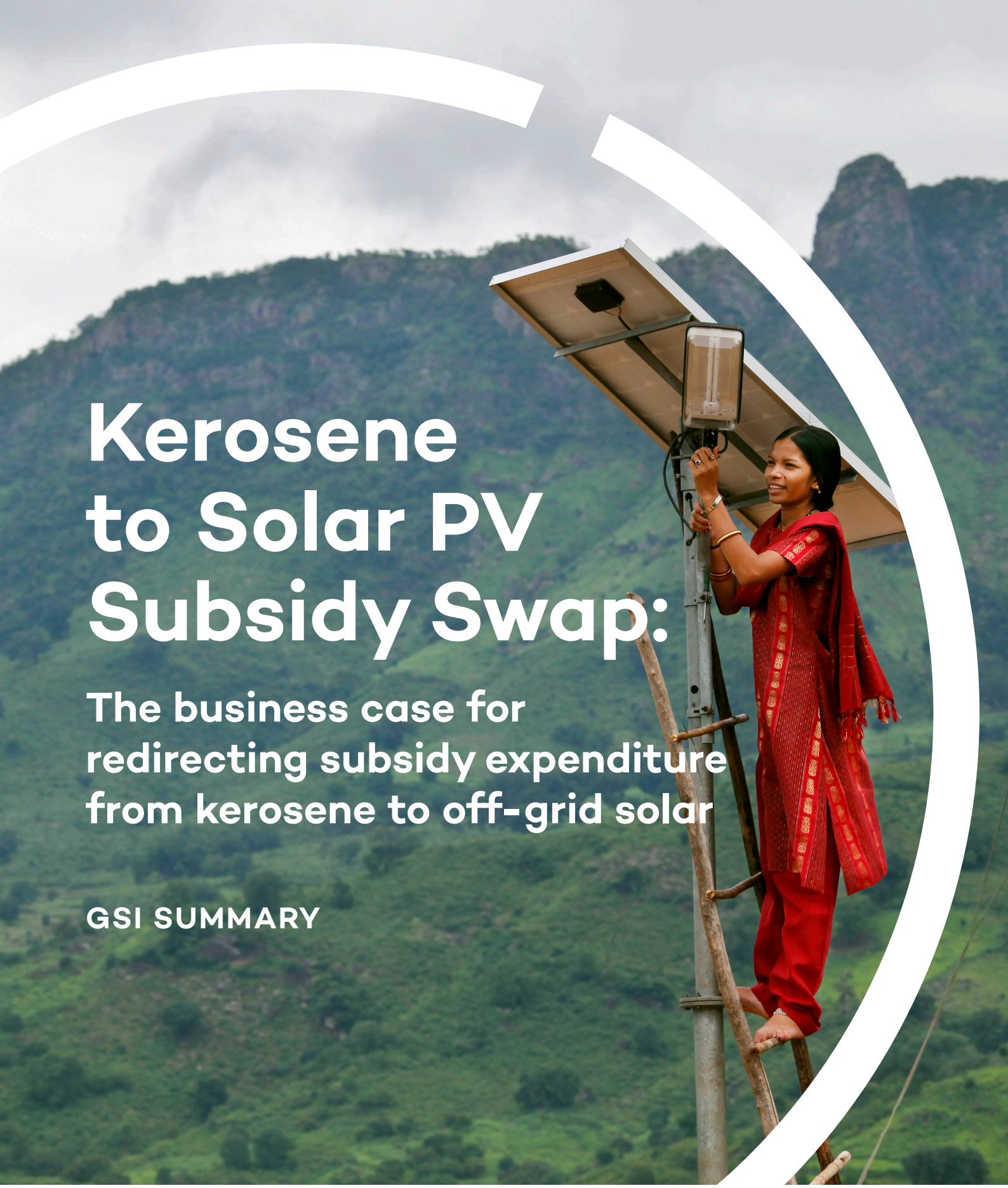

Kerosene to Solar PV Subsidy Swap:

The business case for redirecting subsidy expenditure from kerosene to off-grid solar

