

# SOLARIZING HEALTHCARE

**A Guidebook for Healthcare Facilities to Shift to Renewable Energy**

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In Collaboration with



**Chhattisgarh State Renewable  
Energy Development Agency**  
(Dept. of Energy, Govt. of Chhattisgarh)



## ACKNOWLEDGEMENT

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### Supported by



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**ABBREVIATIONS**

|                       |   |
|-----------------------|---|
| <b>Ah</b>             | <i>Ampere hour</i>  |
| <b>BLDC</b>           | <i>Brushless DC Electric Motor</i>                            |
| <b>CFL</b>            | <i>Compact Fluorescent Lamp</i>                               |
| <b>CHC</b>            | <i>Community Health Center</i>                                |
| <b>CO<sub>2</sub></b> | <i>Carbon Dioxide</i>   |
| <b>CREDA</b>          | <i>Chhattisgarh State Renewable Energy Development Agency</i> |
| <b>GST</b>            | <i>Goods and Services Tax</i>                                 |
| <b>kWp</b>            | <i>Kilowatts Peak</i>   |
| <b>LED</b>            | <i>Light-emitting Diode</i>                                   |
| <b>LFP</b>            | <i>Lithium Ferro Phosphate Batteries</i>                      |
| <b>LMLA</b>           | <i>Low Maintenance Lead Acid battery</i>                      |
| <b>MNRE</b>           | <i>Ministry of New and Renewable Energy</i>                   |
| <b>NHM</b>            | <i>National Health Mission</i>                                |
| <b>NSM</b>            | <i>National Solar Mission</i>                                 |
| <b>OREDA</b>          | <i>Odisha Renewable Energy Development Agency</i>             |
| <b>OT</b>             | <i>Operation Theatre</i>                                      |
| <b>PEDA</b>           | <i>Punjab Energy Development Agency</i>                       |
| <b>PHC</b>            | <i>Primary Healthcare Centres</i>                             |
| <b>PV</b>             | <i>Photovoltaic</i>   |
| <b>RO</b>             | <i>Reverse Osmosis</i>  |
| <b>SPV</b>            | <i>Solar Photovoltaic</i>                                     |
| <b>SPVPP</b>          | <i>Solar Photovoltaic Power Plants</i>                        |
| <b>V</b>              | <i>Voltage</i>  |
| <b>VRLA/T-gel</b>     | <i>Valve Regulated Lead Acid/Tubular Gel Batteries</i>        |
| <b>Wp</b>             | <i>Watt-peak</i>  |

## MEANINGS AND DEFINITIONS

|   |   |
|---|---|
| <p><b>Kilowatt-peak</b></p> <p>It corresponds to the maximum electrical power that can be supplied by a photovoltaic panel under standard temperature and sunlight conditions. 1 kWp = 1,000 Wp <sup>1</sup></p>  | <p><b>Solar Modules</b></p> <p>A single photovoltaic Module/Panel is an assembly of connected solar cells that will absorb sunlight as a source of energy to develop electricity. <sup>2</sup></p>  |
| <p><b>Sustainable development goals (SDG)</b></p> <p>The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.</p> <p>The 17 SDGs are integrated—they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. <sup>3</sup></p> |   |
| <p><b>CO<sub>2</sub></b></p> <p>Carbon Dioxide is a colourless, odourless, incombustible gas resulting from the oxidation of carbon. <sup>4</sup></p>   | <p><b>Wp</b></p> <p>The capacity of a solar installation is expressed in watt peak (Wp). This is the maximum electrical capacity that a solar cell can yield under ideal circumstances: a solar collector directed towards the sun in a cloudless sky. <sup>5</sup></p> |
| <p><b>MNRE</b></p> <p>The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. <sup>6</sup></p>   |   |

1. What is the kilowatt-peak? [Internet]. Energuide. 2022 .  
Available from: <https://www.energuide.be/en/questions-answers/what-is-the-kilowatt-peak/1409/>
2. Sustainable Development Goals | United Nations Development Programme [Internet]. UNDP.  
Available from: <https://www.undp.org/sustainable-development-goals>
3. What is Solar Module? Types of Solar Modules | SolarSmith Energy [Internet]. SolarSmith Energy.  
Available from: <https://www.solarsmiths.com/blog/what-is-solar-module-types-of-solar-modules/>
4. National Center for Biotechnology Information (2022). PubChem Compound Summary for CID 280, Carbon dioxide. Retrieved August 1, 2022 from <https://pubchem.ncbi.nlm.nih.gov/compound/Carbon-dioxide>.
5. What is a solar panel and how does it work?. Energuide.  
Available from: <https://www.energuide.be/en/questions-answers/what-is-a-solar-panel-and-how-does-it-work/136>
6. Ministry of New and Renewable Energy (MNRE) [Internet].  
Available from: <https://mnre.gov.in/>

## **NO WOMAN**

should give birth in the dark.

## **NO SURGERY**

should be carried out by candlelight.

## **NO CHILD**

should be left vulnerable to disease  
because vaccines cannot be refrigerated.

For too long, a lack of reliable power has prevented people in remote and rural communities from accessing the healthcare they need.<sup>7</sup>

*"Solar for Health"* Initiative

United Nations Development Programme

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7. *Solar for health - United Nations Development Programme* | UNDP.  
Available from: <https://stories.undp.org/solar-for-health>



In April 2020, representatives of India's healthcare and renewable energy sectors wrote a letter to the Indian government requesting swift action for solarizing around 39,000 health centers across rural India. Chhattisgarh is an Indian state that solarized most of its health centers. Chhattisgarh offers a model for other states to follow. The state is home to 790 functioning primary health centers, many of which face regular power outages at peak patient times during the day (from 12 pm to 4 pm). The state embarked on an innovative green energy path to make health centers more efficient by using solar power. Chhattisgarh installed two kilowatts peak (kWp) off-grid solar photovoltaic (PV) rooftop systems across 570 primary healthcare centers (around 72 percent of all functioning centers) through the Chhattisgarh State Renewable Energy Development Agency (CREDA).<sup>8</sup>



