









Financing Solar-powered Livelihoods in India

Evidence from Micro Enterprises

Shaily Jha, Sasmita Patnaik, and Abhishek Jain

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Abhishek Jain, CEEW. Image shot at a DRE-powered loom in Rajkot, Gujarat.

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"While conducting interviews with stakeholders across financial institutions we realised that for most financiers productive use of DRE was a fairly new concept. This study is especially important for bridging the awareness gap amongst financiers by demonstrating the need and viability of micro enterprises that are already using solar-powered livelihood appliances."



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"Despite the importance of reliable energy access for the mechanisation of rural economic activities, in our interviews with financiers across the board, almost no one placed energy in this context. We also realised the aspect of drudgery reduction through mechanisation was given a lower priority over immediate economic outcomes, whereas development theories have emphasised on time poverty and drudgery as notable barriers to human development. I hope this report is able to bring these converging ideas to the attention of the policymakers, to enable a conducive financing ecosystem for rural livelihoods."



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"Among other things, the report fills in a major evidence gap on the commercial viability and loan repayment performance of existing solar-powered livelihoods. I hope this would help boost financiers confidence in lending for such solutions to even first time entrepreneurs who struggle to furnish a collateral or credit history."



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Abbreviations

CGFTMSE: Credit Guarantee Fund Trust for Micro and

Small Enterprises

CLCSS: Credit-Linked Capital Subsidy Scheme

DAY-NRLM: Deendayal Antyodaya Yojana - National

Rural Livelihood Mission

DRE: decentralised renewable energy

DRI: differential rate of interest

EDEG: Entrepreneurship Development and

Employment Generation Scheme

GCC: General Credit Card Scheme

GTAB: Governing and Technology Approval Board

JLG: joint liability groups

KVIC: Khadi and Village Industries Commission

LDM: lead-district managers

LSK: Lok seva kendras

MFI: micro finance institutions

MNRE: Ministry of New and Renewable Energy

MSE: micro and small enterprises

MSME: Ministry of Micro, Small and Micro

Enterprises

MUDRA: Micro Units Development and Refinance

Agency

NABARD: National Bank for Agriculture and Rural

Development

NBFC: non-banking financial company

NGO: non-governmental organisation

NHDP: National Handloom Development

Programme

NPA: non-performing assets

NRLM: National Rural Livelihood Mission

NSSH: National SC-ST Hub

PACS: primary agricultural cooperative societies

PDC: PACS Development Cell

PMEGP: Prime Minister Employment Guarantee

Programme

PM-KUSUM: Pradhan Mantri Kisan Urja Suraksha

Evam Utthan Mahabhiyan

PMMY: Pradhan Mantri Mudra Yojana

PSL: priority-sector lending

RBI: Reserve Bank of India

RRB: Regional rural banks

SC: Scheduled Caste

SCLCSS: Special Credit-Linked Capital Subsidy

Scheme

SFB: Small finance banks

SHG: self-help groups

SIDBI: Small Industries Development Bank of India

SKDRDP: Shri Kshethra Dharmasthala Rural

Development Project

SNA: state nodal agencies

SRLM: State Rural Livelihood Mission

ST: Scheduled Tribe

TEQUP: Technology and Quality Upgradation

Support to MSMEs



Executive summary

wo-thirds of the Indian population resides in rural areas. Even though agriculture lacksquare remains the primary livelihood source for most rural Indians, its share in the Indian GDP is dwindling, and the share of non-farm incomes are rising. As of 2015–16, rural India is home to over 32 million unincorporated non-agriculture micro enterprises that are involved in various kinds of value addition—from agro-processing and custom tailoring to petty shops and restaurants. For most rural micro enterprises, reliable energy supply can enable mechanisation, which in turn can improve productivity and, consequently, incomes. Despite improvements in electricity provision in rural India, gaps in the reliable supply have led to the emergence of a market for decentralised renewable energy (DRE)-powered livelihood appliances that stand to improve the productivity of Indian rural micro enterprises. Livelihood solutions powered through DRE help businesses increase their revenues and reduce drudgery. Such products include solar-powered sewing machines, looms, milking machines, printer and photocopy machines, flour milling machines, milk chillers, cold storage units, carpentry tools, welding machines, aerators, fishing boats, and many more. However, the micro enterprises often struggle to procure these solar-powered appliances due to their high capital cost. Access to affordable finance is necessary to enable and scale the adoption of such solutions among cash-deprived rural micro enterprises.

These enterprises suffer as financiers perceive lending for such products as risky, owing to a lack of understanding of solar-powered products and the viability of these enterprises.

