Making Remote Monitoring of Solar Pumps Work for States

Anas Rahman and Abhishek Jain

Issue Brief | September 2021

Image: Alamy

Abstract

Data is imperative to inform policymaking and improve governance. But often, well-intentioned data collection initiatives can result in suboptimal or non-usage of data due to poor implementation. In this brief, we assessed the state of Remote Monitoring Systems (RMS) of off-grid solar pumps – one of the few government-supported assets in the country that are equipped with RMS – to understand the prospects of leveraging such data for policy insights. As a case, we looked at the RMS data of solar pumps from Chhattisgarh—India's leading state in the deployment of solar pumps. While the insights are from one state, they are equally applicable to others as the same solar pumps manufacturers are supplying pumps across the country.

We find that the data is fragmented across multiple portals maintained by different controller manufacturers. There is neither standardisation of data parameters across portals nor any provision to export data into a common portal through Application Programming Interfaces (API). These portals are primarily designed for data storage and not analysis,

leading to the non-utilisation of such portals by the state government. Due to implementation gaps, public resources are ill-utilised to support such RMSs. We also find that controller manufacturers/system integrators are not giving attention to the maintenance of the system, likely because the state government is not monitoring it. Furthermore, we identified issues of poor-quality hardware resulting in data loss. The advent of the Solar Energy Data Management (SEDM) platform by the union government would likely address the challenges of data standardisation. It must ensure that useful insights from the RMS data are easily accessible to the state administration for them to take an active interest in RMS data. Alongside, states must leverage the portal to ensure compliance with performance mandates and guide the future deployment of solar pumps, in a sustainable manner.

1. Introduction

The Internet of Things (IoT) is fast becoming ubiquitous in our lives. Among other benefits, IoT enables remote monitoring and controlling of connected devices. In solar pumps, IoT integration is commonly referred to as a Remote Monitoring System (RMS) and has been mandated by the government for several years. It enables pump users to remotely monitor and control their operation; and the state governments, to keep a close watch on the use of these subsidised assets.

The real-time data generated from solar pumps across the country can give critical insights on asset use, water withdrawals, and irrigation patterns among the rapidly increasing solar pump beneficiaries. It makes RMS highly valuable in guiding data-based decision-making for the expansion of public support to solar pumps. However, to realise this potential of RMS, it is critical to have standardised, comparable, and publicly available data from such RMS across government-supported solar pumps. Since 2015, many states like Maharashtra, Andhra Pradesh and Chhattisgarh have mandated RMS for solar pumps supported by the state. In this brief, we use a sample of RMS data from Chhattisgarh,[1] a leader in the deployment of solar pumps in India, to examine the prevailing state of solar pump RMSs.

2. Key findings

The following are the main insights from our analysis of the RMS portals:

1. **No unified portal:** Typically, it is the manufacturers of the solar pump controller who design the RMS, as these are integrated with the controller. Solar pump installations in Chhattisgarh, since 2016-17, has witnessed seven different controllers. Consequently, the data from solar pumps is hosted across the respective portals of controller manufacturers, making it extremely difficult for the government or any agency to undertake an aggregate analysis or

Table 1 The parameters and frequency of RMS data vary between different portals.

	Portal 1	Portal 2	Portal 3	Portal 4	Portal 5	Portal 6	Portal 7
Output frequency	✓	✓	✓		✓		✓
Output current	✓	✓	✓	✓	✓	✓	✓
Output voltage	✓		✓	✓	✓	✓	✓
Output torque	✓						
Output power			✓		✓	✓	✓
Input power	✓	✓	✓	✓	✓	✓	✓
Bus voltage	✓	✓	✓	✓	✓		✓
Module temperature	✓					✓	
DC current	✓	✓	✓		✓		✓
Flow speed	✓	✓	✓	✓	✓	✓	
Cumulative total flow	✓		✓	✓		✓	
Cumulative energy (daily)	✓		✓	✓		✓	✓
Data frequency	30 mins	1 min	2 mins	5 mins	5 mins	5 mins	No specific interval identified

Source: Authors' compilation

1 The data was made available to us by the Chhattisgarh Renewable Energy Development Agency (CREDA).

The lack of a standardised data structure makes it impossible to unify the data, and make an aggregated sense of the state of solar pumps, across the state.

