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A CASE FOR HYBRID ROOFTOP SOLAR SYSTEMS FOR FASTER ADOPTION

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ABOUT

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In December 2021, the Ministry of Science and Technology, Department of Science and Technology (Policy Research Programme) made an open call for the submission of Expressions of Interest in STI Policy Research towards the Establishment of the Center for Policy Research (CPR) by the academic and research Institutes In India. After multiple rounds of consultations and review, the DST-CPR at NISER received the final sanction order from the Government of India, Ministry of Science & Technology, Department of Science & Technology, bearing the letter No DST/PRC/CPR/NISERBhubaneswar-2023 (G)(PCPM) dated 29/03/2023.

The primary focus of the DST-CPR at NISER is to study the Energy Transition, and the secondary focus is to study Tribal Education and Innovations for Tribal Education in Eastern India covering Odisha, Bihar, Chhattisgarh, Jharkhand, and West Bengal.

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ABBREVIATIONS

CFA:	Central Financial Assistance
DISCOM:	Distribution Company
GoI:	Government of India
IPCC:	Intergovernmental Panel on Climate Change
MNRE:	Ministry of New and Renewable Energy
NAPCC:	National Action Plan on Climate Change
NSM:	National Solar Mission
OERC:	Odisha Electricity Regulatory Commission
OREDA:	Odisha Renewable Energy Development Authority
PIB:	Press Information Bureau
PV:	Photo Voltaic
RTS:	Rooftop Solar
TPCODL:	Tata Power Central Odisha Distribution Limited
UN:	United Nations
VGF:	Viability Gap Funding
PMSG: MBY:	PM Surya Ghar: Muft Bijli Yojana
Kw:	Kilowatt
MW:	Megawatt
GW:	Gigawatt

EXECUTIVE SUMMARY

This policy brief explores the challenges and opportunities associated with the adoption of Rooftop Solar Systems (RTS) in Odisha, emphasizing the potential of hybrid systems (a combination of on-grid and off-grid) as a promising solution. Although Odisha possesses significant solar energy potential, RTS adoption remains limited due to high installation costs, low public awareness, and complex administrative procedures.

Currently, on-grid RTS systems in Odisha allow two-way power flow but lack storage capabilities, rendering them ineffective during power outages—an issue particularly problematic in rural areas. Hybrid systems, which integrate grid connectivity with backup power, offer a more reliable alternative and can help build consumer trust and boost adoption rates.

However, the uptake of hybrid RTS is further constrained by metering challenges, such as delays in net-metering approvals and technical glitches. To accelerate RTS adoption in the state, it is essential to promote hybrid systems and invest in consumer education, especially to demystify net-metering processes. In addition, enhanced financial incentives and stronger technical support are urgently needed to overcome existing barriers.

A Case for Hybrid Rooftop Solar Systems for Faster Adoption

BACKGROUND

The Government of India launched the PM Surya Ghar: Muft Bijli Yojana (PMSG: MBY) in 2024 to accelerate rooftop solar adoption and ensure energy sovereignty. The scheme aims to install RTS units in 1 crore households by FY 2026-27 with a total financial outlay of ₹75,021 crore. It provides a 60% subsidy for the first 2 kW of RTS capacity and a 40% subsidy for an additional 1 kW of capacity. This initiative is expected to generate 1,000 billion units of clean energy over 25 years and reduce 720 million tons of CO2 emissions, thereby enhancing energy security and lowering consumer electricity bills. By enabling households to produce their own electricity, the scheme aims to reduce dependence on grid power and promote energy independence.

CURRENT SCENARIO

As of May 2024, India's total installed solar capacity stands at 84.28 GW, which includes 66.07 GW of ground-mounted solar projects, 12.46 GW of grid-connected rooftop solar (RTS), 2.57 GW of hybrid projects, and 3.18 GW of off-grid solar. Despite India's overall progress in solar energy deployment, Odisha's contribution remains marginal. Odisha's total installed solar capacity is 495.83 MW, which accounts for just 0.58% of India's total installed solar capacity. The state's grid-connected RTS capacity stands at 48.42 MW, representing less than 0.4% of the country's total grid-connected RTS capacity. This highlights the limited penetration of RTS systems in Odisha compared to other states.

