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A VERY SHORT POLICY BRIEF

Promoting Off-Grid Solar Energy in India

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Summary

For hundreds of millions of Indians without reliable central grid electricity, off-grid solar products are an attractive option that can provide access to basic electricity supply. 'Off-grid solar products' include solar lanterns and household-scale solar systems designed to operate independently of any electricity grid. This Very Short Policy Brief reviews India's off-grid solar market and identifies key interventions that can promote its development, and therefore energy access in India, including:

1. A new subsidy mechanism to support Below Poverty Line (BPL) households to buy off-grid solar products.
2. Platforms to provide public education and information about the quality and performance of off-grid solar products.
3. Better labelling of off-grid solar products.
4. Building capacity for the repair and recycling of solar products and batteries.

Electricity Access in India

As of 2018, the electricity grid reaches all of India's more than 600,000 villages.[1] Despite this extraordinary achievement in extending electricity infrastructure, approximately 29 million households, 200 million Indians, do not have an electricity connection. [2,3] In India, a village is officially recorded as electrified when just 10 percent of households have connections.

Millions of households with electricity connections receive unreliable supply. More than fifty per cent of electrified rural households in the states of Uttar Pradesh, Bihar, Madhya Pradesh, Jharkhand, Odisha, and West Bengal receive less than 12 hours of supply in a day. [4]

Many poor households cannot afford to pay for a connection or monthly minimum electricity tariffs. This situation continues even though government programmes promise free electricity connections and electricity to Below Poverty Line (BPL) households. Other households do not take a connection because of unreliable electricity supply. Electricity distribution companies in most states impose hours of power cuts every day to limit the financial losses they accrue from supplying electricity at below-cost tariffs to rural areas.

Off-grid solar products can deliver basic electricity supply for households that cannot rely upon the electricity grid. The cost of solar modules has fallen rapidly, making them affordable. The Solar Home System (SHS) is the most common off-grid solar product sold to populations without electricity throughout the developing world. The SHS is a 'plug and play' system, that typically includes a module, battery, charge controller, lights, and wiring. Low-powered electrical devices can be powered by SHSs, such as LED lights, radios, mobile phones, and televisions. Branded solar lanterns have also been developed and commercialised in recent years for the off-grid market.

To date, the number of Indian households relying on solar power for lighting is still small relative to potential. Census statistics in 2011 revealed just over one million households using solar power as a main source of lighting.[5] However, the off-grid solar market is now growing rapidly. Annual sales of off-grid solar products are close to two million units. [6]

In sum, tens of millions of households are unlikely to access reliable electricity from India's grid in the short to medium term. India's off-grid solar market has the potential to grow rapidly in the coming ten years, with off-grid solar products providing these households with reliable basic electricity.

1. Government of India's "GARV" electrification dashboard. Accessed July 4 2018 from http://www.garv.gov.in/dashboard
2. Government of India's "Saubhagya" electrification dashboard. Accessed July 4 2018 from http://saubhagya.gov.in/dashboard
3. International Energy Agency (2015) World Energy Outlook 2015. Paris: International Energy Agency. 436
4. Jain, A., Urpelainen, J., Stevens, L. (2016) Energy Access in India, Rugby, UK: Practical Action Publishing. Accessed July 4 2018 from http://dx.doi.org/10.3362/9781780446639
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6. World Bank/Dalberg (2018) The 2018 Off-Grid Solar Market Trends Report, International Finance Corporation. Accessed July 4 2018 from http://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

India's Off-Grid Solar Market

India's off-grid solar market has developed over the last twenty years, from a low base. It is a liberalised competitive market, with limited regulation. Numerous private manufacturers and dealers sell and distribute branded domestic and imported solar products. Formal and informal businesses retail a wide range of off-grid solar goods throughout rural India.

In the 1990s/ 2000s a handful of pioneering businesses and social enterprises started to sell significant numbers of SHSs and solar lanterns in rural India. They were motivated by ambitions to extend energy access to rural, unelectrified households. They were enabled by rapid falls in the cost of solar module and LED light technologies. They sold good-quality, standardised SHSs and branded solar lanterns, together with after-sales servicing and, in several instances, with consumer financing. Notable examples of businesses selling SHSs include the social enterprises SELCO in Karnataka and TATA Solar Power operating throughout India. D.Light and SunKing expanded the sale of good-quality solar lanterns through India during this period.

