for country deployment have not been fully considered.

A cold chain is a network of refrigerated manufacturing, storage, and transportation infrastructure that can maintain a precise temperature range from start to finish, and is used to safeguard and extend the shelf life of products. Decentralized solutions, such as solar-powered refrigerators mounted on trucks or at health facilities, can provide a speedy and cost-effective solution with long-term benefits, not only for COVID-19 vaccine distribution but also for rural health care services in general.

5.2.1 Vaccine Supply Chain in India

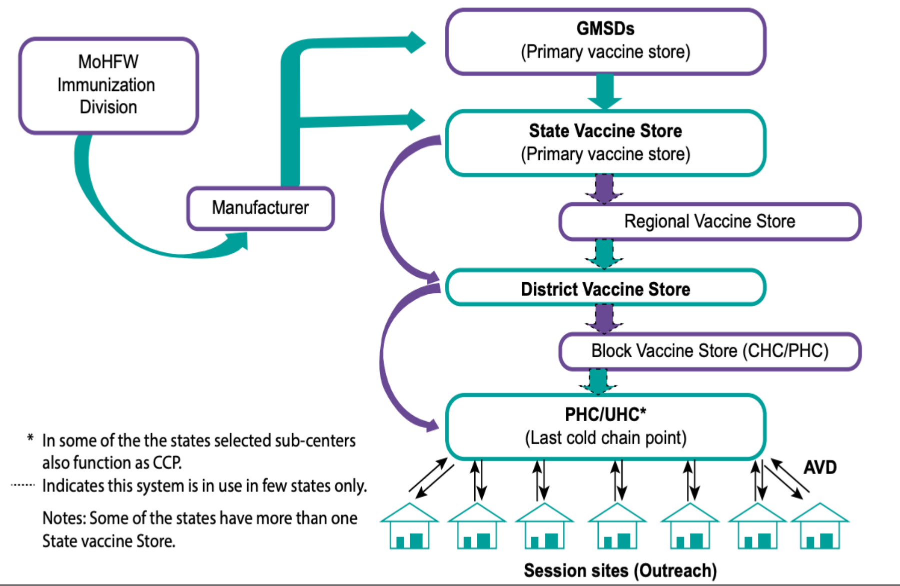


Figure 24 : An outline of Vaccine Supply Chain Management

The extensive network of cold storage facilities ensures that vaccines are manufactured, distributed, and stored at the right temperature. This network includes vaccine stores at the state, regional, and district levels as well as cold chain points in CHCs, PHCs, and even Sub-Centers across the nation. There are four National Government Medical Store Depots (GMSDs) in Karnal, Mumbai, Chennai, and Kolkata. 95 percent of the 27,000 cold chain stations in this network are located at the sub-district level.[15]

5.2.2 **Challenges at Health Centers for tracking and maintaining vaccines :** Other challenges in the peripheral management of the cold chain include a lack of power or extended power outages of more than 8 hours; poor internet connectivity in outreach or hard-to-reach areas due to limited availability of service providers; poor availability of IT infrastructure; a lack of data entry operators; and the issue of distance from the district store.

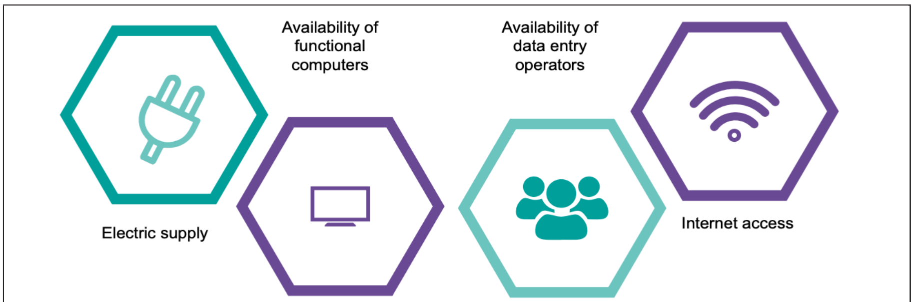


Figure 25 : Preconditions for functioning of a cold chain in a health center

5.2.3 Strategies for Vaccine management:

In the public health system, cold chain management for vaccinations is always fraught with problems. Addressing these issues necessitates a significant amount of effort, and the following strategies can be employed to keep vaccinations in good condition.[16]

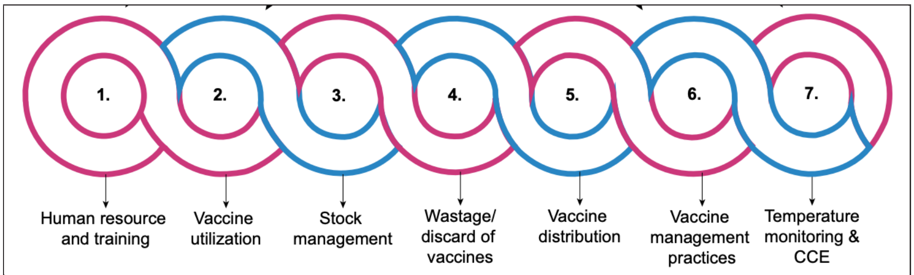


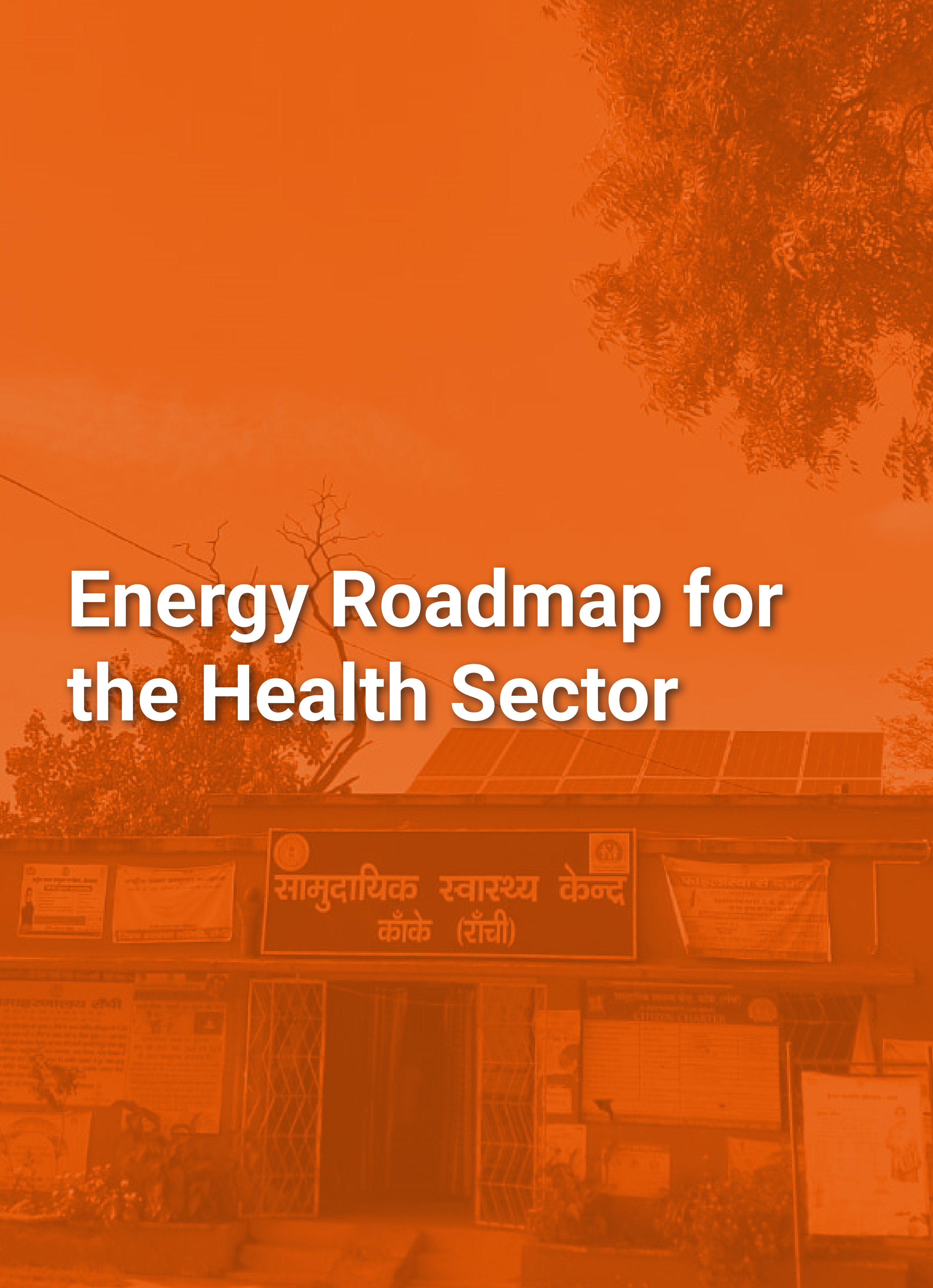
Figure 26 : Strategic Approach to a Vaccine Management

5.2.4 Savings from Prevention of Vaccine Wastage

As per a report[17], Jharkhand could save INR 11.27 crores annually (all vaccines utilization+ discard vaccines+ missed opportunity cost) through proper vaccine management through effective cold chain management (including all vaccines - both assessed and new vaccines).