GSI SUMMARY

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Global Subsidies Initiative

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July 2018

Executive Summary

India is aggressively moving toward its target of universal household electrification by March 2019 (Ministry of Power, 2017). Solar power has a key role to play in this transition. Market trends suggest that this will involve a combination of grid-connected and decentralized energy systems, including standalone solar lighting products and solar home systems (SHSs). India became the third largest grid-scale solar photvoltaic (PV) market in the world in 2017, reaching a total installed capacity of 8.8 GW (Bridge to India, 2017); that year, it also recorded its highest sales volume of off-grid products, with 1 million branded pico PV and SHS products sold in the first half of 2017 (Gada, 2017). Pico PV products under 3 watt peak capacity (Wp)—like solar lanterns, study lamps, task lights and torches—make up a considerable share of the off-grid solar market as affordable backup lighting systems, in both high quality and cheaper, non-quality-assured options. According to the International Energy Agency (IEA), off-grid systems including solar PV and mini-grids are the least-cost solution for three quarters of the additional connections required in India to provide electricity for all by 2030 (IEA, 2017a).

Nonetheless, despite recent progress, and the wide range of on- and off-grid electricity and lighting options, a large number of marginalized households in India continue to remain without power. This is due to a range of factors—their geographical isolation, the upfront cost of such systems, the lack of access to solar distribution supply chains, the lack of consumer awareness of the technology and access to consumer finance.

Surprisingly, a key opportunity to further invest in household clean energy access is not a renewable energy policy, but a policy on fossil fuel subsidy reform—to be precise, kerosene subsidy reform.

For many years, the Government of India has sought to gradually reduce kerosene subsidy expenditures by increasing product prices and restricting the volume of subsidized fuel supply. Kerosene subsidies were originally provided as a way to promote access to affordable fuel for lighting and cooking—but the case for reform is compelling. Kerosene contributes to household indoor air pollution and has negative impacts on health, particularly for women and children. The subsidies are also costly and inefficient because it is easy for fuel to be illegally diverted in the distribution system.

If kerosene subsidies are being gradually removed, can a share of the subsidy savings not be reinvested in helping the most vulnerable households access electric lighting through off-grid solar technologies? This paper explores this idea in detail, referring to it as a "kerosene to solar subsidy swap" or a "subsidy swap."

A kerosene to solar swap could create sufficient funds to provide a pollution-free and cost-effective alternative for lighting some of the most vulnerable homes in India. It is estimated that government expenditures on kerosene subsidies could fund the full capital cost of 350 million entry-level solar lanterns over 1.5 years or 97 million mid-level solar lanterns over two years (Garg, Sharma, Clarke, & Bridle, 2017).

To further explore the feasibility of this concept, this study:

- Reviews the extent to which pico solar PV products (see Box 1) are currently available on the market to provide an affordable, reliable, direct replacement for lighting with kerosene.
- Examines how the current business models and market structure for the suppliers of these products could enable a subsidy swap.
- Presents an analysis of household usage patterns for subsidized kerosene in Uttar Pradesh and Odisha to determine the feasibility of the replacement of kerosene lamps with pico solar systems.
- Reviews the suitability of Uttar Pradesh and Odisha to host a subsidy swap pilot study, assessing the real-world impact of increased adoption of solar energy and a reduction in kerosene consumption.

The study finds that there are in fact a large number of products available that present a practical replacement for kerosene lamps. Nearly 200 pico PV products from various manufacturers were identified and reviewed.

Subsequently, 15 pico PV products were identified as meeting the specified price, quality and performance criteria deemed necessary to reliably replace kerosene at an affordable price.

These shortlisted products are manufactured by d.light, Greenlight Planet, Omnivoltaic Power Co. Ltd (OV Solar), RAL Consumer Products Ltd. and Barefoot Power. All five companies import fully integrated products made at their manufacturing units in China. These companies sell products that have achieved laboratory certification and are manufactured according to international quality standards (Box 1). These companies' products have been used for analysis because third-party certification provides indication of quality; data on sales from these companies was available from IFC-World Bank Lighting Global program and the Global Off-grid Lighting Association; and international certification requires companies to publish data on product specifications and distribution channels.

This shortlist should not be taken as an endorsement of only these specific products. Indeed, many other competing products are likely to be perfectly adequate alternatives—it was simply not possible for this report to assess them in detail. There remains an active debate about the role of certification schemes to ensure that consumers are protected from substandard products. Rather, the key conclusion of the review is that there is a surfeit of available, market-ready options for reinvesting kerosene subsidies into solar lighting, including but not limited to the shortlisted products. A summary of market segmentation and quality standards is shown in Box 1.