Also in the 1990s, the Government of India begun to support the establishment of Akshay Urjaa ('Everlasting Energy') shops in each district of every state throughout the country. The first of these were run by state-level nodal agencies, manufacturer's associations, and NGOs. However, from 2002 onwards the government also supported the establishment of Akshay Urjaa shops being set-up and run by private entrepreneurs.

Since 2010, numerous manufacturers and dealers have entered the market, and sales have risen rapidly. At a retail level, most states have seen a proliferation of formal and informal businesses selling off-grid solar goods. There are few barriers to entry into business, with products easily accessible from dealers. Unlike older solar businesses, such as SELCO, which sell customers branded SHS packages with warranties and guarantees, many of these new businesses offer low-priced components for setting up self-assembled SHSs without any such assurances. Self-assembled SHSs using low-quality photovoltaic (PV) modules can be up to 50 per cent cheaper than branded, standardised SHSs.[7] Many Indians buy solar products incrementally, starting with just a basic solar module and lights, and later adding other components and products as needed over time.

Several innovative social enterprises have been established in recent years, seeking to fill niche opportunities in the off-grid solar market. For example, Australia's Pollinate Energy is successfully marketing and financing good-quality, branded solar lanterns to low-income people living in informal settlements in Indian cities.

Businesses and social enterprises selling good-quality SHSs and branded solar lanterns continue to operate regionally, yet none have scaled-up.[8] The off-grid solar market is now characterised by large numbers of informal shops selling mostly low-quality solar goods.[9]

7. Balls, J. (2017) "Fluid Capitalism at the Bottom of the Pyramid: A Study of the Off-Grid Solar Power Market in Uttar Pradesh, India" DPhil diss. Oxford: University of Oxford

8. World Bank/Dalberg (2018) The 2018 Off-Grid Solar Market Trends Report, International Finance Corporation. Accessed July 4 2018 from http://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

9. Singh, K. (2017) Of sun gods and solar energy. Issues in Science and Technology. 33:2. 48

Past Interventions to Support the Development of India's Off-Grid Solar Market

The Government of India and international development actors have since the 1990s actively intervened to support India's off-grid solar market. Interventions have been targeted towards promoting a competitive for-profit private market and at subsidising the sale of good-quality products.

1. The Government of India

In 2010, the Government of India launched the Jawaharlal Nehru National Solar Mission (JNNSM) scheme to promote renewables in India. As part of this scheme, customers who purchased a government-approved SHS from a government-approved dealer or retailer received a subsidy by way of a loan from a rural development bank. India's National Solar Mission programme distributed approximately seven million subsidised SHS,[10] but subsidies were discontinued after the Bharatiya Janata Party (BJP) assumed government in 2014. Since 2014, the Government of India has stepped back from supporting India's off-grid solar market. It has instead focused on grid-based electrification.

Individual states have acted to promote off-grid solar markets through various state-level programmes.

2. International development actors

In the 1990s, the World Bank provided financing to promote India's off-grid solar market through their General Environment Facility (GEF) fund.[11] The UK's Department for International Development (DFID) and other international development funds have supported a number of off-grid solar programs. More recently, the Asian Development Bank (ADB) invested in the off-grid solar company Simpa Networks, which sells SHSs to customers using a pay-as-you-go payment model.[12]

Challenges for India's Off-grid Solar Market

India's off-grid solar market faces four key challenges in its continued development. Overcoming these will be necessary to effectively and sustainably serve the electricity needs of millions of poor households.

1. Targeted subsidies and financing

Currently there is no systematic nationwide subsidising of off-grid solar products. Subsidies and financing options have an important role to play in helping millions of Indians with low levels of disposable income to buy or finance good-quality off-grid solar products. During the last two decades, when the off-grid solar market was still nascent, various interventions by the Government of India and by international development actors helped hundreds of thousands of low-income households buy good-quality branded SHSs and solar lanterns.