सामुदायिक स्वास्थ्य केन्द्र
काँके (राँची)

Energy Roadmap for the Health Sector



6. The Future Power Demand to Bolster Health Services

The power demand in the health sector can potentially reach to 175 MW

As per the IPHS guidelines, the electrical load needed per bed at district or sub-district hospitals (DH/SDH) lies in the range of 3 kW to 5 kW[18], with a bed count ranging from 100 to 500 whereas the normal load in sub-district hospitals it is around 90 kW to 500 kW with 30-100 beds.

Similarly, a CHC is a 30-bed hospital that provides expert care in Medicine, Obstetrics & Gynecology, Surgery, Pediatrics, Dental, and Ayush, according to IPHS criteria. The typical load should lie between 10 and 25 kW. As per IPHS guidelines, a CHC should have an appropriate power backup/inverter should be in place to ensure there is no disruption of services and the cold chain for vaccine and diagnostics must be properly maintained.[19]

The electrical load at a typical PHC with 4-6 beds shall lie around 5 kW-20 kW electrical load. However, according to IPHC rules, a sub-center bearing 2-4 beds and concerning the obligations of a sub-center, the electrical load of a sub-center shall lie around 500kW-2kW.

However, considering the present gaps in the health centers concerning the availability of such facilities as per need the demand for electricity in the Business as Usual scenario shall lie around 56 MW whereas in the case of the business as usual scenario it shall be somewhere around 80 MW after five years down the line.

While the goal of this study is to determine the influence of enhanced power access on health care units, it's critical to first establish the backdrop in terms of health care services and infrastructure. Because the primary goal of any health system is to provide effective and high-quality care when it is needed, access to electricity is critical, but only as a facilitator of these services. It cannot influence isolation since it lacks the necessary equipment, infrastructure, and manpower.

As per the Central Electricity Authority (CEA)'s Long Term Electricity Demand Forecasting report, Bihar, Jharkhand, Odisha, Rajasthan, Mizoram, Tripura, and Nagaland, which are significantly less economically developed, are expected to grow at a faster rate than the all-India compound annual average rate of 4.86 percent from FY 2016-17 to FY 2036-37[20].

However, according to the same forecasting report [21], Jharkhand's compound annual growth rate is between 6-7 percent (Table 8). For the next ten years, the expected power consumption in the business as usual (BAU) scenario and the optimistic scenario will be roughly 40 MW and 175 MW, respectively, based on the same rate (Figures 27,28,28).

Table 9: CAGR of forecasted electricity demand in the Jharkhand

Compound annual growth rate (CAGR)	FY 2016-17 to FY 2021-22	FY 2021-22 to FY 2026-27	FY 2016-17 to FY 2026-27	FY 2026-27 to FY 2036-37	FY 2016-17 to FY 2036-37
PAM Baseline Scenario	8.32	6.61	7.46	5.97	6.71
PAM Optimistic Scenario	8.41	6.75	7.58	6.68	7.13
PAM Pessimistic Scenario	7.89	5.51	6.69	5.37	6.03

Source: Central Electricity Authority

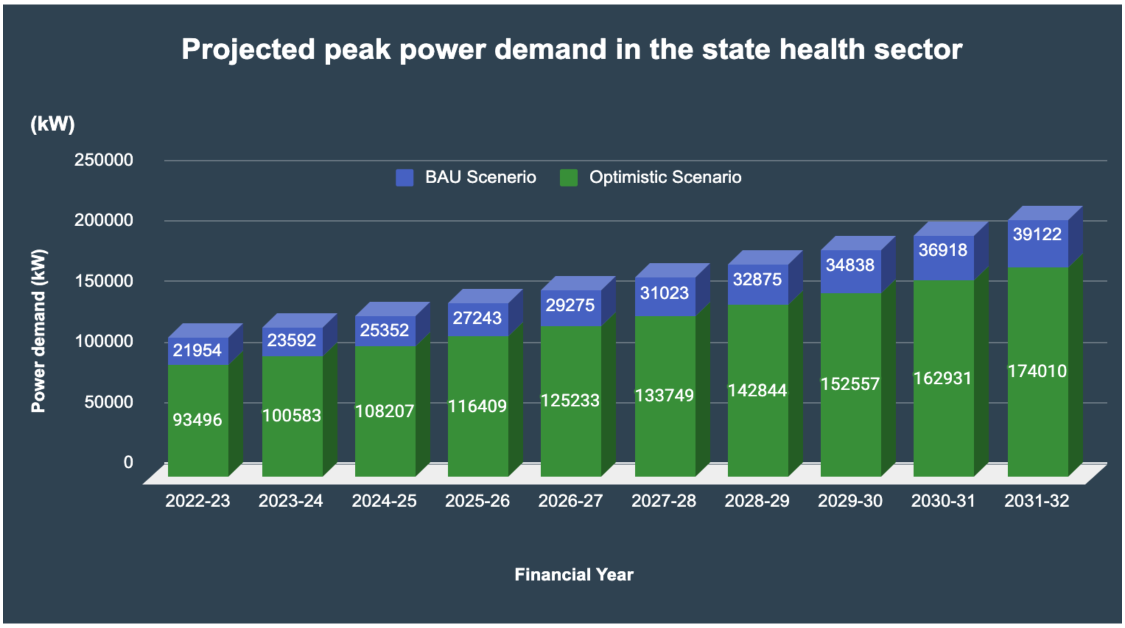


Figure 27. Projected Power Demand in the Jharkhand's Health sector

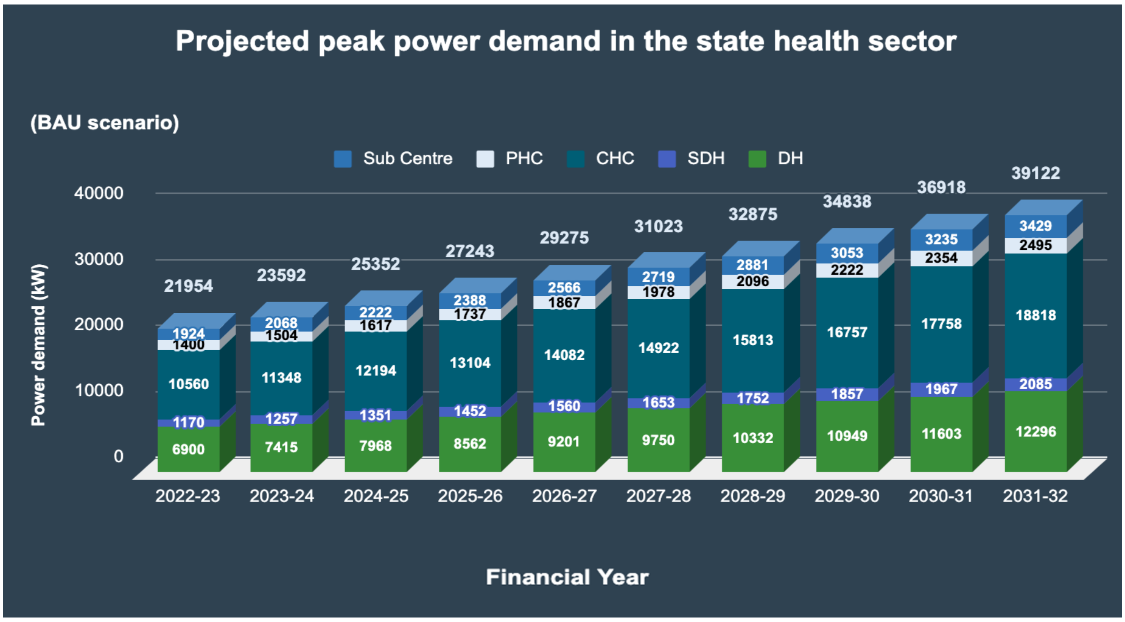


Figure 28: Electricity demand at health centers in Jharkhand in BAU scenario

The bifurcated power consumption at health center levels under the business as usual (BAU) scenario and the optimistic scenario based on IPHS guidelines and CEA forecasting benchmark are approximately 40 MW and 175 MW, respectively (Ref: Figure 27, 28, and 29).