8. D'Rozario A. *Solarizing India's Healthcare System*. Csis.org. 2021.

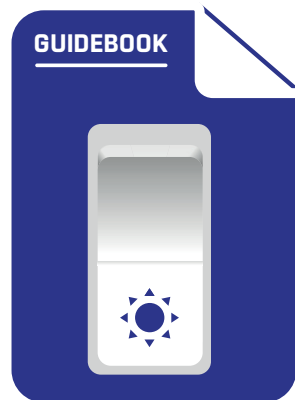
Available from: <https://www.csis.org/blogs/new-perspectives-asia/solarizing-indias-healthcare-system#:~:text=Cost%2Dsaving%20benefits%3A%20Using%20the,measures%20will%20help%20lower%20costs.>

In 2017, an Oxfam India study evaluated the role of electricity access on health outcomes in rural Chhattisgarh. The study establishes a strong correlation between sustainable development goals (SDG), focusing on good health and well-being (Goal 3), and focusing on affordable and clean energy (Goal 7). The study is based on an evaluation of 147 primary healthcare centres (PHCs), including 83 having solar photovoltaic (PV) systems, across 15 districts in Chhattisgarh. The study points out that solar for healthcare is an opportunity to simultaneously address the (often competing) goals of energy access, energy security, resource management, and health outcomes.

The study recommended including electricity access as a critical component in health infrastructure while drafting policies. To augment electricity supply with solar systems and give priority to power-deficit health facilities, especially those providing 24x7 services. Tailor-made solar system designs based on local needs and considerations were prepared to equip PHCs with off-grid solar systems. Conducting regular monitoring and repair of all systems was also recommended. Finally, the need to scale solar across health centres in India to meet the targets of both the National Solar Mission (NSM) and the National Health Mission (NHM).<sup>9</sup>

## AIM

Solarization of the public healthcare facilities as an integral part of the health system to provide universal healthcare to the population in Chhattisgarh.



## OBJECTIVES

- To bridge the gap between the healthcare workforce and the technicality of solarization of healthcare facilities to provide quality and uninterrupted healthcare services.
- To address the frequently asked questions by the healthcare workforce about solarizing the healthcare facility.
- To technically and systematically choose solarisation as a choice of energy in healthcare facilities by the healthcare workforce.

## METHODOLOGY

- The staff at SHRC, Raipur and CREDA made multiple visits to the public healthcare facilities in Chhattisgarh to understand the progress and status of solarisation in these facilities.
- These visits helped identify the gains and gaps of the solarisation process in healthcare facilities.
- This gave rise to a need to develop a simple guidance document to facilitate the solarisation process.
- In addition to the findings from the field visits, the recommendations from the assessment report titled 'Solarization and Public Health Facility of Chhattisgarh 2021' was also used in formulating this document.
- Following literature reviews and field visits by the authors, the frequently asked questions were identified and the answers were framed with the support of the technical experts in CREDA.

9. Ramji A, Patnaik S, Mani S. Powering Primary Healthcare through Solar in India [Internet]. COUNCIL ON ENERGY, ENVIRONMENT AND WATER (CEEW). Available from: <https://www.ceew.in/publications/powering-primary-healthcare-through-solar-india>



## Frequently Asked Questions

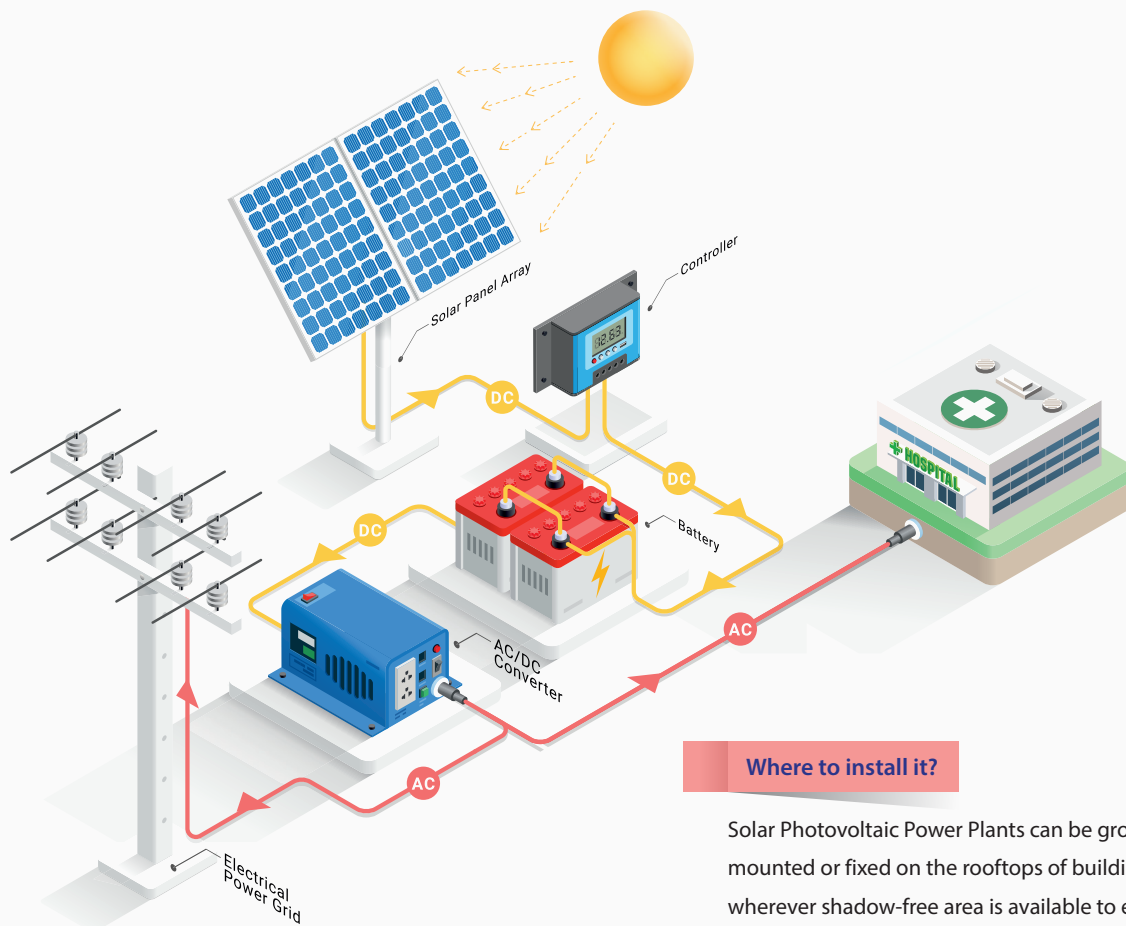


### Solar Photovoltaic (PV) System

#### What is Solar Photovoltaic System?

Photovoltaic systems contain cells that convert sunlight into electricity. Inside each cell, there are layers of a semi-conducting material. Light falling on the cell creates an electric field across the layers, causing electricity to flow. The intensity of the light determines the amount of electrical power each cell generates. A photovoltaic system does not need bright sunlight in order to operate. It can also generate electricity on cloudy and rainy days from reflected sunlight.<sup>10</sup>

#### How does it work?



#### Where to install it?

Solar Photovoltaic Power Plants can be ground mounted or fixed on the rooftops of buildings wherever shadow-free area is available to ensure proper solar irradiance.