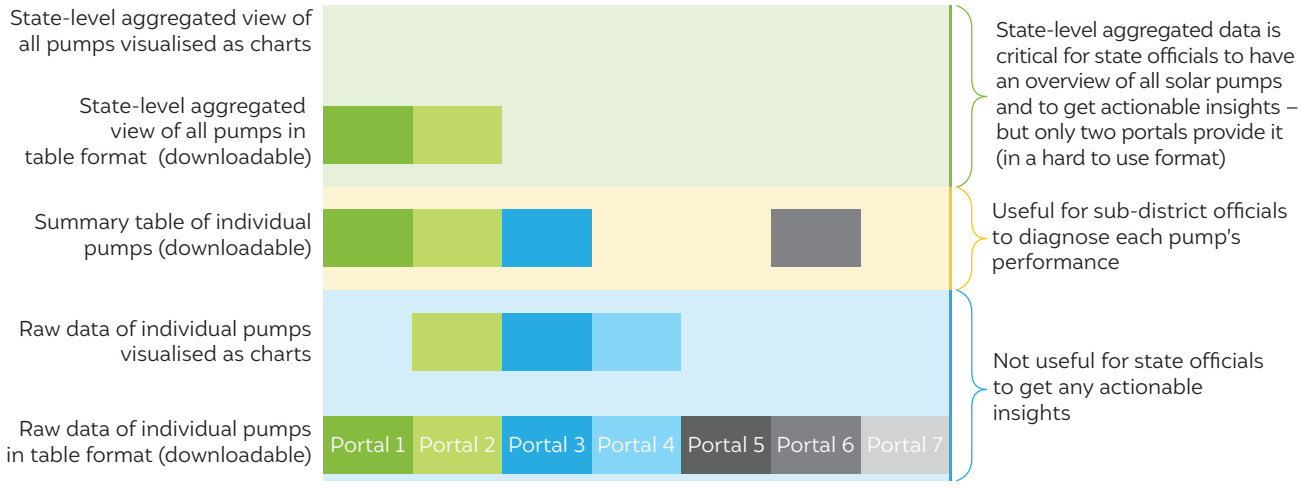
have a complete overview of the solar pumps across the state.

2. **No standardised data structure:** We find that the parameters recorded and the frequency of data captured, widely differs across the portals. Table 1 summarises the data structure in different portals. The lack of a standardised data structure makes it impossible to unify the data, and make an aggregated sense of the state of solar pumps, across the state.
3. **All data, no insights:** Data is only as good as how it is presented to the user. The existing RMS portals do not provide any aggregated information across all pumps, for they only provide pump-by-pump information. Such information is not useful for the state administrators to understand the big picture about the usage, performance, and maintenance issues at the state- or district levels. The only state-level data readily available in any portal are the total number of pumps installed and the number of pumps actively logging data in real-time. The remaining data are provided at the individual pump level. Figure 1 summarises the user interface of different portals.

To take a deeper dive into the quality of the RMS data, we selected one among the seven portals; the one with the largest number of registered solar pumps (designated as Portal 1). The following analysis is primarily based on this one portal, but a cursory assessment of other portals confirmed that most of the issues are common across portals.