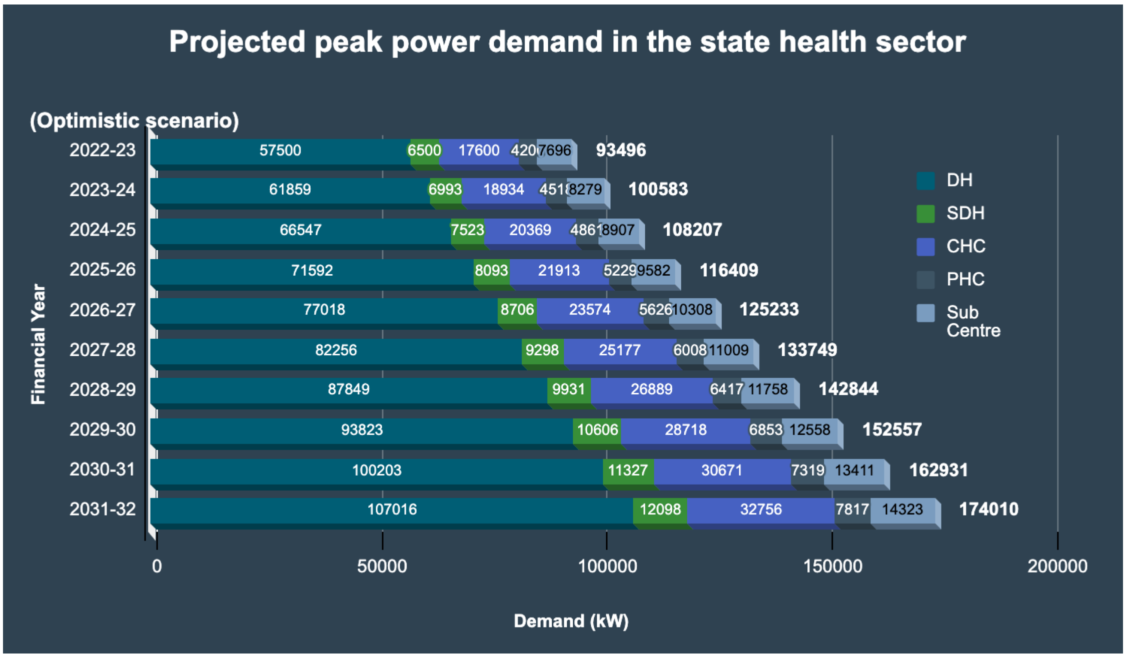


Figure 29: Electricity demand at health centers in Jharkhand in optimistic scenario

DRE Roadmap for the Health Sector

7. DRE Roadmap for Strengthening Health Services

7.1 Business As Usual (BAU) Scenario

DRE can help save 227 crores with a mere investment of 124 crore

The DRE has 17 MW more potential in the health sector due to its versatility and decentralized nature in rural locations. According to our analysis, the health industry has a potential investment of Rs. 124 crores in the DRE category in the BAU scenario (considering 6 hours of backup power).

Note: JREDA has already added over 7 MW of DRE capacity, hence the earlier solarized health centers were excluded from this analysis. If this is taken into account, the DRE's scope in the health sector will be roughly 24 MW, with 6 hours of backup power in the BAU scenario (Ref: Figure 30).

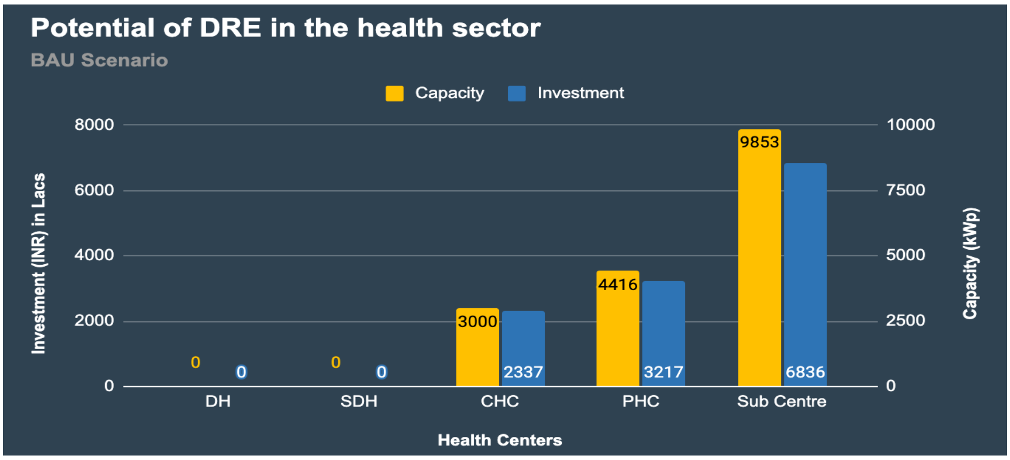


Figure 30: DRE Potential in Health sector in the BAU scenario

7.2 Optimistic Scenario

DRE can help save 559 crores with an investment of 250 crore

According to our analysis, in this scenario, the health sector has a potential of around 40MWp considering a battery backup provision at PHCs, CHCs, and SCs only thus attacking an investment potential of Rs. 250 crores.