#### Who will install it?

A trained team who has expertise in the installation of Solar Photovoltaic systems executes the work. Usually System Integrators/Contractors/Agencies selected through competitive bidding or empanelled by state nodal agencies such as CREDA/PEDA/OREDA etc.

10. Solar Generation 6, Solar Photovoltaic Electricity Empowering the World. Presentation presented at; 2011.

<https://www.greenpeace.org/static/planet4-netherlands-stateless/2018/06/Final-SolarGeneration-VI-full-report-lr.pdf>

## Frequently Asked Questions

### What is the lifespan of a Solar Photovoltaic (PV) system?

Usually, the life span of SPV systems depends upon the operational life of the system components i.e. Solar Modules, Inverters and Batteries. As per Govt. guidelines, Solar Modules should be warranted for 10 years and other components for five years.

### What is the difference between on-Grid and off-Grid electrical supply?

“On-Grid” receives electricity from the grid supply. The electrical grid is the intricate system designed to provide electricity all the way from its generation to the customers that use it for their daily needs. These systems have grown from small local designs to stretching thousands of kilometres and connecting millions of homes and businesses today. The grid consists of countless complex interconnections, however, there are three main sections—electricity generation, transmission and distribution. Grid-connected buildings receive electricity from power plants, which mainly use natural resources such as coal and natural gas as energy to convert into electrical power.<sup>11</sup>

On-grid generates power using a solar power system and is working in conjunction with the national grid . In the case of an installation, the system could be placed on the roof or any safe ground area around the hospital that receives good sunlight. From this configuration, the actual customer receives electricity from two sources. On bright sunny days, the solar system will feed power to the house and at night or during cloudy days, the local utility company will supply electricity from the grid to the hospital.

The term “off-the-grid” traditionally refers to not being connected to the electrical grid, and the power is generated onsite through a renewable resource. The three main methods of off-grid power production are solar, wind, and micro-hydro.<sup>12</sup> Any excess electricity supplied is stored in batteries and can be reused at night. Solar photovoltaics (PV), which use energy from the sun, is one of the most popular energy solutions for off-grid buildings.<sup>13</sup>



## Benefits of Using Solar Photovoltaic (PV) System

### How can the health facility benefit from using solar photovoltaic systems?



#### Continues electric supply

An SPV system provides continuous or 24 hour power supply, which is especially useful in rural and remote areas where there is a shortage of electricity and voltage fluctuation. So that the hospital has the power supply both day and night.



#### Lighting

SPV system provides continuous light supply at the hospital, which helps in improved quality care. In rural areas, along with the hospital nearby communities are also benefited from solar. When there is no power supply at night, power is provided from the hospital as an extension to a common point in the village.

11. Electrical grid - Energy Education [Internet]. Energyeducation.ca. Available from: [https://energyeducation.ca/encyclopedia/Electrical\\_grid](https://energyeducation.ca/encyclopedia/Electrical_grid)

12. Off-the-grid - Wikipedia [Internet]. En.wikipedia.org. Available from: <https://en.wikipedia.org/wiki/Off-the-grid>

13. Electrical grid - Wikipedia [Internet]. En.wikipedia.org. Available from: [https://en.wikipedia.org/wiki/Electrical\\_grid](https://en.wikipedia.org/wiki/Electrical_grid)



### Connectivity

In remote health centres, continuous electricity supply improves staff communication by improving charging and connectivity of their mobile phones and other devices. It provides the possibility of advanced treatment options such as telemedicine etc. The continuous electricity supply also makes staff feel safe thereby leading to better retention. Communities near the hospital are also benefiting from the power supply since their mobile phones can be charged at night when there is no electricity.



### Transportation

Solar-powered ambulances have the potential to become a form of independent transportation during emergencies. Vehicles and ambulances powered by solar energy can provide uninterrupted movement of supplies and transfer of patients in times of disasters.



### Health System Resilience

Photovoltaic power systems provide emission-free electricity fueled by the sun which is reliable, secure, noise free, and does not need refuelling. PV systems have an extremely low CO<sub>2</sub> emission per kWh of electricity generated. They are considered an important technology to slow down global warming due to the increased greenhouse effect. They provide clean and sustainable electricity to the world. Clean electricity contributes to international targets to cut emissions and mitigate climate change.<sup>15</sup> By switching hospitals to solar energy, it makes health systems better prepared for extreme weather events and makes them more resilient.



### Cost Reduction

The energy it takes to make a solar power system is usually recouped by the energy costs saved over one to three years.<sup>14</sup> With the SPV system, the hospital will produce electricity, so the cost of purchasing electricity will be reduced, ultimately helping patients reduce healthcare costs.



### During Disasters

When a serious disaster strikes, local electrical power in most cases is the first utility to be affected, at least temporarily. Disruption of electricity can last for weeks on end as transmission lines are repaired. Solar powered hospitals can serve as a point of reference for communities during medical emergencies because they have continuous power supplies during disasters. Thereby deaths can be averted. During disasters, these hospitals will be able to broadcast public safety information in the hospitals.



## Cost of Solar Photovoltaic (PV) System

### What is the cost of installation of a solar PV system?

As per MNRE, the cost of Supply, installation & commissioning of Solar Power Plant ranges from Rs.94 per Wp (with minimum 6hr of battery backup). However, if we design the battery bank compatible with the energy load available at Primary and Community health centers then, the price shall be as mentioned below:

| Type of Health Centre   | System Specification | Amount in Rs. (Excluding GST) |
|-------------------------|----------------------|-------------------------------|
| Sub-health Centre       | 1200Wp/120Ah/48V     | 1,67,000 7.18                 |
| Primary Health Centre   | 2400Wp/300Ah/48V     | 3,26,340 7.35                 |
| Community Health Centre | 10,000Wp/600Ah/120V  | 11,92,000 8.38                |

The above systems are designed with one full day autonomy.