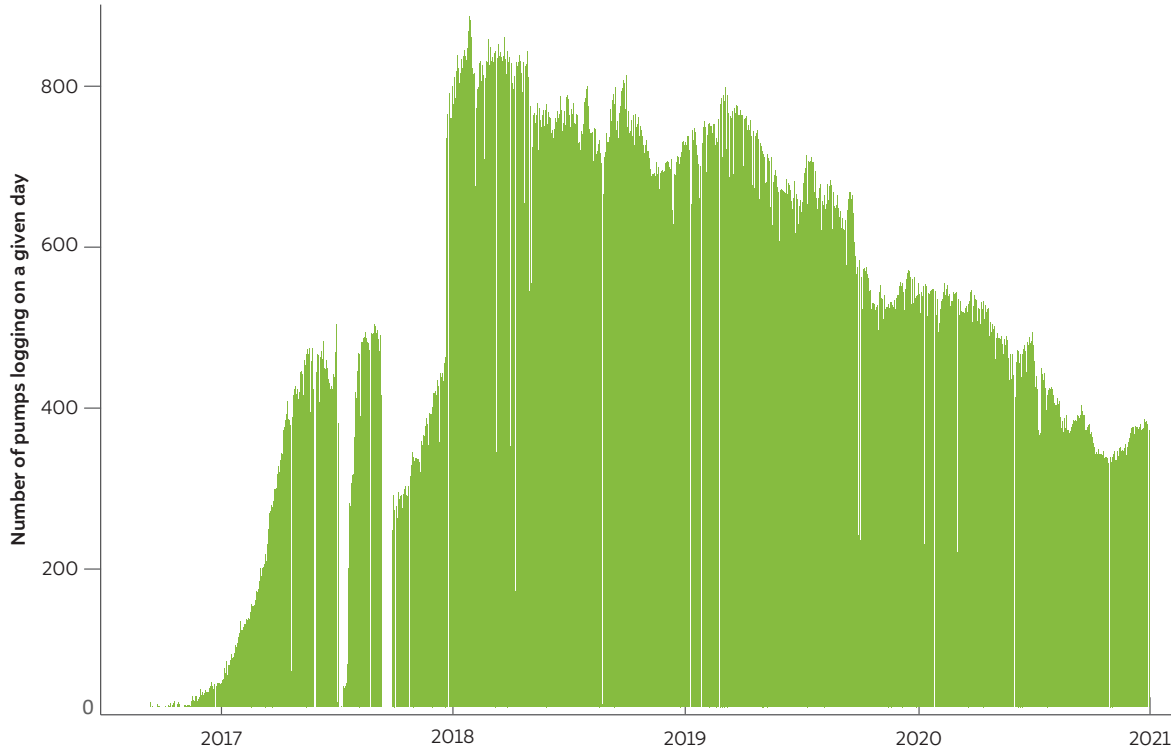
1. **Improper entries:** We find that many critical parameters are entered incorrectly, and pump identifiers are missing. For instance, we found that for about 80 per cent of the pumps, the geotag was missing or pointing to the controller manufacturer's headquarters. Similarly, other critical metadata like the pump owner's address and the pump and PV array capacity were incorrectly entered for most of the pumps. We notice a similar issue in some of the other portals as well.
2. **Poor maintenance and upkeep:** We find that a majority of the RMS systems lack proper maintenance, which is reflected in two ways:
   a. The number of pumps transmitting data has been gradually declining, in most of the portals. Figure 2 shows the number of pumps logging data on any given day. Out of the 1,306 pumps that had logged data at least once in the portal since about mid-2016 (when the state solar pump scheme had just begun), only 446 pumps continued to transmit data as of December 2020. Figure 3 depicts the period of data transmission for pumps installed in various years. Occasionally, the pumps go offline in bulk. One likely reason could be that the SIM cards for the RMSs were activated in bulk on a particular date and became invalid due to the lack of timely recharge.
   b. Across all portals, the number of new pumps being registered showed a significant drop; in most cases, dropping to zero by 2019, although the number of installations in the state has remained

Figure 1 None of the portals is designed to facilitate state-level monitoring of solar pumps