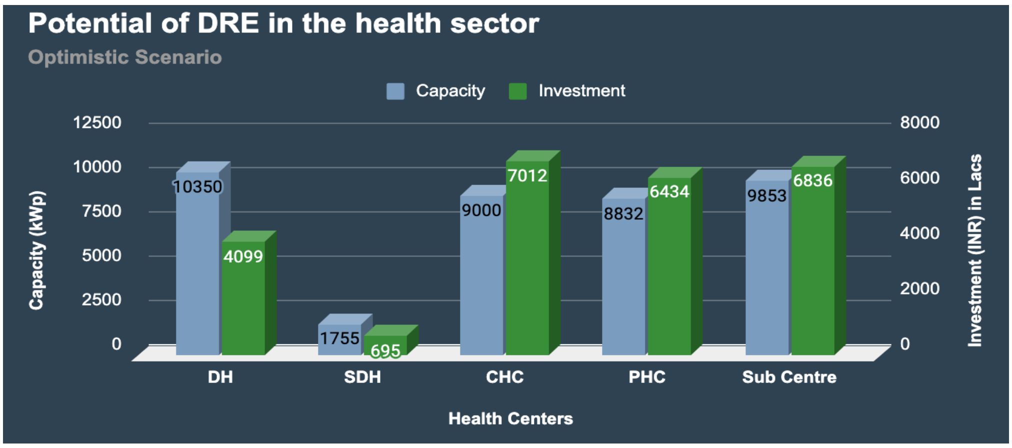


Figure 31: DRE Potential in Health sector in the optimistic scenario

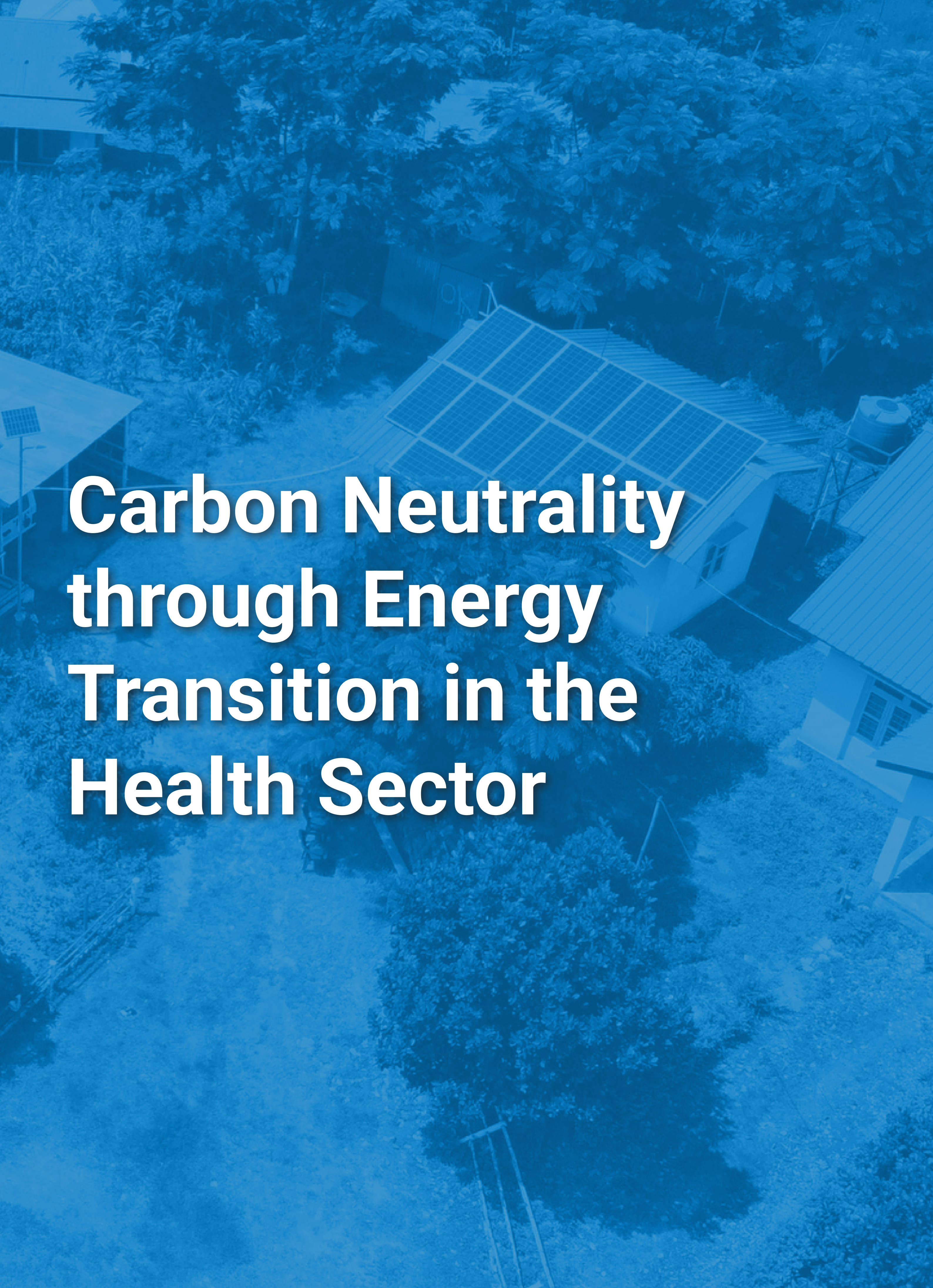
Renewable energy technologies have become more accessible for health facilities, both as primary and backup energy sources since their costs have decreased in recent years. While PV systems appear to have a restricted capacity, they do have a higher level of reliability. Energy projects in hospitals can range from stand-alone off-grid and micro-grid solutions that use a combination of renewable and fossil fuel-based technologies to large-scale grid expansion around centralized power plants.

With an infusion of DRE into the electrical load of health centers, the government not only can strengthen the health infrastructure but also strengthen the state air quality by reducing the carbon emission load by 0.4 million tonnes & 0.8 million tonnes in the BAU and optimistic scenario respectively. However, the investment so made can also help in saving Rs. 227 Cr and Rs. 559 Cr for the entire life of the solar plant planned in the BAU and optimistic scenario respectively i.e. in 25 years (Ref: Figure 30 and 31).

Table 10: DRE Roadmap for Health Sector (2022-2032)

FY	Energy Demand (BAU) kW	Energy Demand (Optimistic) kW	Cost of Supply (BAU) Crore	Cost of Supply (Optimistic) Crore	DRE Capacity Addition kW	DRE Investment Crore	Net Cost of Solar Power Crore	Net Savings for health department for the life of the plant (Crore)	DRE Capacity Addition kW	DRE Investment Crore	Net Cost of Solar Power Crore	Net Savings for health department for the life of the plant (Crore)
					BAU Scenario				Optimistic Scenario			
2022-23	21954	93496	111	471	1250	11	1.02	14	8360	4717	6.8	123
2023-24	45546	194079	230	978	2600	22	2.12	31	18305	10034	13.6	272
2024-25	70897	302286	357	1524	4100	34	3.34	49	21605	12631	21.7	313
2025-26	98140	418695	495	2110	5925	48	4.82	72	25330	15440	24.4	361
2026-27	127416	543929	642	2741	7215	58	5.87	88	27100	16795	27.4	384
2027-28	158439	677678	799	3415	8910	71	7.25	111	29275	18377	28.9	412
2028-29	191314	820521	964	4135	10647	83	8.67	134	31412	19853	30.6	441
2029-30	226152	973079	1140	4904	12717	96	10.35	163	34082	21606	32.4	477
2030-31	263069	1136010	1326	5725	14934	110	12.16	194	36899	23363	34.5	517
2031-32	302191	1310020	1523	6603	17269	124	14.06	227	39790	25076	36.8	559

*Cumulative data representation



Carbon Neutrality through Energy Transition in the Health Sector

8. Carbon Neutrality through DRE in the Health Sector

DRE can contribute in avoiding upto 0.8 million tons of CO2 emissions

In the face of climate change repercussions that have negatively impacted farm and non-farm activities, with droughts, floods, and other natural calamities affecting millions of people regularly, the DRE offers a compelling argument for a cleaner energy paradigm. DRE, being an environmentally friendly technology, has the potential to significantly contribute to achieving the SDGs related to poverty reduction, energy security, and a variety of environmental co-benefits. In this scenario, DRE shall be an effective medium to provide quality health services to its people all around the day thereby enhancing its health services considerably.

The transition to sustainable energy is centered on lowering energy-related CO2 emissions. Increased use of DRE and energy efficiency measures in the health sector may save nearly 0.4 million tonnes of CO2, the equivalent of driving 76,655 passenger cars for a year or burning 393,615,390 pounds of coal, according to our estimate. This is the same amount of carbon stored by 5,882,511 tree seedlings over ten years[22] (see Figure 32).