14. Solar Generation 6, Solar Photovoltaic Electricity Empowering the World. Presentation presented at; 2011.

<https://www.greenpeace.org/static/planet4-netherlands-stateless/2018/06/Final-SolarGeneration-VI-full-report-lr.pdf>

15. Solar Generation 6, Solar Photovoltaic Electricity Empowering the World. Presentation presented at; 2011.

<https://www.greenpeace.org/static/planet4-netherlands-stateless/2018/06/Final-SolarGeneration-VI-full-report-lr.pdf>

## Frequently Asked Questions

### How much is the cost of maintenance of this system?

The cost of maintenance of an off-grid (standalone) power plant ranges from Rs. 4-5 per watt per year with an escalation of 5% per year.



### Service and Maintenance

#### How often should SPV systems be serviced and maintained?

Preventive and predictive maintenance is required to ensure 100% functionality of the solar power plant and to avoid breakdown maintenance. Usually, weekly cleaning of solar modules, and quarterly thorough inspection of other components will reduce the chances of breakdown maintenance. Hence we can say that, one periodic maintenance activity to be performed once every month.

#### Who will be responsible for servicing and maintaining the SPV system?

Installation agency will train the health centre professional or employee for regular operation and weekly cleaning of solar modules whereas the monthly servicing and maintenance shall be in the scope of the installation agency or service units deployed by state nodal agencies as per their policy/guidelines.



### Capacity

#### How much power will be generated from a Solar Photovoltaic (PV) system?

A perfectly designed off-grid solar photovoltaic power plant will generate theoretically 4 units (kWh) of power per kW per day, i.e., a 1kWp Solar Power Plant will generate 4 units per day and a 2kWp solar power plant will generate 8 units per day and so on.

#### For hospitals (PHC, CHC, Speciality Hospitals, Medical Colleges), what type of batteries and capacity should be used when it is connected to a PV system?

The selection of chemistry, capacity and batteries depends on the nature of the load to be catered through the battery bank and geographical conditions. Usually, **three types of battery** chemistry are used with solar power plants.



**LMLA: Low Maintenance Lead Acid battery (flooded)**

**VRLA/T-gel: Valve regulated Lead Acid/Tubular gel batteries**

**LFP: Lithium Ferro Phosphate batteries**

Currently, all the systems are installed with LMLA battery banks due to their rigid uses and ease of maintenance. Now, in urban areas where SPV plants are being installed with LFP and T-gel batteries also. Certainly, as LFP is near and upcoming technology it will increase the overall cost of the SPV power plant. Hence, LMLA is the most cost-effective option.

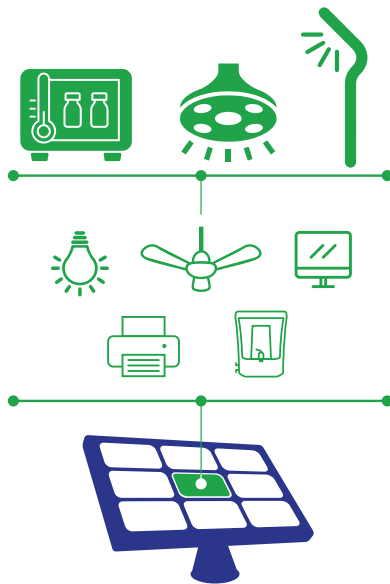
### What is the size of the space required for installing SPV panels and batteries?

For the installation of the solar power plant of one KWp capacity a shadow-free area of 100-120 sq mt is required and for battery bank and inverters a minimum of 36 sq ft area is required.



## Solar Power Driven Equipment

### Which hospital equipment can be connected to a solar photovoltaic system (PV)?



Lights, fans, computers, printers, deep freezers, OT lights, RO water system and any other devices based on the capacity of a solar power plant can be connected.

### Among the hospital equipment to be connected to SPV first, what should be prioritised?

Emergency equipment such as vaccine refrigerators, OT lights and outdoor lights are the priority load that usually should be connected to the solar power plant.

### How long can it support these equipment in a day?

Lights, fans, computers, printers, deep freezers, OT lights, RO water system and any other devices based on the capacity of a solar power plant can be connected.



## Training to Use Solar Photovoltaic (PV) System

### What will the training be given for?

Training is provided to health professionals on solar photovoltaic systems, their importance, how to operate and use them etc.

### Who will provide training for health professionals?

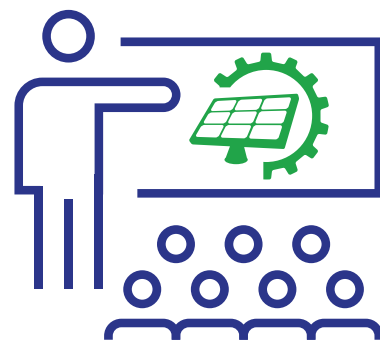
The installation agency or state nodal agency will provide the training.

### Who in the hospital will get the training?

The training will be provided for the hospital incharge to raise awareness on SPV as well as for down-the-line staff for the operation and cleaning of solar modules.

### How frequent will the training be provided?

The training will be provided once a year as per the policy of the state nodal agency.



## Frequently Asked Questions

### Is there any specific person appointed from the hospital to take care of the system?

It is very necessary for the hospital to appoint a nodal contact person who will ensure regular cleaning and maintenance of the solar power plant.



### Standards and Protocol

### What are the specific standards and protocols for the type of panels, batteries and their usage?

The Ministry of New and Renewable Energy (MNRE) is implementing a quality control order on SPV systems, Devices and components Goods Order 2017 under the BIS act (Compulsory Registration Scheme). The said order includes SPV modules, Inverter and Battery storage, with specified Indian Standards adopted from IEC standards for these products.

| SN | Product                                       | Indian Standard Number | Title of Indian Standard   |
|----|---|------------------------|--|
| 1  | SPV Modules                                   | IS-14286               | Solar PV Modules - Design, Qualification and Type Approval                     |
| 2  | Power Inverters for use in solar power plants | IS-16221 (part-2)      | Safety of Power Converters for use in Photovoltaic power system part -2        |
| 3  | Storage battery                               | IS-16210               | Secondary cells and batteries for solar photovoltaic application <sup>16</sup> |



### Safety

### When installing solar photovoltaic (PV) systems, what safety protocols should be followed?

MNRE has issued various guidelines for ensuring safety during pre-installation and post-installation. Various safety devices such as overload protection, circuit breakers, and short circuit protection are nowadays inbuilt into the inverter itself. Major safety concern is the earthing of solar power plant that has to be checked on a periodic basis.