Even as the off-grid solar market has matured, and solar PV modules have fallen in price, a new subsidy mechanism that targets support to below poverty line (BPL) households is necessary. Without such a subsidy, millions of poor households will remain locked out of the market or will only be able to buy poor-quality off-grid solar goods.

10. World Bank/Dalberg (2018) The 2018 Off-Grid Solar Market Trends Report, International Finance Corporation. Accessed July 4 2018 from http://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

11. Martinot, E., Cabraal, A., Mathur, S. (2001) World Bank/GEF solar home system projects: Experiences and lessons learned 1993-2000. Renewable & Sustainable Energy Reviews. 5:1. 39-57

12. ADB (2013) Affordable Pay-As-You-Go Solar Power for India's Energy-Poor Homes. Manila: Asian Development Bank

2. Poor quality off-grid solar products.

Numerous businesses now import solar PV modules and off-grid solar products from outside India and distribute them around the country to retailers. These businesses and retailers are little regulated.

Governments, policy makers, and researchers have very limited understanding of the likely long-term performance or the provenance of cheap, low-quality solar PV modules and solar lanterns being sold in India. There is no formal, enforced regulation requiring quality assurance for these goods, the majority of which have been imported into India. It is also typically unclear what quality controls products have passed through before reaching the Indian market. It will take several more years before it becomes clear whether or not low-priced solar PV modules are performing as advertised. It is likely that with the proliferation of such products and absence of sufficient quality controls, public confidence in solar power will be undermined.

3. A lack of reliable public information comparing the quality and performance of solar products in the market

India's off-grid solar market is now flooded with a wide range of solar modules and off-grid solar products. In shops and dealerships, multiple brands of solar PV modules and off-grid solar products can typically be found, with brands disappearing and new brands appearing month to month. In informal shops, counterfeit labels of good-quality PV modules have been found affixed to low-quality PV modules. Often low-quality PV modules do not generate the level of output stated on their labels.[13]

Currently, there is a lack of formal public platforms providing easy access to clear, trustworthy information regarding the standard, specifications, and quality of different products that customers can refer to before buying products. Although most PV modules and products are sold with warranties and guarantees, there is neither formal regulation to ensure they are honoured nor any formal avenues for customers to seek redress if the product is faulty.

4. Repair and recycling

Millions of off-grid solar units are now being sold annually in India. Sales are likely to increase in the coming years.

Despite the proliferation of off-grid solar products, there is a lack of infrastructure in place to carry-out the repair, recycling, and disposal of solar modules, batteries, and other components. Little is known about how solar PV modules and off-grid solar products are currently being recycled or disposed of. Batteries are typically recycled and disposed of informally, with few safety or environmental precautions. A significant environmental challenge will emerge in the coming years, as the amount of waste from off-grid solar goods grows. The proliferation of PV module waste and used batteries, both challenging to recycle safely, are particularly significant issues.

13. Balls, J. (2017) "Fluid Capitalism at the Bottom of the Pyramid: A Study of the Off-Grid Solar Power Market in Uttar Pradesh, India" DPhil diss. Oxford: University of Oxford

Supporting a sustainable off-grid solar power market in India

The Government of India and international actors should consider interventions in the following four areas to promote the use of off-grid solar products in India.

1. Provide new subsidised financing mechanisms for below poverty line (BPL) households

There are strong equity arguments in favour of a subsidy scheme to support BPL households to purchase off-grid solar products, similar to those that subsidise kerosene, grid electricity, and gas cylinders for BPL households. The Government of India should look to develop a new subsidy mechanism that can systematically supports BPL Indians to buy good-quality solar PV modules and off-grid solar products. This should be able to support both customers making a cash purchase as well as those requiring financing in order to make a purchase.

While the recent JNNSM subsidy was in many ways successful, it provides some cautionary lessons that should inform any future subsidy mechanism. Under the scheme, only a small range of good-quality, branded SHSs were approved for subsidy support. With a slow process of approval, and strict rules requiring Indian made components to be used, these SHSs were typically assembled from components using out-dated technology and were significantly more expensive then equivalent non-approved SHSs that were available from retailers. Subsidising a small range of select products can act as a disincentive for innovation. Furthermore, the JNNSM subsidy was solely for standardised SHSs, meaning that many people preferring to buy individual solar PV modules and other components and to assemble their own SHSs received no support.