This study aims to identify the issues and challenges associated with low RTS adoption in Odisha and suggest relevant policy interventions to increase the adoption of RTS. For the study, RTS users, non-users, RTS dealers, and DISCOM officials were interviewed. The study involved structured interviews comprising 31 RTS users, 19 non-users, 5 RTS vendors, and 1 DISCOM official. The contact details of some RTS users were obtained from a local DISCOM, TPCODL. The respondents were spread across 13 districts of Odisha. The relevant data were collected by direct personal interview and telephonic interview during the period of 30th May 2024 to 19th June 2024.

OBJECTIVES OF THE STUDY

- ·To assess the issues and challenges associated with RTS adoption in Odisha
- ·To suggest policy interventions to increase the adoption rate in Odisha

LITERATURE REVIEW

Factors such as delays in the disbursement of subsidies, low residential electricity tariffs, unavailability of adequate financing options, delays in approval of net metering applications, and lack of consumer awareness have contributed to the slow adoption of rooftop solar in India (Garg, 2019). The issue of high cost was the most significant hindrance to adopting RTS in Delhi (Dutt, 2020). The govt mandates the use of DCR solar panels to avail subsidy, but these panels usually come with higher price tags and have lower performance in terms of electricity generation as compared to imported panels (Gulia et al., 2022).

Gulia, 2022 confirms that delays in the approval of the net metering process and disbursal of subsidies force residential consumers to revert their decision to install rooftop solar systems. The government's procedure is too time-consuming and requires a lot of documentation to make the subsidy available (Dutt, 2020). Complicated regulations and bureaucratic obstacles discourage individuals and businesses from adopting solar systems (Upadhaya, 2023).
A survey by Luminous Power Technologies, a manufacturer of solar panels, batteries, and inverters, reveals that high installation costs, lack of specialized skill, and accessibility are the top three reasons for the slow adoption of RTS (ET Energy World, 2024).

The lack of an efficient storage system is also a primary concern among RTS adopters (Upadhaya, 2023). Lack of information is a major obstacle to the adoption of RTS. Consumers don't have information about the costs of solar panels, and they are unaware of the associated benefits. Households find it difficult to understand the benefits of selling excess energy back to the grid (Prasad et al., 2020). The lack of adequate financing options for the RTS system is a critical barrier to the adoption of RTS. Due to the poor resale value of the RTS system, lenders are reluctant to provide such financing options (Gulia et al., 2022).
Purohit et al., 2024 explored the potential of IT solutions for accelerating RTS adoption in Odisha. Each project installation requires the involvement of multiple agencies such as the MNRE, SNA of OREDA, local DISCOMs, etc., which leads to an increase in installation time; subsequently, the subsidy disbursal takes 6 months to 1 year. So, they suggested setting up a web-based platform that integrates all implementing agencies to streamline the process, reduce time, and enhance efficiency. Due to the technical aspect of an RTS system, it requires a large workforce of skilled workers. However, there is a lack of skilled workforce in the labour market which is harming the progress of RTS adoption (Rathore, 2018).

The demographic profiles of RTS adopters and non-adopters are significantly different. Adopters have higher education and better education than non-adopters (Satapathy, 2020). This study aims to identify the issues and challenges associated with low RTS adoption in Odisha and suggest relevant policy interventions to increase the adoption of RTS. For the study, RTS users, non-users, RTS dealers, and DISCOM officials were interviewed. The study involved structured interviews comprising 31 RTS users, 19 non-users, 5 RTS vendors, and 1 DISCOM official. The contact details of some RTS users were obtained from a local DISCOM, TPCODL. The respondents were spread across 13 districts of Odisha. The relevant data were collected by direct personal interview and telephonic interview during the period of 30th May 2024 to 19th June 2024.