Box 1: Pico PV market segmentation and certification

Globally, the market for standalone solar products is essentially divided into two product segments based on their power capacities.

- All systems below 10.999 Wp are classified as pico PV systems and include integrated solar lanterns, study lamps, task lights, solar torches and basic solar home lighting systems (GOGLA, 2017).
- Products with capacities of 11 Wp and above are classified as solar home systems and come in varying configurations.

This study focuses on the pico PV product category, specifically on products priced at or below INR 3,000 to equate it to expenditure on kerosene.

In the Indian market, pico PV products are available in three categories depending on their certification:

1. **Products certified to international quality standards** for pico PV solar products according to laboratory testing standards as defined by IEC/TS 62257-9-5 and manufactured to Lighting Global Solar Home System Kit Quality Assurance Protocols.
2. **Indian-verified products** that follow quality standards defined by the Ministry of New and Renewable Energy (MNRE) and/or other independent testing laboratories.
3. **Unverified products** that have not been certified to any quality or performance standards.

Sales data was only available for the first of these categories.

A second finding is that there is a wide range of business models adapted to different contexts. Some companies provide financing through microfinance institutions, some partner with established retailers, and others have worked with social enterprises for distribution and after-sales service. As different niches develop for pico PV products, business models will continue to develop. In terms of geography, a counter-intuitive finding was that some companies found grid-connected areas to be significant drivers of sales, as consumers who had access to electricity sought lighting during power outages. This indicates that the solar industry may continue to co-exist with the electricity grid to a greater extent than might have been assumed. It was also noted that distribution

networks were weaker in more rural areas, where kerosene use for lighting was most widespread. This may have been due to a lack of access to capital, a lack of awareness of the technology or other factors relating to the attractiveness of these markets.

Analysis of the potential for a kerosene to solar subsidy swap in Uttar Pradesh (UP) and Odisha through a series of consultations with government representatives, solar suppliers and end users in Bijnor district (in western UP) found that kerosene subsidies often incentivized the consumption of the fuel for purposes other than lighting or cooking, particularly as a transport fuel. This indicates that the kerosene subsidy as currently designed is not well targeted. The consultations also found that pico PV products in western UP were largely used as secondary backup devices, as most households had access to grid electricity and used grid or solar charged inverters as primary backup options during power failures. Initial research suggests that eastern UP may have more demand for pico PV as a primary source of lighting, and therefore a subsidy swap pilot in this area may achieve greater impact.

In Odisha, the proportion of unelectrified households (even in grid-connected areas), in combination with their dependence on kerosene for lighting and cooking, presents a good market scenario for pico PV products as well as for other solar-based electricity solutions in the state. There is a strong presence of both internationally verified and Indian-verified solar products in Odisha, which indicates that end users are familiar with the technology and there may be potential to swap subsidies from kerosene to solar to accelerate the uptake of solar lighting products. The existing Public Distribution System (PDS) network may be able to be co-opted to engage consumers to replace kerosene with clean solar lighting alternatives.

However, a complication that needs to be considered here is that end users in Odisha rely on kerosene for both lighting and cooking (in the absence of reliable and affordable liquefied petroleum gas or other clean and efficient resources). While a subsidy swap to solar PV can displace kerosene used for lighting, it cannot replace the cooking side of the equation. The state government's opposition to reductions in kerosene quotas is also a key factor that must be considered and explored further to understand the acceptability and feasibility of a kerosene to solar subsidy swap model in the state.

In summary, this report finds that:

- There are numerous market-ready solar products that can replace traditional kerosene lamps at the same or lower cost than existing kerosene subsidies.
- As supply chains strengthen, solar is already starting to replace kerosene in some places.
- In other parts of India, widespread use of subsidized kerosene for lighting continues and could be replaced by these products.

A consolidated government push for a kerosene to solar subsidy swap policy could enable households to transition away from an unhealthy, costly fossil fuel and toward clean and competitive pico solar systems. Further, pilot studies on existing business models can help to identify the impacts of possible swap policies and to design mitigation options to ensure robust policy design and policy effectiveness. This report encourages policy-makers and energy sector stakeholders to further explore the development and implementation of a subsidy swap to support the kerosene to solar transition.

To read full report visit: http://bit.ly/2uRUrcD
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