Any new subsidy mechanism must allow customers to buy a wide variety of the latest good-quality solar PV modules and branded off-grid solar products available on the market. It should also support households who choose to individually and incrementally buy solar PV modules and other off-grid solar goods and assemble their own SHSs.

For international development actors looking to support expanded energy access in India, efforts should be targeted in the three areas identified below.

2. Platforms to provide public education and information about the quality and performance of off-grid solar products.

International development actors should partner with state and national bodies in India to fund initiatives that assess the quality of solar PV modules and off-grid solar products sold by dealers, and research that maps the provenance of such products. This will provide valuable information and knowledge for developing better regulation of product quality and assurance, and to build platforms that can publicly disseminate information.

Any regulatory interventions in this area must be carefully designed. Currently many low-income households can only afford to buy cheap solar PV modules, and so regulation that simply bans such products may reduce the access of poor households to off-grid solar products and hence to electricity.

International actors can also fund the development of innovative platforms and tools that aggregate and disseminate information about the quality of off-grid solar goods and compare different product options which can be accessed by rural people. Efforts by the social enterprise *Frontier Markets*, which operates in northern India, provides a good

example. *Frontier Markets* provides information and educates communities about solar power, helps villagers access good-quality solar power products and servicing options for these products.

3. Resources and tools to promote the standardised and reliable labelling of off-grid solar goods.

Currently, there is no systematic detailed labelling of solar PV modules and other off-grid solar goods. International development actors should partner with national and state governments and with manufacturers to promote the improved labelling of off-grid solar goods. Such efforts should aim to promote the use of labelling that provides customers with reliable, clear, and comprehensive information on the quality and lifetime performance of products, including warranties and guarantees.

4. Building capacity for the repair, recycling, and disposal of off-grid solar goods.

Most of the pioneering businesses and social enterprises that sell good-quality SHSs and branded solar lanterns offer in-house servicing to their customers. However, many shops do not offer servicing or spare parts, and there are few services available for the recycling and disposal of old off-grid solar goods. As off-grid solar goods proliferate, a strong and sustainable market will depend upon the development of an effective ecosystem for the repair, recycling, and disposal of off-grid solar goods.

International development actors should support Indian start-ups that launch innovative business projects that can develop and scale-up sustainable models for the repair, recycling, and disposal of off-grid solar goods. International actors can connect international and Indian researchers with the relevant expertise to develop solutions for solar PV module, electronic, and battery waste. For example, the Australian-based company *ReclaimPV*, is a world leader in the field of PV recycling.

Implications for Australian policymakers

Australia has significant technological and research expertise that can support India's off-grid solar market. A rapidly growing off-grid solar market, in turn, can present commercial opportunities for Australian businesses. The recent 'An India Economic Strategy to 2035' report by Peter Varghese identified that the energy sector offers strong opportunities for Australian businesses. Off-grid solar can be one such area of opportunity. The Australian government should:

1. Explicitly recognise India's off-grid solar market as a key sector to be promoted in order to support energy access in India, and to help the country meet its Paris Agreement commitments.[14]

2. Provide opportunities for strategic dialogue between Australian-based experts and businesses working on solar module and battery disposal and recycling. In the medium term, this sector can see commercial opportunities for Australian businesses, such as ReclaimPV, partnering with Indian counterparts.

3. Support Australian-based academics, businesses, and development organisations to partner with Indian counterparts on initiatives and platforms to promote awareness about solar panel quality and performance amongst Indian consumers.

14. Government of India (2015) India's intended nationally determined contribution: Working towards climate justice. New Delhi: Government of India. Accessed July 4 2018 from http://www4.unfccc.int/ndcregistry/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf

4. Help Australian-based experts and businesses working on technologies and systems that allow households with solar modules to sell electricity back into the central grid to connect with Indian counterparts. As India's central grid becomes more reliable, there is great potential for household solar systems, currently only used off-grid, to be connected into the grid, providing needed generation capacity to the grid and income earning potential for households. In the medium term, this can be an area of commercial opportunity for Australian businesses.

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