FINDINGS

The adoption of RTS in Odisha is primarily concentrated in urban areas, where households with higher income levels are more likely to install solar systems. Over 55% of RTS users have monthly household incomes exceeding ₹80,000, whereas 63% of non-users have monthly incomes below ₹40,000. Higher electricity consumption appears to be a major factor influencing RTS adoption. Among RTS users, 54% reported paying more than ₹4,000 in monthly electricity bills during the summer months before installing RTS. This indicates that high electricity costs are driving RTS adoption among higher-income households. The reasons for adopting RST among the 31 RTS users are highlighted in Figure 1.
Lengthy administrative procedures and slow net-metering approvals also hinder Odisha's current RTS installation process. The average time for RTS installation is 95 days, with some installations taking up to 1 year. Similarly, net-metering approval takes an average of 44 days, with some cases extending to 4 months. These delays discourage consumers from adopting RTS and contribute to low adoption rates.

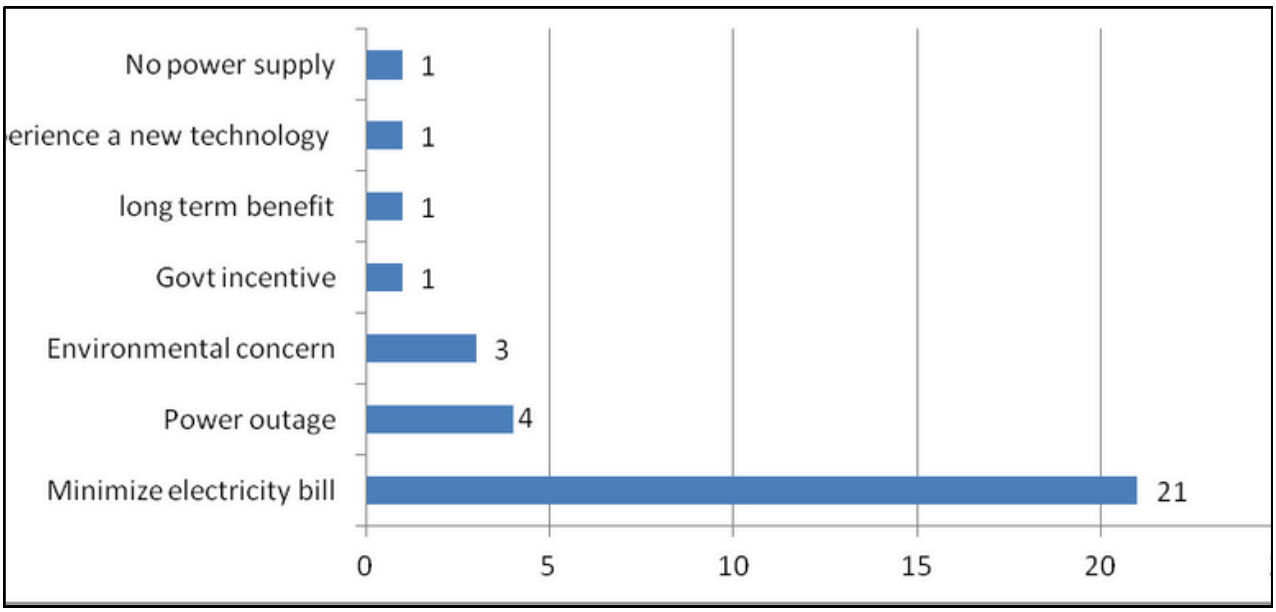

Figure 1: Reasons for Installing RTS

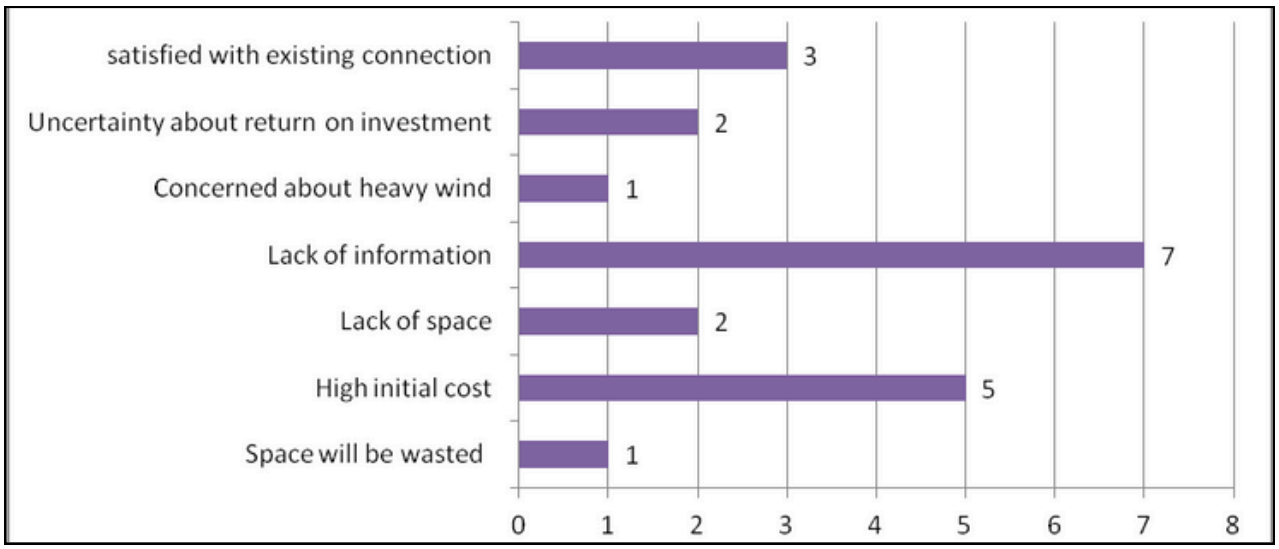

Figure 2: Reasons for not Installing RTS

Moreover, the lack of skilled technicians and inadequate financing options further limit RTS adoption in Odisha. Financial institutions are often reluctant to provide loans for RTS installations due to the poor resale value of solar systems, making it difficult for consumers to secure funding.

CHALLENGES ASSOCIATED WITH LOW RTS ADOPTION

TECHNICAL LIMITATIONS

- On-grid Rooftop Solar (RTS) systems in Odisha cease to operate during grid outages due to the absence of energy storage, which significantly deters adoption in regions with frequent power interruptions.