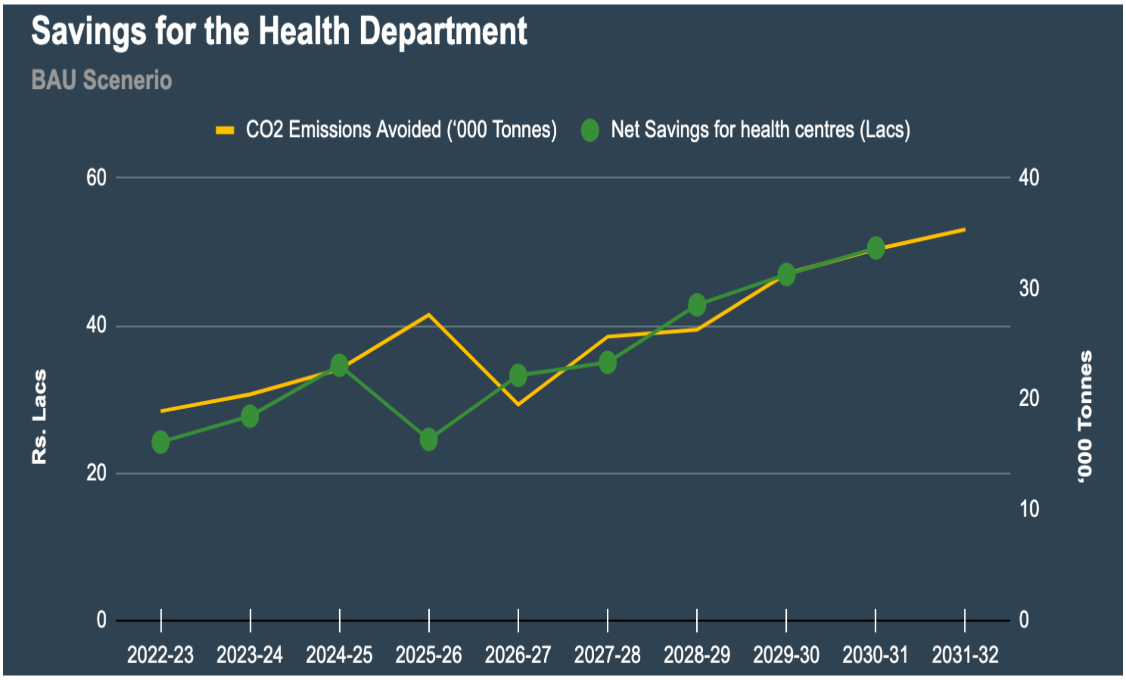


Figure 32: Savings in the State Health Sector in the BAU Scenario

The reduction of CO2 emissions from energy is the main goal of the switch to sustainable energy. We estimate that increased DRE and energy efficiency measures in the health sector may prevent the emission of roughly 0.8 million tonnes of CO2, which is the same as driving 147,762 passenger cars for a year or burning 758,738,808 pounds of coal. This is equivalent to the carbon sequestered over ten years by 11,339,214 tree seedlings (see Figure 30). This would contribute to India's objective of becoming net-zero by 2070 and decarbonizing the state's health sector.

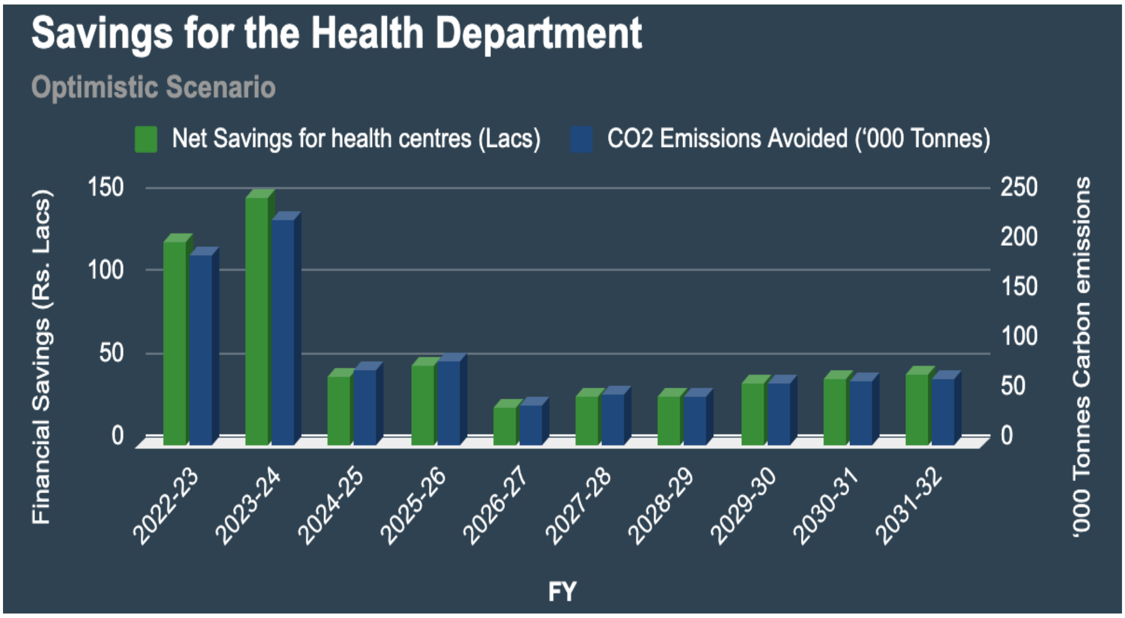


Figure 33: Savings in the State Health Sector in the Optimistic Scenario

Economics of DRE Infusion

9. Economics of DRE Infusion

Health care is one of the most energy-intensive sectors, with operations running 24 hours a day, seven days a week, and therefore availability of energy is critical to universal health care coverage. DRE has the potential to be a game-changer in bolstering Jharkhand's rural health infrastructure, as well as giving greater access to care during outbreaks such as Covid-19, which has put enormous strain on already overburdened health facilities. Sustainable energy, such as DRE, acts as a catalyst, challenging many established delivery paradigms in the process of expanding access to high-quality, dependable health care to the poorest members of society. DRE infusion into the health sector has the potential to add more than 17 MW to the state's renewable energy contribution, consequently strengthening and enhancing health services (Ref: Figure 34 and 35).

