Powering Primary Healthcare through Solar in India

Lessons from Chhattisgarh

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CEEW: among the world’s leading policy research institutions

Energy Access
Renewables
Power Sector
Industrial Sustainability & Competitiveness
Low-Carbon Pathways
Risks and Adaptation
Technology, Finance & Trade

Conserving Now, Preserving Future
What does it take to run a Primary Health Centre?

Essential prerequisites for delivery of primary care

Infrastructure
- Building & Furniture
- Medical equipment
- Medicines
- Water
- Electricity

Manpower
- Staff quarters

Finance
Key discussion points

• Why is electricity important for healthcare?

• What has been Chhattisgarh’s experience with solar panels for primary health?

• What policy lessons can we learn?
Electricity is a critical enabler for health system

- Equipment functionality
- Water supply
- Staff retention
- Immunization services
- Out-patient services
- In-patient services
- Delivery services
- Neonatal Care

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Electricity access is a necessary condition for better healthcare

A large proportion of Indian rural population is dependent on the public healthcare system for their health needs

4.6% - Primary Health Centers (PHCs) in India have no access to electricity

One in two PHCs in India suffer either from no power supply or from irregular power supply

SOURCE: CEEW (2016)
Electricity access is a necessary condition for better healthcare

Significant correlation between PHC electrification and percentage of children fully immunized

SOURCE: CEEW analysis based on District Level Household Survey-4; Annual Health Survey 2012-13
Evaluation of Chhattisgarh’s Solar Intervention
• 20 million people (three-quarters living in rural areas)

• 25% (of the total 27 districts) had more than 80% fully immunized children

• One-third of PHCs are un-electrified or without regular power supply

• Close to 90% of primary health centers report power cuts during peak operating hours

SOURCE: DLHS-4; CEEW (2017)
Current state of electricity access across sample PHCs

Power cuts and voltage fluctuations

- Power deficit PHCs report higher one-hour power cuts: 55.2%
- Power deficit PHCs report higher regular voltage fluctuations: 43.1%

- Power non-deficit: 10.6%
- Power deficit: 15.8%

Equipment damage due to voltage fluctuations

- PHCs with equipment damage due to voltage fluctuation:
  - Power non-deficit: 15.8%
  - Power deficit: 29.3%

SOURCE: CEEW (2017)
Current state of electricity access across sample PHCs

Proportion of PHCs reporting power cuts in the evening

- Power cuts in the evening
  - Power non-deficit: 28%
  - Power deficit: 36%

Proportion of PHCs reporting power cuts in peak hours

- Power cuts in peak hours
  - Power non-deficit: 55%
  - Power deficit: 98%

Source: CEEW (2017)
## Association between Electricity Access and Health Outcomes in Chhattisgarh

Districts with higher proportion of power-deficit PHCs

<table>
<thead>
<tr>
<th>Health Outcome</th>
<th>Value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant Mortality Rate</td>
<td>0.65</td>
<td>0.01</td>
</tr>
<tr>
<td>Delivery at Home</td>
<td>0.35</td>
<td>0.14</td>
</tr>
<tr>
<td>Fully immunized children</td>
<td>-0.77</td>
<td>0.00</td>
</tr>
<tr>
<td>Under Five Mortality Rate (U5MR)</td>
<td>0.91</td>
<td>0.00</td>
</tr>
<tr>
<td>Maternal Mortality Rate</td>
<td>0.46</td>
<td>0.07</td>
</tr>
</tbody>
</table>

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Solar for primary health centres

- Chhattisgarh Renewable Energy Development Agency (CREDA)
- 2 kWh Off-grid Solar PV systems
- 4 Hours of back-up, depending on load
- 570 Primary Health Centres (PHCs) since 2012
Sampling Methodology

Two stage Stratified Random Sampling approach was applied

Four district level indicators were identified to stratify the districts:

- Average number of OPD patients visiting the PHC each month - (DLHS-4, 2012-13)
- Average number of deliveries in the PHC each month - (DLHS-4, 2012-13)
- Percentage of fully immunized children (based on the eligible population identified under the NHM) – (AHS 2012-13)
- Share of PHCs which are functional Cold Chain Points (CCPs) as a proportion of the total number of CCPs in that district - (NCCVMIS)
Sampling in the Chhattisgarh project

• Given that there was no baseline survey carried out prior to the intervention, solar and non-solar PHCs were selected within each stratified district using simple random sampling.

• The non-solar PHCs were determined in consultation with the State Government and served as a control to understand the differences in functionality of the PHCs due to the intervention.