Other basic safety measures to be maintained during installation are:

1. Ensure roof drainage is adequate.
2. Ensure that roof penetration is watertight.
3. Electrical enclosures should only be accessible to authorised personnel.
4. There should not be any debris in the inverter pad area.
5. No loose hanging wires<sup>17</sup>

16. Ministry of New and Renewable Energy (Standards & Quality Control Division) [Internet]. Government of India; 2020. Available from: [https://mnre.gov.in/img/documents/uploads/file\\_f-1598007397731.pdf](https://mnre.gov.in/img/documents/uploads/file_f-1598007397731.pdf)

17. Minimum Technical Specification of SPV Power Plant [Internet]. Creda.co.in. Available from: <https://creda.co.in/wp-content/Technical%20Specifications.pdf>



## Equipment Efficiency

Does the hospital need new equipment , new wirings , connections or upgradation of existing equipment etc to be put as part of the Solar Photovoltaic (PV) system?

For energy efficiency and conservation of the electricity it is better to upgrade all the equipment with star-rated equipment such as normal fans to (BLDC) fan, incandescent and CFL lights to LED lights etc. It is also recommended to upgrade the power distribution network for solar power plants to avoid any electrical conflict between grid and solar supply. This work can be done by the service units/installation agency at the time of installation or post-installation.



## Disposal and Recycling of Batteries

What happens to the batteries after they are used and how are they recycled?

CREDA collects batteries for recycling and disposal and sends them to the vendor who manufactures them.

| PRIMARY HEALTH CENTER- PATEWA,<br>DISTRICT-MAHASAMUND (CG) |                           |                            |
|--|---------------------------|----------------------------|
| 1  | SPVPP Capacity            | 2KWp                       |
| 2  | System Integrator         | M/s K.S.Electricals,Raipur |
| 3  | Commissioning Date        | 15.05.2016                 |
| 4  | Inverter Make             | M.G. Solar                 |
| 5  | Inverter Capacity         | 2KVA                       |
| 6  | Battery Make              | HBL(LMLA)                  |
| 7  | Battery Capacity          | 2V-300Ah                   |
| 8  | Nos. of Batteries         | 24                         |
| 9  | Module Make               | PV Power Tech              |
| 10   | Module Capacity           | 250Watt each               |
| 11   | Nos. of Modules           | 8                          |
| 12   | Nos. of Array             | 4                          |
| 13   | Connected Load            | 1.2KW                      |
| 14   | Project Executed By       | CREDA, NRHM & MNRE         |
| 15   | Project Cost Rs. In Lac's | 4.54                       |

संबंध में किसी भी प्रकार की खराबी आने पर संपर्क करें -कोडा जिला कार्यालय महासमुंद  
दूरभाष नंबर- 07723-223224, श्री संदीप दास  
(रेलस्टर टेक्नीशियन) -8871041870