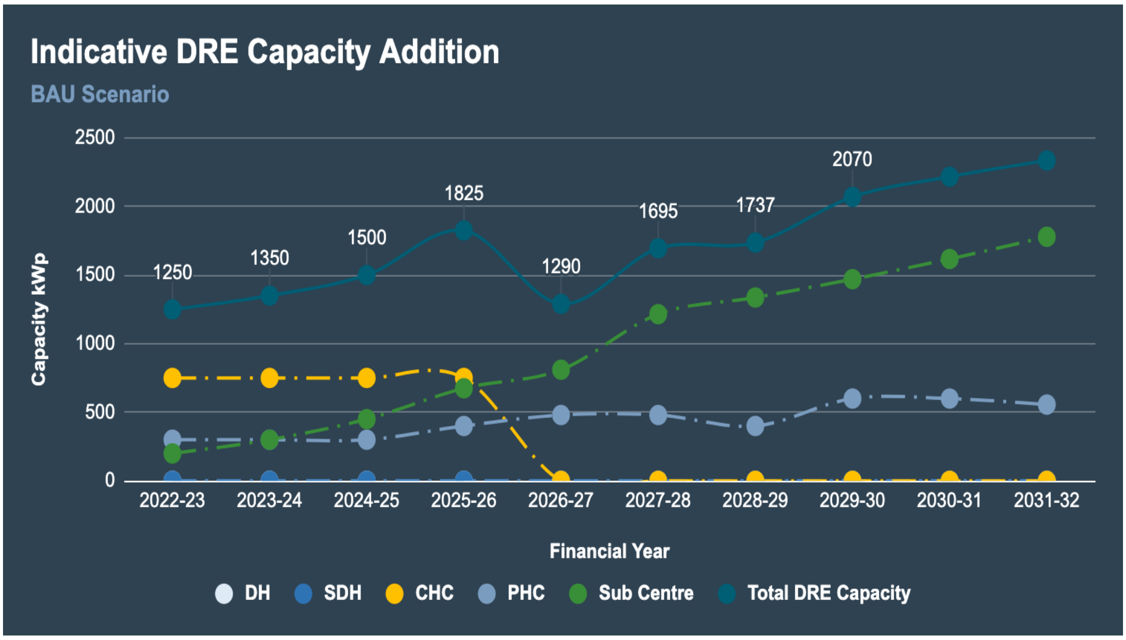


Figure 34: DRE potential in health sector in the BAU scenario

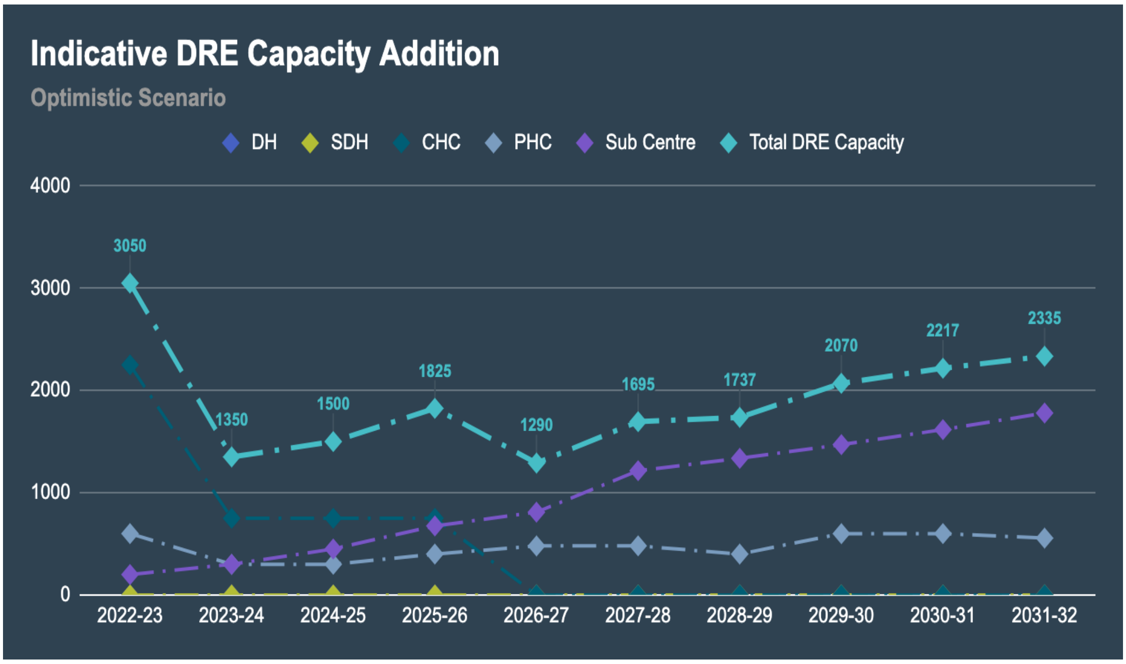


Figure 35: DRE potential in health sector in the optimistic scenario

9.1. DRE as a Budget-Friendly Opportunity

According to Brookings India's analysis of National Sample Survey Office (NSSO) data, India spends Rs 724 per person per year on health, while Jharkhand spends Rs 428 per person per year, less than half of the national average (Table 11). According to the study, Jharkhand has the biggest reliance on private healthcare among Indian states, with nearly 30 million people in the state facing catastrophic healthcare spending[23]. DRE, in combination with cost-effective medical equipment, a long-term service delivery strategy, and financing, can be utilized to revolutionize health care systems for less than USD 0.40 (INR 30) per person.[24]

These approaches can help save money on petroleum and energy while also improving access to timely and effective health care. It can also save money on a variety of out-of-pocket expenses in remote locations. The DRE can fix this issue for less than USD 0.40 (INR 30) per person as an initial capital investment.[25]

Table 11. Scenario of Health Expenditure

Category	Jharkhand	India
Spent on health per person per year	Rs. 428	Rs. 724
Proportion of private in-patient cases	45.7%	56.60%
Proportion of private out-patient cases	85.1%	74.50%
Population covered by health insurance	3.8%	15.20%
Household with catastrophic health expenditure	8.2%	13%
Source: Brookings India's analysis of NSSO data		

9.2. Economic profile for CHCs:

To make more economic sense, the solarization of community health centers has been described below, which appears to be quite impressive considering the payback period of only six years for a solar power plant with a six-hour battery backup. It's worth noting that, in the typical scenario, a CHC center would spend more than Rs 3 lakh every month just to run it professionally, which would include running a Diesel Generator set for power outages. However, an SPV system with backup can save around Rs 10 crore rupees over the plant's 25-year life.

Table 12. Load profile for Community Health Center (CHC) in Jharkhand

LOAD PROFILE FOR CHC		Units
Sanctioned Load	60	kW
Avg. Unit consumed(kWh) per month	32400	kWh
Avg. Units consumed (kWh) yearly	388800	kWh
Backup Source(DG Set)	30	kVA
Hour of Operation of DG Set	8	Hours /Day
Avg. Diesel Consumption Cost per month	155131.2	Rs.
Average Electricity Bill per month	2,26,800	Rs.
Average Electricity bill plus back up cost monthly	3,81,931	Rs
Average Electricity bill plus back up cost yearly	45,83,174	Rs.
Average Electricity bill plus back up cost (In 25 Years)	11,45,79,360	Rs.

Table 13. Finance profile for Community Health Center (CHC) in Jharkhand

FINANCIAL ASSESSMENT FOR CHC WITH BATTERY BACKUP		
CAPEX MODEL		
Cost of the Plant	25,20,000	Rs.
Average Tariff considered	7	Rs. per kWh
Cost of Generation from Plant		
Monthly	23,940	Rs.
Annually	2,87,280	Rs.
Lifetime (25 years)	71,82,000	Rs.
Payback Period	6	years
Total Savings on Investment	9,70,09,856	Rs.

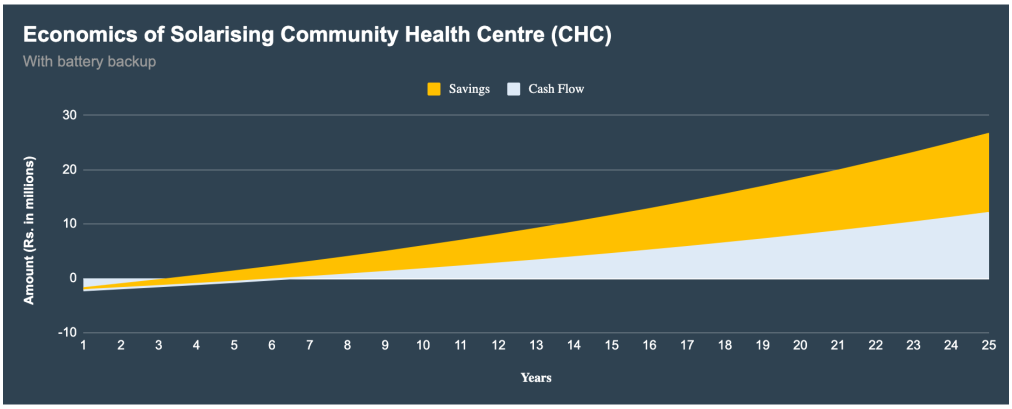


Figure 36: Economic Profile for CHC in Jharkhand

9.3. Economic profile for HSCs:

With 6 hours of battery support and fast payback of 7 years, solarizing a Health Sub-Center can help save roughly Rs 57 lakh during the life of the plant (Table 14, 15, and Figure 37). HSCs are the initial point of contact with the community; the success of any national program would rely heavily on well-functioning Sub-centers providing people with services of acceptable quality.

Table 14. Load profile for Health Sub-Center (HSC) in Jharkhand

LOAD PROFILE FOR HSC		Units
CAPACITY OF PLANT CAN BE INSTALLED (ACCORDING TO SANCTIONED LOAD)	2	kW
**1kWp solar rooftop plant will generate 4.6 kWh of electricity per day (considering 5.5 sunshine hours)		
Total Electricity generation from plant		
Monthly	228	kWh
Annual (Considering 300 Sunny Days)	2736	kWh
Lifetime (25 Years)	57730	kWh

Table 15. Finance profile for Health Sub-Center (HSC) in Jharkhand

FINANCIAL ASSESSMENT FOR HSC WITH BATTERY BACKUP		
Cost of plant	1,88,000	Rs.
Average Tariff considered	7	Rs. per kWh
Cost of Generation from Plant	(2kWp)*	
Monthly	1,596	Rs.
Annually	19,152	Rs.
Lifetime (25 years)	4,78,800	years
Payback Period	7	Years
Total Savings on Investment	57,17,664	Rs.