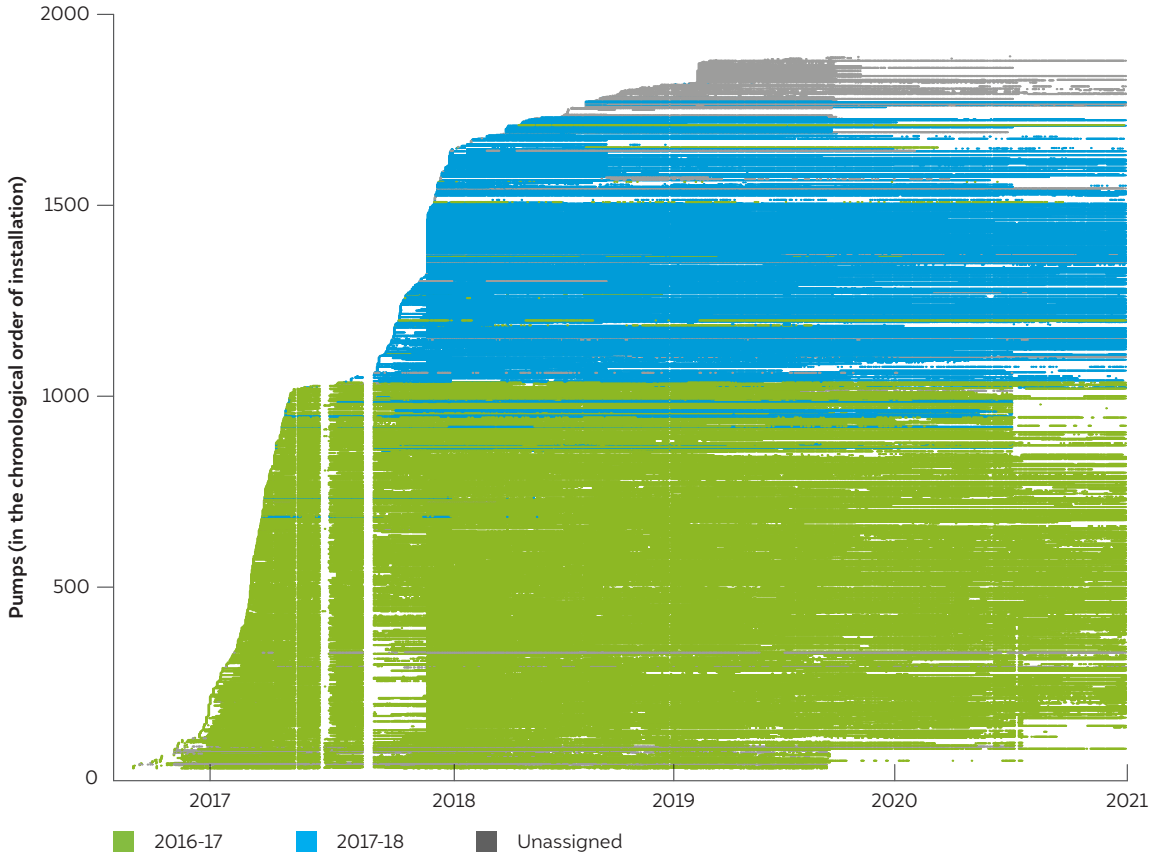
Source: Authors' compilation

Figure 2 The number of pumps logging data is consistently decreasing over the years



Source: Authors' analysis

Figure 3 A significant proportion of pumps in the portal stopped transmitting data after the second year of installation itself, indicating non-compliance with the RMS mandate as per the contracts