Seamless Healthcare Services for the Tribal Population

**Health and Wellness Center,  
Kulhadi Ghat**

**1.  
CASE  
STUDY**

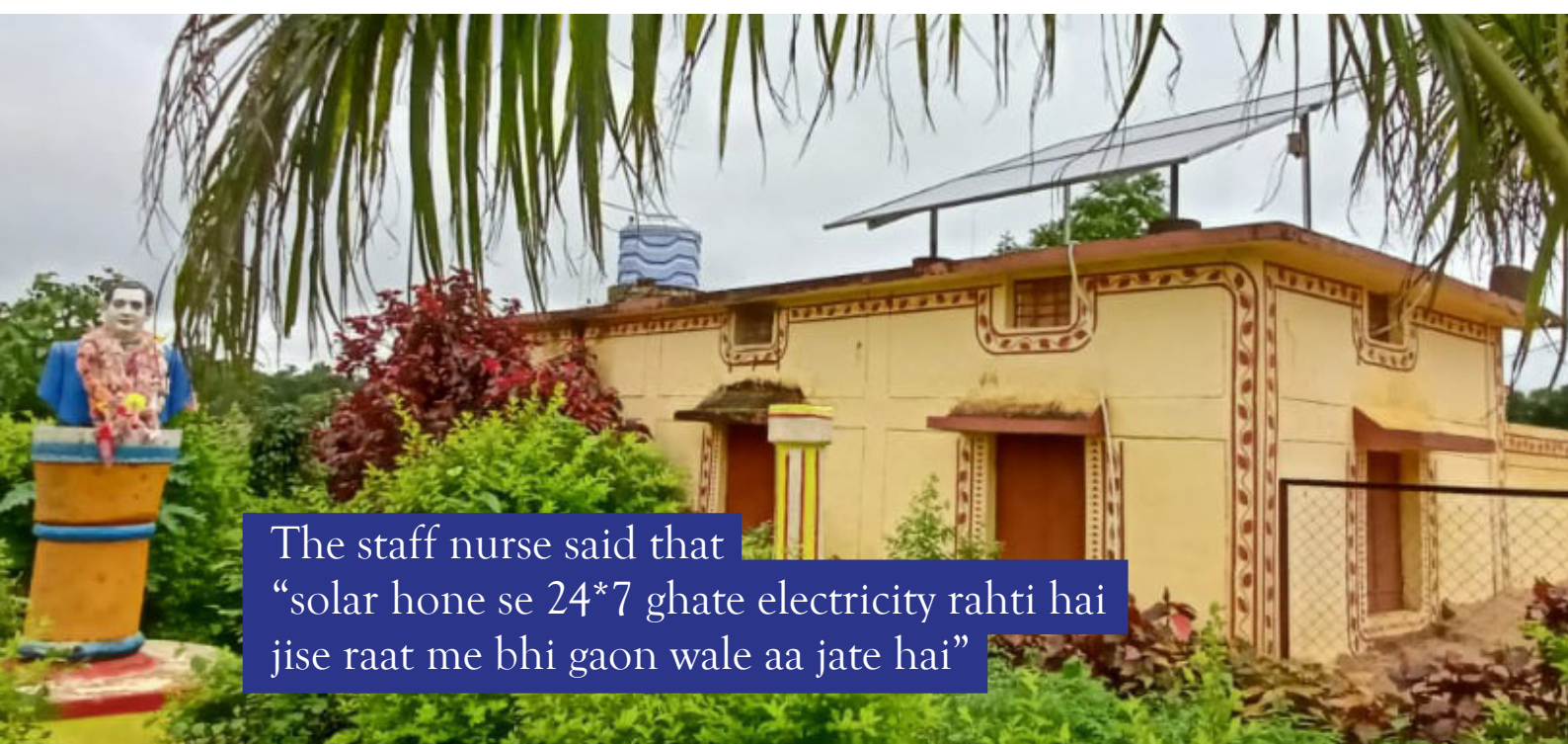




Kulhadi Ghat, a small 'Kamar tribe' (Primitive Vulnerable Tribal Groups (PVTG)) village located in the remote valley region, around 65 km away from Gariyaband district of Chhattisgarh. Often power outage is a usual scenario in the village along with low voltage during night.

The Health and Wellness Center (HWC), a grass root level public health facility serves the tribal population in this village. Since 2014, the HWC was functional in the village in a small mud house. In 2016, the centre was shifted to a new building. The HWC is able to deliver quality care to 590 families covering a population of 1428 people.

The staff nurse who has witnessed the journey of HWC from the mud house to the concrete building shares that she feels safe because of the continuous electricity supply. This was possible with the 'Solar Panels' of about 3.4 kW installed on the terrace of the building. Currently, the HWC has 100% solar energy connection and utilization. The HWC was switched to solar electrification in two phases. As part of the first phase in 2019, a solar photovoltaic power plant (SPVPP) with



The staff nurse said that  
 “solar hone se 24\*7 ghate electricity rahti hai  
 jise raat me bhi gaon wale aa jate hai”

a capacity of 1.2kW was installed. Phase 2 was completed in February 2022 with the installation of 2.4 kW.

The current HWC is a single-storeyed building, which is divided into two separate blocks. In the first block, there is a consultation room with medicines, equipment such as sphygmomanometers, Glucometer, weighing scale, etc, a washroom, and a separate room to keep the batteries and inverters. The other block is the staff quarters with a room for the staff to stay in, a kitchen and a washroom.

The HWC provides outpatient services, first aid treatment, vaccination services, and maternity services. On average, the staff conduct one institutional delivery per month and the rest are home deliveries. Currently, the HWC has a 24\*7 electricity supply because of solar. HWC functions from 8 a.m. to 6 p.m. Since there is a continuous electricity supply, people from the village come to the health centre even at night.

## Case Study: Health and Wellness Center, Kulhadi Ghat

### SOLARIZATION BENEFITS

#### 1. Infrastructural

The HWC is completely solar-powered. Solar energy is connected to 10 lights, 5 fans, and equipment such as a nebulizer, fridge, autoclave machine, weighing machine, fumigator, electric needle cutter, etc. The solarization of the HWC has benefited the community in getting quality healthcare.

The connection of solar power is also extended to a common point in the village. With the help of panels placed outside the HWC, 1 unit of energy is supplied to the village. Many women in the community prefer home delivery over institutional delivery. So at night, the staff is able to stay there and conduct safe deliveries keeping in mind the patient's comfort.



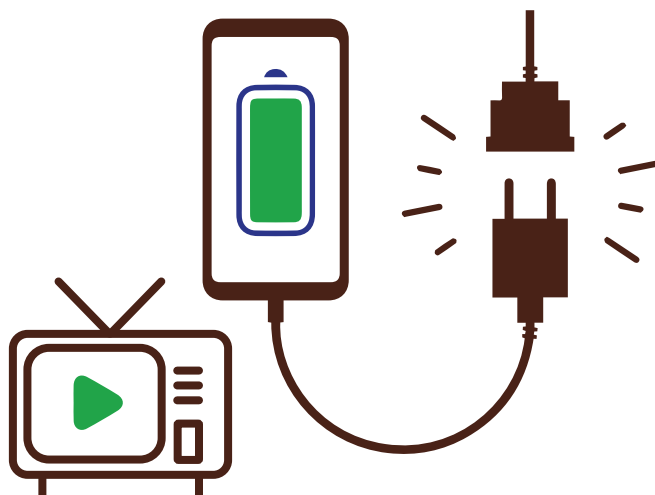
#### 2. Water supply and hygiene



The source of water in the HWC is a well. A separate panel is kept outside the HWC to pump water. With the help of a solar water pump, the water is pumped from the well to the overhead tank, placed near the HWC. The water tank has a capacity of 10,000 litres. The tank gets filled two times a day, which makes 20,000 litres of water available per day. The water is utilized by the health and wellness center, staff, and the entire panchayat. From the tank, water gets supplied to the center, and staff quarters, and taps are connected near the tank so that the people from the village are also able to get water from the tank.

#### 3. Communication

Since the HWC had solar energy, the staff were able to charge their phones. Health education materials and awareness videos are played to the community, such as videos on vaccination, especially during COVID times, population control videos, etc. Even though the villagers hesitate to get vaccinated, with the help of this video, 90% of them got vaccinated. Video is played by connecting the pendrive to the television. This television provides entertainment for villagers while they wait for their consultation. Even at night, villagers are also able to utilize the power to charge their phones.



#### 4. During extreme weather events

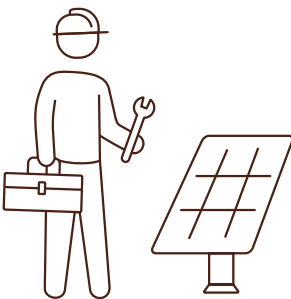
Even though there is heavy rain in these areas, there are no reported incidents of flooding in the HWC. Since the centre has a solar energy connection, there is adequate lighting in the HWC. So that the staff is able to provide care.

#### 5. Social life of staff and villagers

A solar energy connection is also extended to the staff quarters. It brings a sense of security and comfort to the staff, especially female staff to stay in this remote area. Also, solarization helps in the social betterment of the villagers. Since the area has poor voltage at night, the villagers are able to utilize the health and wellness centre premises for conducting their meetings and for social interactions, etc.