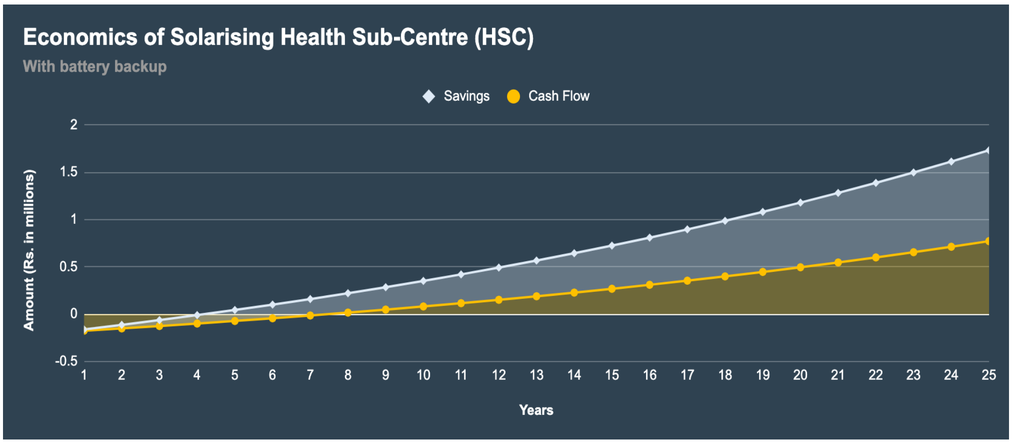


Figure 37. Economic profile for Health Sub-Center (HSC) in Jharkhand

9.4 Economic profile for PHCs:

With battery support, solarizing a Health Sub-Center can save roughly Rs 1.5 crores over the plant's lifetime, with a 6-year payback (Table16, 17 and Figure 38). Preventive, promotive, basic curative, palliative, and rehabilitative care are mostly provided through Primary Health Centers, which cater to both community and programmatic needs. Sub-centers and primary health centers in rural areas and Urban Primary Health Centers in urban areas have previously provided primary healthcare services in India.

Table 16. Load profile for Primary Health Center (PHC) in Jharkhand

LOAD PROFILE FOR HSC		Units
CAPACITY OF PLANT CAN BE INSTALLED (ACCORDING TO SANCTIONED LOAD)	5	kW
**1kWp solar rooftop plant will generate 4.6 kWh of electricity per day (considering 5.5 sunshine hours)		
Total Electricity generation from plant		
Monthly	570	kWh
Annual (Considering 300 Sunny Days)	6840	kWh
Lifetime (25 Years)	144324	kWh

Table 17. Finance profile for Primary Health Center (PHC) in Jharkhand

Financial Assessment for CHC with battery backup		
Cost of plant	4,70,000	Rs.
Average Tariff considered	7	Rs. per kWh
Cost of Generation from Plant	(5kWp)*	
Monthly	3,990	Rs.
Annually	47,880	Rs.
Lifetime (25 years)	10,10,268	years
Payback Period	6	Years
Total Savings on Investment	1,49,18,309	Rs.

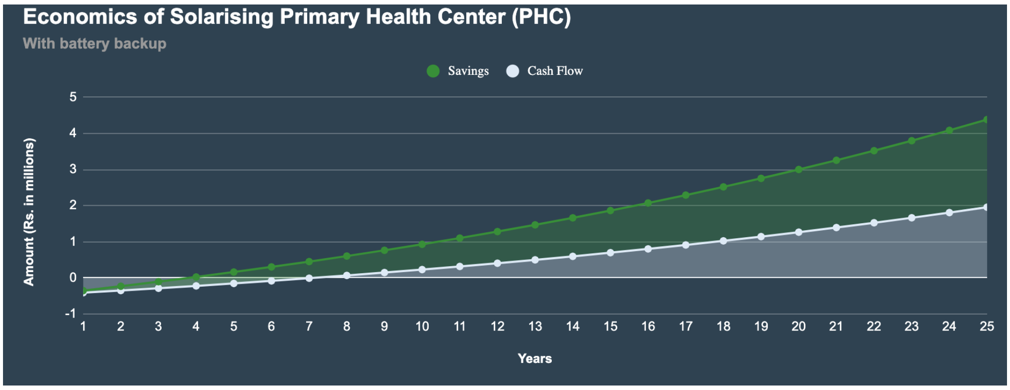


Figure 38. Economic profile for Primary Health Center (PHC) in Jharkhand

Enabling Ecosystem for Strengthening Health Infrastructure

10. Enabling Ecosystem for Strengthening Health Infrastructure

Considering the current status of health infrastructure, Jharkhand urgently needs to bring in an ecosystem that takes a holistic approach to a comprehensive public health system with improving energy access across all levels for rendering effective service delivery to the people in dire need.

10.1 Policy Framework for Strengthening Health-Energy Integration

Traditionally, infrastructure for healthcare largely includes equipment and physical building, however, as the Indian Public Health Standards lays emphasis on electricity availability it brings energy as one of the main elements in the idea of health service delivery. It calls for creating policies that encourage and reward collaboration between state-level health and renewable energy departments, which leads to the adoption of distributed renewables and the realization of universal health care for all.

The integration of health and energy can be viewed from two perspectives: first, assuring the supply of necessary health services with greater power access, and second, improving health services leading to better electricity utilization. Despite the intertwined relationship between the energy and health sectors, they are frequently treated separately and rarely collaborate in practice. Collaboration between the health and energy sectors is critical to fully exploit the promise of renewable energy for health care organizations. A strong energy supply ecosystem, which includes laws, rules, regulations, markets, and institutions, is also required for effective energy delivery. This ecosystem must enable equal access to energy and its efficient usage.

It is also important to note that partnering agencies such as bilateral and multilateral donors/funders, academia, research think tanks, knowledge, and technical partners, and actors from outside of governance systems such as civil society organizations and community-based organizations all contribute their expertise, domain knowledge, and concerns, demands, and suggestions through a variety of mechanisms. As a result, Jharkhand needs a clearly-defined strategy for integrating health and energy, as well as an enabling structure that takes a multi-stakeholder and convergent approach to achieve universal health coverage.

A statewide program 'Solarization of Health infrastructure' should be started to install distributed solar energy systems in all government-owned public health care centers in revenue village, Gram Panchayat, Block, sub-division, and district level to provide reliable round-the-clock power supply cost-effectively to ensure continuous primary and secondary healthcare services. The program covers all aspects of healthcare infrastructure including healthcare centers, hospitals; medical, para-medical & non-medical staff quarters; pathology laboratories, and nutrition centers.

Similarly, a special scheme "Solar for Mother & Child Health" should be launched with a focus on the solar cold chain for the vaccine, solar-powered labor rooms, solar-powered ambulances along with necessary equipment under the supervision of well-trained ANM and support staff.

10.2 Access to Finance to Upscale DRE Models

Health is a subject in the concurrent list of the Indian Constitution, hence the Union and

States both have legislative and financial oversight. However, the central government is the key actor in designing health policies and programs due to its greater spending ability and availability of better technical resources. Health financing is important for funding health projects for obvious reasons e.g. access through prepayment and pooling of funds in preference to direct out-of-pocket payments and using funds for promoting efficiency and equity.[26] Generally, health-related funding is released through two channels[27], i.e; through the state budget and directly through the State Health Society or NHM.

However, one of the deepening concerns is that India's (and Jharkhand as well) health care system is characterized by low levels of spending.[28] According to the National Health Profile-2018, India is amongst the countries with the least public health spending trend, despite the recurrent demand from various quarters that it must be a minimum of 8% of the GDP.

As per a study, Jharkhand spent Rs 428 per capita on health, which is considerably less than the Indian average and equal to spending 1.33 percent of its GDP on health.[29] Another study[30] indicates that health expenditure trends in Jharkhand between 2007-08 and 2013-14 have been very low actual spending along with low budgets, where a large portion of the budget was unused. Thus, it gives an impression that resource scarcity is compounded by low budget utilization, which impacts the overall performance of the health sector. Therefore, the state machinery efficiency needs to enhance its ability to spend money more effectively.

A dedicated state fund should be provisioned that will strengthen the health centers making them self-reliant in wider adoption of solar applications and doing away with diesel Genset. Additionally, adequate financing can be explored through bilateral and multilateral aid from development agencies, foreign funding from philanthropic foundations, corporate social responsibility supports, and private domestic foundations.

