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POLICY BRIEF | APRIL 2018

Using Solar Technologies to Increase Household Satisfaction with Power Supply

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Introduction

Access to daily hours of grid electricity is strongly associated with people's subjective satisfaction with power supply. But users of off-grid solar power are less sensitive to the number of hours available. Where grid electricity is unavailable or unreliable, technologies such as solar home systems offer an alternative that rural households value.

Subjective satisfaction with electricity access plays a key role in driving demand for off-grid technologies, which are becoming increasingly important in rural electrification efforts. However, the issue has been relatively unstudied. Using the 2014-2015 ACCESS survey conducted by the Council on Energy, Environment and Water in collaboration with Columbia University and Shakti Sustainable Energy Foundation, in six energy-poor states in India (Bihar, Jharkhand, Madhya Pradesh, Uttar Pradesh, Odisha, and West Bengal) we examine levels of satisfaction across technologies and investigate patterns of subjective satisfaction as they relate to average daily hours of electricity usage across users of

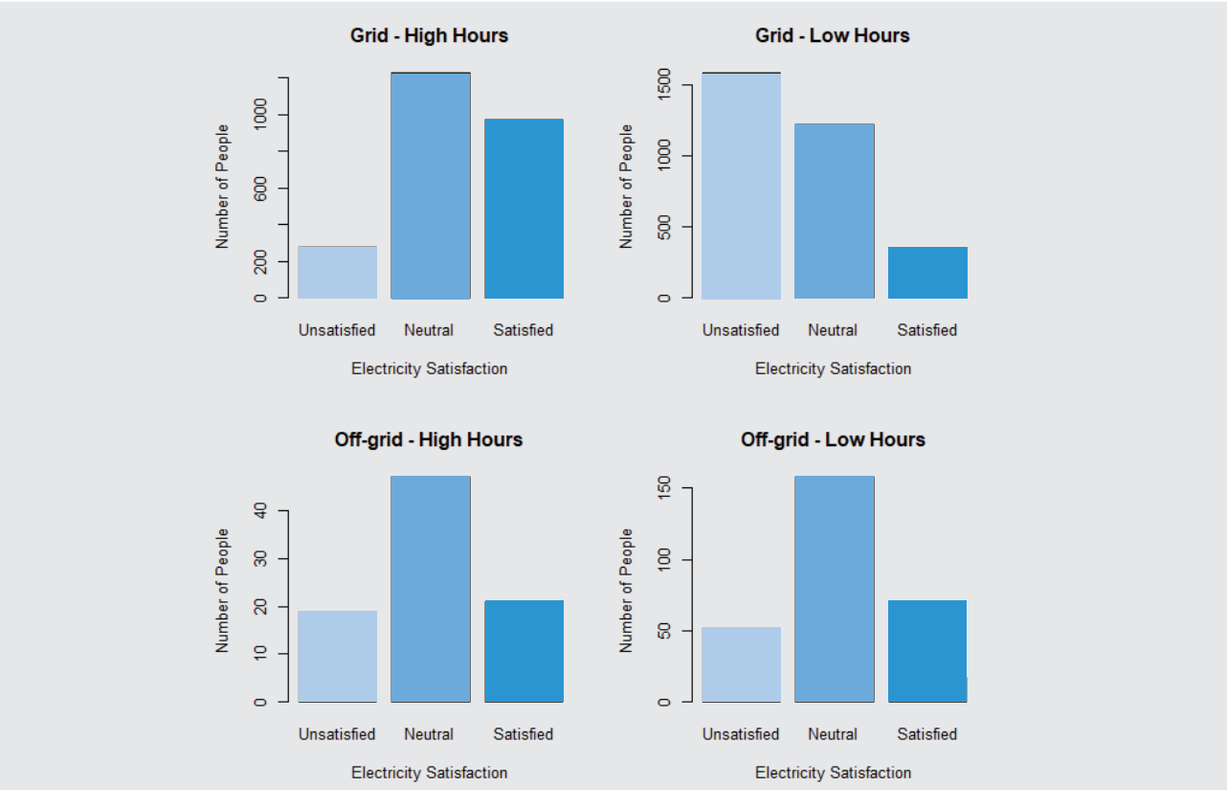
different technologies. Our findings confirm there is a robust association of electricity hours and satisfaction. The association is stronger among users of grid electricity and weaker for those who rely on off-grid technologies, especially solar home systems.

Analysis

Household electrification remains a pressing and well-recognised challenge for governments, though off-grid alternatives to grid extensions have begun to address the problem in some areas. However, the issue of subjective satisfaction has been relatively unstudied, especially with respect to off-grid technologies such as solar lanterns, home systems, and micro-grids. We attempt to fill this research gap by using the 2014-2015 ACCESS survey of 8,566 households in six energy-poor states of India (Bihar, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal). Using statistically representative data from the survey, we examine levels of subjective satisfaction across technologies—grid electricity, solar home systems (SHS), and micro-grids (solar or diesel)—and investigate how patterns of subjective satisfaction depend on average daily hours of electricity across users of different technologies.