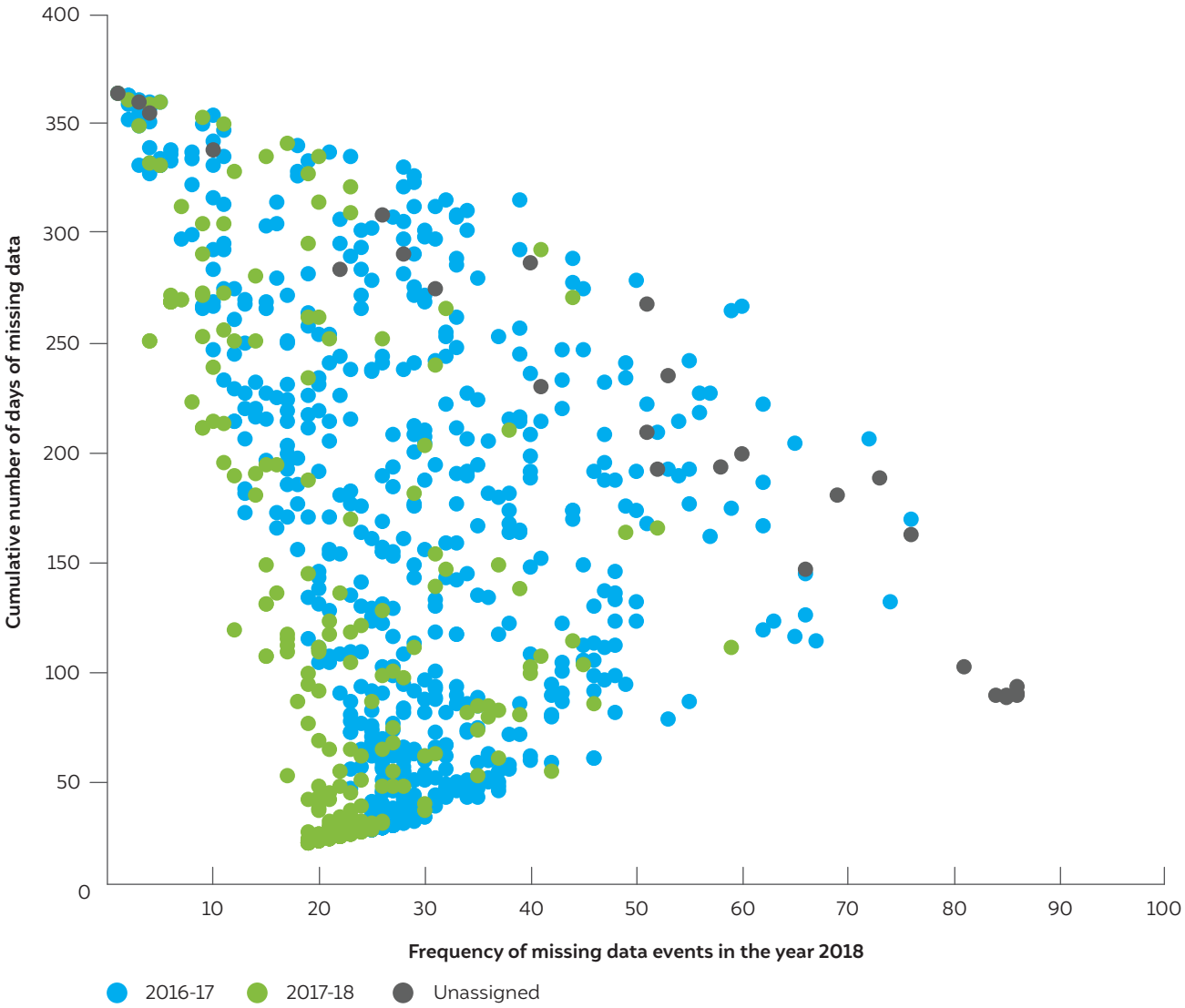
Source: Authors' analysis

Note: The number on the y-axis represents individual pumps in their chronological order of installation. Each dot in the image represents a day when the pump's RMS transmitted data to the server. Blank areas represents days without any data from the particular pump.

at a constant 20,000 pumps a year since 2016-17. In Portal 1, the last pump was registered at the beginning of 2019, although the scheme is ongoing and vendors use the same controller as before (Figure 3). Across all the portals, we could only account for about 10,000 pumps, which is only 16 per cent of the total number of pumps installed. In the absence of proper scrutiny by the state government—which itself is a result of poor portal design—the manufacturers are not complying with the RMS mandate, as specified in their contracts; especially that of providing RMS data during the lifetime of the solar pumps, in an attempt to corner undue profit margins.