10.3 Access to Innovative Technology and Capacity Building Measures

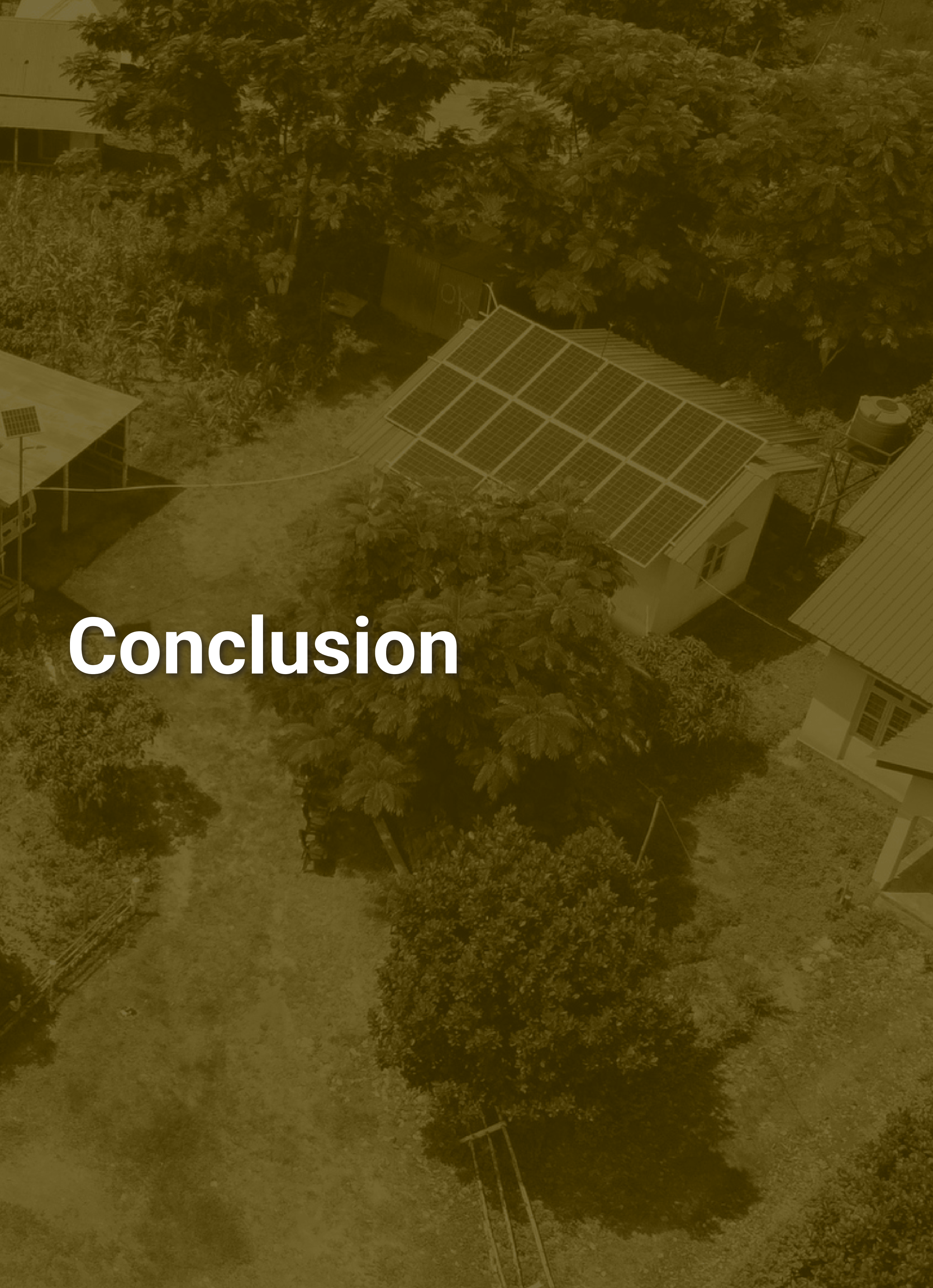
Various models, like Chhattisgarh and North-East states, have given impetus to the solarization of health facilities in India.[31] These models have emphasized that energy-efficient medical devices have the potential to generate considerable savings for health facilities in resource-constrained environments. In this scenario, government support, as well as a public-private partnership, can be directed towards procuring more energy-efficient medical equipment in health facilities that usually suffer from power intermittencies. The majority of medical devices in the market today are extremely inefficient in terms of power use thus raising the financial burden. It is important to encourage manufacturers to build more reliable, ruggedized appliances suitable for rural health services.[32] Giving due prominence to climate change and human health, incentivizing the usage of energy efficiency standards and green building codes should be promoted.

Moreover, capacitation and operation & management are the key to ensuring a techno-friendly environment in health institutions. So, adequate training of health center staff on basic PV system maintenance for system efficiency and on-site troubleshooting is highly required. This can enhance and build the overall capacity of the rural health system to effectively handle increased load and efficient service accordingly.[33] This can be facilitated by laying suitable terms of service contracts between private DRE providers and the state health mission, the state renewable energy agency (e.g. JREDA), which can take care of the maintenance of technological systems and other equipment for better services.

10.4 Auditing, Planning, Monitoring, and Evaluation

As most of the health centers in the state follow IPHS guidelines in the true sense, it is necessary to enhance the check and balance criteria for the proper functioning of the health centers. Using the state action plans' climate change and human health focus, the state shall disincentivize the usage of backup diesel generators for health centers in favor of solar PV installations (while also incentivizing the use of energy efficiency standards and green building codes).

Mandatory health center audits shall be conducted to match the size of solar PV systems to the medical equipment required in a specific site, depending on population density and the area's electricity load). The department shall define KPIs for each facility based on the National Health Ministry's checklist, which includes thorough technical criteria (e.g., equipment for maternal and child health, immunization and cold storage, running water, adequate lighting, and internet connectivity for telemedicine services).



Conclusion

11. Conclusion and the Key Recommendations

Decentralized Renewable Energy (DRE) solutions can play a vital role in the development of the health sector because they are well suited for diverse terrain and hamlets of sparsely located habitats in Jharkhand and they can be customized in innovative ways. Accelerated deployment of renewable energy to strengthen health care centers and recalibrate the public health infrastructure is the need of the hour.

- There must be a robust policy mechanism for Health and Energy integration and the creation of an enabling atmosphere that takes into consideration prevailing issues, systematic gaps, and priorities with the prism of energy access for ensuring better health services to the people.
- National Health Policy-2017 aims [34] to increase public spending up to 8% of GDP for State governments and this can be implemented at a priority level since more funding for the health sector will solve many riddles of procuring resources and help out in managing the finances for more infrastructure projects, technological up-gradation, and sound human resource management in place.
- 'Solarization of Healthcare' is much needed and a specific program should be launched to install distributed solar energy systems in all government-owned public health care centers in revenue villages, block blocks, sub-division, and district levels to ensure primary and secondary healthcare services.
- To prevent maternally and child mortality from lack of vaccinations and institutional delivery facilities, a scheme "Solar for Mother & Child Health" should be launched with a focus on the solar cold chain for the vaccine, solar-powered labor rooms, solar-powered ambulances along with necessary equipment under the supervision of well-trained ANM and support staff.
- The MNRE-led 'Off-grid and Decentralized Solar PV Applications program' should take due consideration of success stories witnessed in Chhattisgarh and speed up the deployment of renewable energy to power all PHCs and SCs at the state level.
- All public health centers must meet the Indian Public Health Standards criteria, where road, communication and trained and skilled medical staff should be provided. Similarly, all PHCs and CHCs must be equipped with clean energy-based medical devices, cold chain facilities, water heating, and essential lighting services.
- There should be certain measures that contribute to aligning the goals of the NHM and the Energy Department to meet shared objectives. Similarly, convergent roles of inter-aligned departments for overall health and human development should be ensured with a clear vision.
- Private financing and philanthropic grants from every possible means must be channelized for ensuring proper funding for energizing the health sector. Promote incentives and reward cooperation between the public-private partnership for the implementation of distributed renewables.
- The crisis of Covid-19 has compelled the government and policymakers to rethink the current state of health affairs and devote more resources to strengthening public health facilities. Thus, the fresh push for a new policy and roadmap has been well-positioned than ever before. This makes ample opportunity for the solarization process of the health care system which will address the twin objectives of enhancing energy security in the health institutions and simultaneously increasing access to health services to the people in dire need.

12. References

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