Respondents to the ACCESS survey who reported having electricity access rated their satisfaction with their electricity access as being unsatisfied, neutral, or satisfied, which we treated as a three-point scale from 0 to 2. Mean reported satisfaction in the six states from highest to lowest are 1.55 in West Bengal, 1.10 in Odisha, 0.80 in Uttar Pradesh, 0.78 in Bihar, 0.74 in Madhya Pradesh, and 0.52 in Jharkhand., which would be interpreted as relatively satisfied in West Bengal and neutral or unsatisfied in the other five states. However, these numbers alone do not tell the whole story as they do not account for the different technologies being used for electricity access.

We compare respondents' subjective satisfaction with their electricity access depending on whether they have a grid connection or rely on off-grid technologies. Our analysis is based on the 5,953 respondent households that reported having access to some electricity. We focus on responses to questions about the specific technology through which they access electricity, their subjective satisfaction with their electricity access, and the number of hours of electricity they receive. Grid electricity users are defined as respondents who have grid electricity access at home. Respondents without grid electricity are coded according to



Source: Authors' Analysis

whether they have solar home systems (SHS) or micro-grids, which were predominantly diesel-based. This coding ensures that there is no overlap between users of grid electricity with users of off-grid technologies and minimal overlap between off-grid technologies.

Our findings confirm a robust positive association of electricity hours and satisfaction as found in Aklin et al. (2016), though off-grid users are less dissatisfied compared to grid users at lower numbers of electricity hours. In addition, we find that the relationship between electricity hours and satisfaction is stronger among users of grid electricity and weaker among those who rely on off-grid technology, especially solar home systems. This pattern may in part be explained by the fact that in off-grid solutions, electricity, even though for limited hours, is available in the hours when needed the most, which is not the case with grid electricity always, despite longer duration of supply.

The graph illustrates the role that electricity source and number of electricity hours play in subjective satisfaction. The graph shows subjective satisfaction levels by high and low hours for grid and off-grid electricity users, with the off-grid category consisting of both SHS and micro-grid users. High and low hours is determined by the mean number of electricity hours of each category: 12.7 or more hours is considered high for grid electricity and at least 4.755 hours for off-grid. While the distribution of satisfaction is relatively similar for off-grid users with high hours compared to low hours given the lower number of respondents for that group, there is a significant difference between grid users with high hours and those with low hours. Grid users with high hours have relatively low levels of dissatisfaction with a plurality being neutral while a majority of grid users with low hours report being unsatisfied with their electricity access.

With off-grid technologies playing an increasingly important role in rural electrification, understanding how subjective satisfaction drives demand for these technologies and is affected by rural households' expectations and aspirations for grid and off-grid technologies is key to understanding the development of distributed energy markets. Our results suggest that many rural households may have much higher expectations from grid electricity than that of off-grid solutions. Moreover, off-grid solutions users may have more realistic expectations that account for their lower dissatisfaction despite a lower number of electricity hours. Further, the fact that even though for less number of hours, off-grid solutions providing electricity during hours when it is needed the most could be the primary driver for higher satisfaction despite lower hours of supply. Our results present a greater challenge for governments responsible for grid extension and electricity delivery, in terms of improving the duration of supply significantly to improve households' subjective satisfaction. Whereas, they offer an opportunity for off-grid companies that are able to impress customers with better-than-expected service.

POLICY RECOMMENDATIONS

- Subjective satisfaction with grid connectivity is highly sensitive to daily hours of electricity access.
- Where grid electricity is unavailable or unviable, off-grid technologies offer an alternative that rural households value.
- Improving the availability and affordability of off-grid solar technologies can produce substantial gains in rural areas with low-quality grid electricity supply.

HIGHLIGHTS

Our findings confirm a robust positive association of electricity hours and satisfaction as found in Aklin et al. (2016), though off-grid users are less dissatisfied compared to grid users at lower numbers of electricity hours. In addition, we find that the relationship between electricity hours and satisfaction is stronger among users of grid electricity and weaker among those who rely on off-grid technology, especially solar home systems.

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ABOUT CEEW

The Council on Energy, Environment and Water (http://ceew.in) is one of South Asia's leading not-for-profit policy research institutions. CEEW 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 2018, CEEW has once again been featured across eight categories in the '2017 Global Go To Think Tank Index Report'. CEEW has also been consistently ranked among the world's top climate change think tanks. Follow us on Twitter @CEEWIndia for the latest updates.

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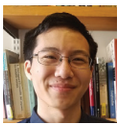
The Initiative for Sustainable Energy Policy (ISEP) is an interdisciplinary research program that uses cutting-edge social and behavioral science to design, test, and implement better energy policies in emerging economies.

Hosted at the Johns Hopkins School of Advanced International Studies (SAIS), ISEP identifies opportunities for policy reforms that allow emerging economies to achieve human development at minimal economic and environmental costs. The initiative pursues such opportunities both pro-actively, with continuous policy innovation and bold ideas, and by responding to policymakers' demands and needs in sustained engagement and dialogue.



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