- Although the Ministry of New and Renewable Energy (MNRE), Government of India, has introduced policy frameworks under the Pradhan Mantri Suryodaya Yojana: Mukhyamantri Bijli Yojana (PMSG: MBY) to incentivize the deployment of hybrid RTS systems with integrated battery storage and hybrid inverters, implementation progress in Odisha has been sluggish.
- State-level initiatives, such as the 'Green City Mission,' aimed at promoting hybrid RTS adoption, have encountered significant obstacles, including bureaucratic delays, inadequate coordination among relevant departments, and difficulties in site identification and system planning.
- At the household level, the uptake of hybrid RTS systems is further impeded by persistent challenges in the net-metering process—such as delays in application approval, the presence of legacy rural grid infrastructure incapable of supporting bidirectional energy flow, and widespread consumer misconceptions regarding the financial implications of net-metering.
- A notable proportion of potential users mistakenly believe that exporting electricity to the grid will result in increased electricity charges.
- Under net metering, the electricity bill reflects the net energy consumption (imported minus exported).
- Consumers often expect their bills to drop to zero, but in reality, they still need to pay for fixed charges, grid maintenance fees, and other non-energy-related costs.
- Rural grids are often weak and prone to frequent power cuts.
- If the grid is down, on-grid RTS systems with no backup (non-hybrid) will stop working.
- Hybrid systems with battery storage can provide backup during outages, but the reverse flow of power during outages can further destabilize the grid.

HIGH INITIAL COST

- The average cost of an RTS system is ₹65,408/kW, exceeding the government's benchmark of ₹50,000/kW.
- Consumers must cover the full installation cost upfront before receiving subsidies.