### MAINTENANCE SERVICES

Maintenance is taken care of by CREDA. One technician and one helper are allotted for the centre. CREDA has a separate maintenance system for the remote areas, named as "Remote Village Maintenance System". As part of this system, a technician will visit the HWC twice a month and do the operations and maintenance services.



### SATISFACTION AND SUGGESTIONS OF STAFF

The staff in the HWC is completely satisfied with the solarization process. She feels the SPV system in the HWC is well maintained and the villagers are able to utilize it to the fullest.



## Solarization of Patewa PHC

A Success Story



# 2. CASE STUDY

The Primary Health Centre (PHC) is located in Patewa village in Mahasamund district of Chhattisgarh. The PHC is present on a slope along NH6, which connects the state of Odisha. This area is in the outskirts of Raipur, the capital of the state. Power cut was a main problem faced by the health staff in Patewa PHC. *“hamaara aspataal sudoor ilaake mein hai, pahale ham raat mein bhee 2 ghante bijalee katauti dhe. Aspataal mein solar hone ke baad, hamaare paas bijalee hai”* said by the rural medical assistant (Our hospital is in a remote area. Earlier, there were power cuts for two hours during nights. But, after the hospital has become solarized, electricity is available).

Rural medical assistants and a staff nurse in the PHC were the main informants for this case study. Currently, the PHC serves a population of thirty-three thousand (33000), of which 30-40% are tribal. The PHC works 24x7 hours and provides outpatient services, emergency services, vaccination services, and speciality services such as maternity services, etc. A monthly average of 50 deliveries are performed, and 30-40 outpatients visit the PHC every day. The PHC has two single-



According to a rural medical officer,  
*“injekshan room mein, ab hamaare paas raat mein bijalee hai, jo aapaatakaaleen upachaar dene mein bahut madadagaar thee”*

storey buildings. One building has a room for doctors, a waiting area, an emergency room with one bed, a ward, a pharmacy, a laboratory, a store room, a washroom, and a separate room to keep solar batteries and their inverters. The second building has a delivery room, a 10-bedded maternity ward, a washroom, and a room to keep the refrigerator and an autoclave. They have 16 permanent staff and one each from Jeevan Deep Samiti (JDS) and Ayushman Bharat schemes.

The PHC was solarized in 2016. They have an off-grid system. Before the solarization process, an assessment was conducted by CREDA to understand the electricity needs of the PHC. The assessment also included an inspection of the site, identifying the location to keep the panels and the type of photovoltaic system needed in the centre. Possibilities for climate vulnerabilities were also considered during this process.

## Case Study: Solarization of Patewa PHC

Currently, 30% - 40% of PHC is solarized. Solar energy is mainly connected to lights, fans, one deep freezer and one computer system. As part of solarization, new wires to connect the SPV system were setup in the PHC. Most of the lights and fans that are connected to solar energy are energy efficient, such as light-emitting diode (LED) lights etc.

Lighting in the emergency room makes it possible for the staff to provide treatment. *"Now, we have electricity in the injection room at night which is helpful for us to provide emergency treatments"*, said a rural medical assistant. In addition, it enables them to conduct deliveries even when the grid fails. *"Solar se kanekt hone ke baad maitaranitee vaard mein paryaapt roshanee hotee hai. ham raat mein bhee prasav karaane mein saksham hain. Saur bahut achchha hai. ham raat mein bhee navajaat shishuon ke lie suction aur aapaatakaaleen resuscitation karane mein saksham hain"* (After connecting to solar, there is enough light in the maternity ward. Even at the night, we are able to conduct deliveries and in case of emergencies we are able to do suction and resuscitation for newborn babies) said a rural medical assistant. Solarization of the PHC has made a great impact on the service delivery by the health centre.

## SOLARIZATION BENEFITS

### 1. Communication

Since there is an SPV, the staff are able to charge their phones even when the grid fails. It brings a sense of safety and security, especially for female staff working on the night shift.

### 2. Water and sanitation

Solarization has brought better availability of water in the PHC. Water from the well is pumped to the tank with the help of a solar-powered motor, which is later supplied to taps inside and outside the PHC. Outside the PHC, there is a solar dual pump. It is an innovative pump designed to utilize the power of the sun during the day and act as a normal hand pump when solar energy is not available, hence ensuring an uninterrupted water supply for drinking, sanitation, personal hygiene, etc.<sup>18</sup> Solar heaters are also available in PHC so that the patients, especially the postnatal mothers and staff, are able to access hot water. Drinking water is supplied by the grama panchayat.

### 3. Financial benefits

Since there is an SPV, the staff are able to charge their phones even when the grid fails. It brings a sense of safety and security, especially for female staff working on the night shift.

### 4. During extreme weather events

In the extreme rainy season, there are voltage fluctuations and power outages. Since there is a solar energy connection, the PHC was able to provide services during these times. Even in situations when the battery is getting drained, CREDA is able to do a booster charge to the batteries for a continuous supply of power.

## MAINTENANCE SPV SYSTEM

The maintenance services are provided by CREDA. Maintenance is done once a month. In the PHC, one technician and one helper are appointed for this purpose. During the monthly maintenance process, panels are cleaned, they are checked for rust, and the branches of trees that shadow the panels are removed. In cases when solar gets shut down, the PHC staff informs the in-charge rural medical assistant and they will contact the corresponding maintenance technician. CREDA also had a complaint and grievance system. On the website, PHC staff can submit complaints so that CREDA can resolve them as soon as possible.



18. Why Solar Dual Pump is a must for every village's development! - Spanpumps India [Internet]. Spanpumps India. [cited 4 August 2022]. Available from: <https://spanpumpsindia.com/why-solar-dual-pump-is-a-must-for-every-villages-development/>

## SATISFACTION AND SUGGESTIONS OF PHC STAFF

PHC staff are completely satisfied with the solarization of the hospital. At present, the PHC is 30% solarized, but the staff expect at least 80% of the PHC to be solarized. The suction, warmer, and autoclave machines need to be connected as a priority. Once the power goes out, a person has to manually switch to the battery system. The process will take 5 to 10 seconds. This time can be reduced if the system is automatic.