<table>
<thead>
<tr>
<th>District</th>
<th>Number of solar PHCs</th>
<th>Number of Non-solar PHCs</th>
<th>Total number of PHCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bastar</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Bijapur</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Durg</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Gariaband</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Janjgir-Champa</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Jashpur</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Kawardha</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Kondagaon</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Koriya</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Narayanpur</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Raigarh</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Rajnandgaon</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Sukma</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Surajpur</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Surguja</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>83</strong></td>
<td><strong>64</strong></td>
<td><strong>147</strong></td>
</tr>
</tbody>
</table>
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PHCs (147)

POWER DEFICIT
With grid power supply of 20 hours and below
48.3% (71)

With Solar (38)
Without Solar (33)

POWER NON-DEFICIT
With grid power supply of 21 hours and above
51.7% (76)
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**Hypothesis**: Improved electricity access can lead to better health service delivery

Two stage stratified random sampling for selecting the primary health centers

Matched them with controls i.e. PHCs without solar

| 147 PHCs | 83 Solar | 64 Non-Solar |
Snapshot: District-wise proportion of power deficit PHCs

SOURCE: CEEW (2017)
Higher service provision in health facilities with solar

70% of health facilities with solar provided 24 x 7 services compared to 48% of those without solar

<table>
<thead>
<tr>
<th>Out-patients treated per PHC per month</th>
<th>In-patients treated per PHC per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Solar</td>
<td>Without Solar</td>
</tr>
<tr>
<td>630</td>
<td>480</td>
</tr>
<tr>
<td>23</td>
<td>19</td>
</tr>
</tbody>
</table>

SOURCE: CEEW (2017)
Perceptions of health staff in PHCs (1/3)

Proportion of PHCs reporting service improvement due to solar

- OPD Services: 59%
- In-patient Services: 77%
- Deliveries: 78%
- Laboratory Services: 45%

SOURCE: CEEW (2017)
Perceptions of health staff in PHCs (2/3)

- Solar has helped the day-to-day operations of the staff/doctors in the PHC: 98%
- Solar provides back-up as promised: 79.5%
- Experienced cost savings on electricity expenditure: 89%

SOURCE: CEEW (2017)
Perceptions of health staff in PHCs (3/3)

“PHC services less affected by power cuts”

“Services during the night, especially delivery and emergency services, have significantly benefitted from Solar”

“We face less equipment damage as solar has also helped reduce voltage fluctuations”

“We would like the capacity of these systems to be expanded

SOURCE: CEEW (2017)
What lessons can we learn?
Impact of electricity on healthcare: Patient statistics

Average in-patients treated in a month

<table>
<thead>
<tr>
<th></th>
<th>Non-deficit</th>
<th>Power deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td></td>
<td>17</td>
</tr>
</tbody>
</table>

Average Deliveries in a month

<table>
<thead>
<tr>
<th></th>
<th>Non-deficit</th>
<th>Power deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.6</td>
<td></td>
<td>6.5</td>
</tr>
</tbody>
</table>

SOURCE: CEEW (2017)
Impact of solar: Patient statistics

Median values of IPD patients and deliveries in a month - within power deficit PHCs

Median number of deliveries in a month:
- Power deficit without solar: 5.3
- Power deficit with solar: 8.6

Median number of IPD patients in a month:
- Power deficit without solar: 11.5
- Power deficit with solar: 19.3

SOURCE: CEEW (2017)
Prioritise solar for 24x7 services

Power-deficit PHCs designated to provide 24x7

With solar: 63%
Without solar + without back-up: 21%
Without solar + other back-up: 16%

21% of power deficit PHCs are designated to provide 24x7 services, but do not have any power back-up

SOURCE: CEEW (2017)
Prioritise solar for critical services such as cold chain

- For PHCs with good power supply, expand cold-chain equipment
- In other PHCs, provide both reliable electricity supply as well as equipment
Final thoughts

- Mainstream energy access as a critical component of health system infrastructure

\[ \text{Better Energy Access} \rightarrow \text{Better Health Services} \]
\[ \text{Better Technology} \rightarrow \text{Better Utilisation} \]

- Renewable energy policy is not geared to address institutional energy access
Final thoughts

Tailor solar system design based on local needs. Need better understanding of energy needs of such facilities to design cost-effective and resilient solutions.

**Better data**: Need facility-level surveys.
Final thoughts

• Augment electricity supply with solar systems with a priority in:
  – power deficit health facilities and 24x7 services
  – staff quarters for improving residential facilities
  – back-up for cold chain points in power deficit PHCs

• Scaling solar systems across health centers is in India’s interest – for achieving both health and energy targets
  – National Solar Mission target of 100 GW by 2022
  – Universal Health Care
THANK YOU

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