LENGTHY ADMINISTRATIVE PROCESS

- Average installation time: 95 days (up to 1 year in some cases).
- Average net-metering approval time: 44 days (up to 4 months).

LACK OF AWARENESS

- 84% of non-users are unaware of on-grid RTS systems.
- 47% of non-users are unaware of government subsidies and incentives.
- Some consumers believe that installing an RTS system will increase their electricity bills because they assume that they will be charged for exporting electricity back to the grid
- Some consumers assume that they will receive the same tariff for exported power as they are charged for imported power — but in Odisha, exported power is often credited at a lower rate.

- Some consumers expect their hybrid RTS system to work like a generator during power cuts.
- Unless the hybrid system includes sufficient battery capacity, it cannot provide backup for prolonged outages.

FINANCING BARRIERS

- Lack of financing options for RTS systems from banks and financial institutions.
- Banks are reluctant to provide loans due to the poor resale value of RTS.

WORKFORCE SHORTAGE

- Shortage of skilled technicians for RTS installation and maintenance.
- Limited capacity of local vendors to handle the demand.

SOLUTIONS

HYBRID SYSTEMS AS A SOLUTION

- Hybrid systems combine the benefits of grid connectivity with battery storage, ensuring power availability during outages.
- Installing hybrid RTS can address consumer concerns about power reliability and increase confidence in solar adoption.
- Hybrid systems enable consumers to store excess solar energy and reduce dependency on grid power.
- Odisha needs to promote grid modernization supporting two-way energy flow and consumer education, removing confusion about how net-metering works to foster large-scale adoption of hybrid RST

EXPAND PMSG: MBY

- Modify the PMSG: MBY scheme to provide subsidies for hybrid RTS installations.
- Offer higher financial incentives for hybrid systems to cover the additional cost of battery storage.

DIRECT FINANCIAL ASSISTANCE

- Provide upfront subsidies to reduce the financial burden on consumers.
- Explore phased subsidy disbursement to improve vendor and consumer cash flow.

STREAMLINE INSTALLATION AND APPROVAL PROCESS

- Implement a single-window clearance for RTS applications.
- Set a strict timeline for net-metering approval (within 30 days).
- Develop a fast-track approval system for hybrid RTS installations.

STRENGTHEN AWARENESS AND TRAINING

- Conduct targeted awareness campaigns about hybrid systems and their benefits.
- Include hybrid solar technology in vocational training programs for technicians.

INTRODUCE FINANCING OPTIONS

- Mandate banks to offer low-interest loans for hybrid RTS installations.
- Introduce EMI-based payment options to make hybrid systems affordable.

CONCLUSION AND POLICY RECOMMENDATIONS

Despite Odisha's high solar energy potential, RTS adoption remains low, with a large disparity between urban and rural areas due to high installation costs, limited awareness, lack of backup during power cuts, and lengthy administrative processes. The introduction of hybrid RTS systems can transform Odisha's solar energy landscape by addressing the reliability and affordability concerns associated with on-grid systems. Hybrid systems would allow households to store excess solar energy and use it during power cuts, ensuring an uninterrupted electricity supply.

However, the adoption of hybrid RTS in Odisha is further hindered by administrative delays, poor inter-departmental coordination, site identification challenges, and, most importantly, metering issues such as delayed net-metering approvals, outdated rural grid infrastructure incapable of supporting two-way energy flow, and consumer confusion about how net-metering will affect their electricity bills. The government should mandate a fixed timeline for net-metering approvals and streamline the installation process through a single-window clearance system. Grid modernization supporting two-way energy flow should be the government's utmost priority.

Financing options should be improved by offering low-interest loans and EMI-based payment plans for hybrid RTS systems. Public awareness campaigns should focus on the benefits of hybrid systems, especially in rural areas. Technical training programs should be developed to create a skilled workforce capable of installing and maintaining hybrid RTS systems. Insurance schemes should be introduced to protect solar installations from natural disasters, and local vendors should receive financial support to strengthen the supply chain.

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