3. **Data loss:** We find that the data logging of pumps is not consistent even between their installation dates and the last login dates. Figure 3 indicates such days—with no data—as white, blank spaces. That is to say, on these days, no data is received from the pumps. Some of the data losses are common across all pumps, indicating system-level errors. Besides these system-induced errors that present data gaps, individual pumps also often fail to log data. The likely reasons could be network unavailability and device errors. Figure 4 plots the number of such missing events against the cumulative number of days of missing data in the year 2018. It can be seen that the pumps installed in 2017-18 have markedly better data logging consistency compared to pumps installed in 2016-17, despite catering to similar geography. Hence, it is unlikely all these data losses are due to network unavailability. Since the vendors buy pump

Figure 4 Pumps installed in 2016-17 face a higher rate of data loss than those installed in 2017-18



Source: Authors' analysis

Note: A missing data event is the gap between when a pump stops transmitting data and eventually restarts, signifying some technical issues in between. The duration of this event can vary from a day to months.

While many states progressively adopted RMS in their schemes, there were critical gaps in their regulation and implementation.

controllers against the annual contracts by CREDA, the RMS devices used in 2017-18 were likely to be of better quality than those used in the 2016-17 pumps. This points towards the need for mandating good quality RMS devices and prescribing the limits of data loss for individual devices.

3. What went wrong?

While many states progressively adopted RMS in their schemes, there were critical gaps in their regulation and implementation. For instance, the only relevant clauses dealing with RMS in the Chhattisgarh solar pumps scheme are the following:

> *"Controller must have Remote Monitoring Arrangement as per MNRE & CREDA guidelines. System Integrators shall have to provide a link for monitoring of installed SPV Pumps and on-site data storage sufficient to log & store 1-year data...Login ID & Password of RMS must be submitted to CREDA as and when required."*

Instead of giving vendors a free hand to decide the RMS structure, the states should develop a standardised data structure and data capture frequency for uniformity across multiple vendors. Also, as discussed earlier, a unified portal is the only way to make sense of the state-wide installations and compare the performance of pumps across vendors. If leveraged well, RMS data can generate significant actionable insights. But not all state agencies have enough capacity or expertise to implement such IT systems.

The states of Maharashtra and Andhra Pradesh had attempted to create a unified data portal for the solar pumps, but according to the representatives from the respective state agencies, both the states did not operationalise it. Gujarat developed a unified portal for its *Suryashakti Kisan Yojana* (SKY) scheme. The same platform has been further developed into the Solar Energy Data Management (SEDM) portal, following the advent of the *Pradhan Mantri Kisan Urja Suraksha evam Utthhan Mahabhiyan* (PM-KUSUM) scheme.

Solar Energy Data Management (SEDM) platform

The SEDM system, being developed by the central government, envisions a single platform for gathering data from multiple types of solar power systems, including standalone pumps, grid-connected pumps, distributed power plants, and rooftop plants. It aspires to be a one-stop shop for multiple stakeholders, including farmers, vendors and government agencies. It performs multiple functions like monitoring and management of pumps and complaint registration and redressal. The portal is designed, based on the prescribed standards of the Ministry of New and Renewable Energy (MNRE) for RMS systems. It has a multi-tiered structure with a state-level portal as the main portal with the raw data and dashboard displaying different performance metrics and the national portal providing a high-level view of solar pump schemes. Currently, MNRE is developing the portal for states, based on their demands and interests.

4. The way forward

The SEDM platform can resolve some of the data standardisation gaps. All states implementing solar pump promotion schemes should adopt the SEDM platform at the earliest. States will have to review their ongoing solar pump promotion scheme, to integrate these pumps into SEDM. States should also make an effort to enable the transition of already installed pumps to the SEDM platform.