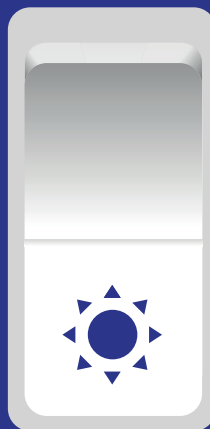


## CONCLUSION

The benefits of solarizing health facilities are multi-dimensional. Uninterrupted power supply enables health professionals to provide quality care for their community. In areas that are remote and rural, communities are able to access the healthcare they need, when they need it. Money is also saved when using solar energy, which can be reinvested to support other priority health programmes. Solar energy also contributes to making health systems more resilient. Reliable power supply ensures the effective management of health facilities. By solarizing the health facility, we are able to contribute to the overall universal health coverage.

Given the importance of solarizing health facilities, clear communication between the engineers and health professionals must be ensured, so the technical team can plan what equipment is needed at each health facility. The SPV must become a complete part of a hospital. Efforts should be made to incorporate the batteries, panels, inverters, and other items into the hospital inventory list. Therefore, responsibility and ownership can be shared by both health staff in the solarized hospitals and the technical team. The performance should be audited on a yearly basis to ensure proper utilisation. This task should be assigned to a responsible person of the concerned health centre. An energy audit should also be conducted and every facility should have an audit report.

Given the number of health facilities adopting solarization, a stringent management policy to deal with the waste arising out of the operation of SPV must also be ensured. Batteries, inverters etc. contain heavy metals such as lead, selenium, and cadmium, and hence must be disposed off with care.





## ANNEXURE

### Interview Guidelines

📅 Date: \_\_\_\_\_

🕒 Time: \_\_\_\_\_

### Hospital Details

#### General Details

1. Name of the Hospital
2. Address
3. Accessibility to the hospital
4. Geography of the area where the hospital is situated

#### Building Details

5. From when did the hospital started functioning?
6. How many buildings the hospital had in total?
7. How many floors hospital had in each building?

#### Details on the Services and Staffs

1. Type of Hospital (PHC/CHC/Specialty Hospital)
2. Serving population (In terms of Numbers, Tribal Population etc.)
3. Working hours of the hospital
4. What services are provided in this hospital (IP, OP, speciality services)
5. If the hospital had IP service, what is the total number of beds in the hospital
6. Total number of staff in the hospital
7. When was the hospital switched to solar

Good Morning,

Thank you for sparing time to talk with me.

I am **Nitha Thankam George**, working in a program named Healthy Energy Initiative India. As part of my work, I am doing a study to understand the process of solarizing this healthcare facility. The purpose of this interview is for you to share your ideas and experiences before and after solarizing this hospital. Kindly share the information. The information you share will be highly beneficial for both of us.

#### 1. Can you tell me how the idea of solarizing your health facility came about?

##### Probe

- Who has taken this initiative to solarize the healthcare facility?
- Stories of Leadership that supported/motivated to switch to solar?
- What is the role of CREDA, medical officers in a solarizing healthcare facility?
- Was there any other external agency involved in solarizing this facility?

#### 2. Could you describe the whole solarization process that happened in your hospital?

##### Probe

- When did the work for solarization start in your hospital?
- Could you explain the whole process step-by-step (Changing the electrical line, identifying the area to keep the panels etc.)?
- When did the process complete?
- When did the hospital start using SPVs?

### 3. Has solarization brought any changes in the financial status of the hospitals?

#### Probe

- Any cost savings after solarizing the hospital

### 4. According to you, has the hospital faced any difficulty while switching to SPV? Can you elaborate more on this?

#### Probes

- Financial constraint
- Any damages
- Power outage

### 5. In your opinion, does this solarization made any changes in the quality of patient care provided in your hospital?

#### Probe

- Are there any new patient care equipment purchases at the hospital?
- Has the hospital's working hours changed since it switched to solar power?
- Is there any infrastructure change since the hospital switched to solar energy (More lighting, new wiring of the building)?
- Was the hospital able to make any changes in the specialized services (more hot water facility – improved maternal service)?
- Does solarization bring any changes in the communication systems of the hospital (through the installation of a charging facility etc)?
- Do you think solarization had any impact on the sanitation and hygiene of the hospital (more electricity- better water availability for cleaning purposes)?
- Does solarization impact the hospital's environment (more greenery, agriculture)?
- Are there any changes in patients' out-of-pocket expenditures due to solarization?
- Was the hospital able to start any advanced treatment options after the solarization (Telemedicine etc.)?
- Is there any availability of safe drinking water solarizing the hospital?

### 6. When it comes to maintaining your solarized facility, what steps do you take?

#### Probes

- Does the hospital have a separate person for maintenance?
- How frequently the maintenance service is done?
- Does the hospital provide any training for maintenance staff?
- How frequently training is provided?
- Any damages faced after switching to solar?

### 7. What are your thoughts on your solar-powered hospital's capacity to cater services during extreme weather such as rainy seasons, etc.?

#### Probes

- Was the hospital able to provide services during extreme weather events?
- Were the people able to access the hospital during such events?
- If the power supply is fully on solar, does the hospital have any backup supply when the power fails?

### 8. Based on your observation, how satisfied are staffs and patients with the switch to solar power?

#### Probes

- Hospital staff satisfaction with having SPV in the hospital (Positive and negative)
- Feedback from patients after switching to solar in terms of service delivery, quality of service, and infrastructure development such as the lighting in hospitals?

### 9. Do you have any suggestions or changes you would like to see in your facility as part of solarization?

Thank you for your valuable time and participation in the study.





## Chhattisgarh State Renewable Energy Development Agency

(Dept. of Energy, Govt. of Chhattisgarh)

Chhattisgarh State Renewable Energy Development Agency has been constituted on 25th May 2001, under the Department of Energy, Government of Chhattisgarh for the implementation of various schemes pertaining to Renewable Energy sources and Energy Conservation activities. CREDA is established as the State Nodal Agency by the State Govt. for the development and promotion of non-conventional and renewable sources of energy.



The State Health Resource Centre works as an additional technical capacity to the Department of Health and Family Welfare Chhattisgarh, with the aim of improving access, quality, and equity in the public health system.



Healthy Energy Initiative (HEI) is led by 'Health Care Without Harm' and is comprised of a network of partners made up of health professionals, health organizations, and academic research institutions, from around the world. The Healthy Energy Initiative in India is coordinated by Community Environmental Monitoring (CEM), a program of The Other Media. Based in Chennai, CEM addresses the plight of pollution-impacted communities through environmental health monitoring skills training, information and organizing support, and emergency response services and funding.