However, data standardisation is only the first step. The states must also make sure that the vendors comply with the RMS requirements under their contracts, and ensure that the data is regularly logged for each installation. This can be achieved by introducing penalty clauses for non-compliance and incentivising the vendors through a grading system. Furthermore, states should ensure that vendors enter the static data, including geotags, addresses, and other farmer-related information. States should insist on creating in-built data quality checks within the state-level portal of SEDM.

Finally, the data is only as good as how it is utilised. Based on the challenges we faced and the insights we gained during this study, we make the following recommendations to the states:

- States should build the capabilities of the officials of the implementing agency to get them to utilise the insights from SEDM and integrate them into their decision-making process.
- States should recognise the need for developing an effective monitoring plan, since most of the issues regarding the existing portals—such as the lack of maintenance and data loss—are due to a lack of proper supervision by the implementing agencies. This challenge will continue, regardless of the platform and standardisation of data, unless states institute clear guidelines for the monitoring process.
- States should strongly encourage public access to the anonymised, block-level aggregated data from the SEDM. The data will help researchers and civil society to regularly analyse the state of publicly supported infrastructure, and to guide and shape future strategies for the deployment of solar pumps in the country.
- States should constantly review and revise their tender documents and other statutes, based on the insights generated from SEDM. Standards like minimum up-time and the amount of continuous downtime that should be considered as potential pump default, etc., can be decided on the basis of the data of the initial years.
- States should also train officials from departments other than the implementation agency, such as the agriculture and horticulture department, groundwater board, etc., in order to get them to use the SEDM for their decision-making.

Image: Alamy

The authors

Anas Rahman
anas.rahman@ceew.in

Anas is a Programme Associate at CEEW working on solar-powered irrigation and energy access for rural livelihoods. He is a Prime Minister's Rural Development Fellow and an alumnus of the Tata Institute of Social Sciences and IIT Madras.

Abhishek Jain
abhishek.jain@ceew.in | @ajainme

As a Fellow at CEEW, Abhishek develops and leads its practices on energy access, rural livelihoods, and sustainable food systems. He also directs 'Powering Livelihoods', a $3 million initiative. He has even co-conceptualised and currently leads CEEW's flagship research project, 'Access to Clean Cooking Energy and Electricity – Survey of States'. He is a Chevening Fellow and an alumnus of the University of Cambridge and IIT Roorkee.

Disclaimer:

The views expressed in this issue brief are those of the authors and do not necessarily reflect the views and policies of the Council on Energy, Environment and Water.

The views/analysis expressed in this report do not necessarily reflect the views of Shakti Sustainable Energy Foundation. The Foundation also does not guarantee the accuracy of any data included in this publication, nor does it accept any responsibility for the consequences of its use. For private circulation only.

Suggested citation:

Rahman, Anas, and Abhishek Jain. 2021. *Making Remote Monitoring of Solar Pumps Work for States.* New Delhi: Council on Energy, Environment and Water.

Peer reviewers:

Prasun Das, Technical Expert, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH; Ashwin Gmabhir, Fellow, Prayas Energy Group and Sunil Mani, Programme Associate, CEEW.

Organisations:

The **Council on Energy, Environment and Water (CEEW)** is one of Asia's leading not-for-profit policy research institutions. The Council uses data, integrated analysis, and strategic outreach to explain – and change – the use, reuse, and misuse of resources. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions, and engages with the wider public. In 2021, CEEW once again featured extensively across ten categories in the *2020 Global Go To Think Tank Index Report.* The Council has also been consistently ranked among the world's top climate change think tanks. CEEW is certified as a Great Place To Work®. Follow us on Twitter @CEEWIndia for the latest updates.

Shakti Sustainable Energy Foundation seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following areas: clean power, energy efficiency, sustainable urban transport, climate change mitigation and clean energy finance.

Council on Energy, Environment And Water (CEEW)
Sanskrit Bhawan, A-10, Aruna Asaf Ali Marg Qutab Institutional Area New Delhi 110 067, India
T: +91 11 4073 3300
info@ceew.in | ceew.in | @CEEWIndia | ceewIndia