The relatively novel nature of the technology also entails a lack of familiarity, and financial institutions perceive higher risks in lending for solar-powered livelihood appliances. Low lender confidence is further exacerbated by the lack of market data, including details on deployments, the performance of those deployments, history of borrowers' credit extensions, and servicing of loans for such products. There is very limited documented evidence on the performance and impact of clean energy-powered productive-use appliances. In addition to bridging the awareness gap among financiers, there is a need to evaluate whether such technologies have successfully yielded an adequate additional net income for end-users across different contexts to effectively pay back the investment. Given these knowledge gaps, this report:

 Identifies the challenges, including the perceived risks, that limit end-user financing for solar-powered livelihood appliances.



As of 2015–16, rural India is home to over 32 million unincorporated nonagriculture micro enterprises

- ii
- Generates evidence on the impact of solar-powered productive-use technologies
 on the net incomes of end-users and their loan repayments, so that financiers can
 better understand the economic viability of these technologies.
- Assesses prevailing policy solutions and provides recommendations to improve access to finance for end-users of such products.

Financiers' perspective on financing solarpowered livelihood appliances

We analysed the risk perceptions of financiers in the states of Assam and Odisha and gathered the viewpoints of All-India Financial Institutions including Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), and Reserve Bank of India (RBI). We also interviewed a broader community of financiers, including micro finance institutions (MFIs), small finance banks (SFBs), commercial banks and regional rural banks (RRBs).

Financiers cited lack of awareness and the unreliability of the technology as key concerns. We find that bankers are sceptical of the techno-commercial viability of proposals relating to solar-powered livelihood appliances. This is partly due to the fact that the economic returns of emerging technologies like solar-powered sewing machines or IT kiosks are yet to be documented and proven at scale. However, an equally significant reason for this higher risk perception is financiers' lack of familiarity with, and knowledge of, solar-powered appliances beyond solar home lighting systems and solar pumps. Previous experiences with solar lanterns of inferior quality have made financiers sceptical of the reliability and quality of solar-powered technologies, particularly those manufactured by less-known, younger, and new brands. Additionally, in our interviews, bankers have pointed out that these appliances require regular maintenance and repair, and as manufacturers often fail to provide these services, this could have a direct impact on end-users' income and, consequently, on their loan repayments.

In addition, financiers cited concerns regarding the cost of evaluating and recollecting loans vis-à-vis low loan sizes. Financiers also highlighted concerns around lending to first-time borrowers' in the absence of collateral and credit histories. The loan size for small solarpowered livelihood appliances range from INR 30,000 – 80,000, making it a relatively small loan with higher administrative costs for banks. Collecting repayments in remote areas poses an additional cost for banks. The lack of collateral, a savings history, and a credit rating score among first-time borrowers discourages bank managers from sanctioning loans to them. These challenge are further exacerbated for women entrepreneurs due to socio-cultural biases as well as lack of assets in their name that could act as collateral for the loan. Even if banks exempt collateral, a guarantor and margin money remain a requirement for the loans. Moreover, banks require businesses to provide an operational track record for securing loans, with some banks requiring enterprises to furnish proof of about three years of operation regardless of the technology and the age of the enterprise, which could be a challenge for many new enterprises. Further, banks in rural areas currently do not have adequately trained human resource capacity to assess the viability of new technologies and business models including solar-powered livelihood technologies.



Bankers are sceptical of the techno-commercial viability of proposals relating to solarpowered livelihood appliances

Evidence of impact of existing solar-powered livelihood appliances

With the aim of plugging a critical gap in financiers' perceptions, we assessed the economic impact and viability of selected solar-powered livelihood appliances, with the support of SELCO Foundation. Since 2016, SELCO India has deployed over 1,000 digital service centres, called Lok Seva Kendras (LSKs)1 and 385 sewing machines powered by DRE. We analysed the changes in the net incomes of the entrepreneurs, their cash flows, their credit and repayment histories, and economic viability of their business (measured through the payback period). The data for this analysis was collected by SELCO Foundation from 200 randomly selected entrepreneurs using LSK and 100° entrepreneurs using sewing machines across 25 districts in Karnataka.

The upfront cost of solarising an existing sewing machines ranges between INR 15,000 and INR 25,000, while for LSK the cost of solar and equipment (printer/photocopier) ranges between INR 10,000 and INR 35,000, depending on the model. Most of the existing deployment are financed by Shri Kshethra Dharmasthala Rural Development Project (SKDRDP). The rate of interest for these loans is about 16 per cent per annum, repayable in up to two years.

Median loan amount taken by entrepreneurs







We see an increase in net income for most entrepreneurs after purchasing the product.

Before solarising their machines, the annual income for tailoring entrepreneurs ranged from less than INR 20,000 to more than INR 1,40,000 (with a median value of INR 65,000). These enterprises experienced an increase of 39 per cent, on average, in their annual incomes after the integration of solar with their machines, with the median value increasing up to INR 90,000. In the case of LSK, entrepreneurs experienced a median increase in income of about INR 20,000 per annum (Figure ES1 and Figure ES2).

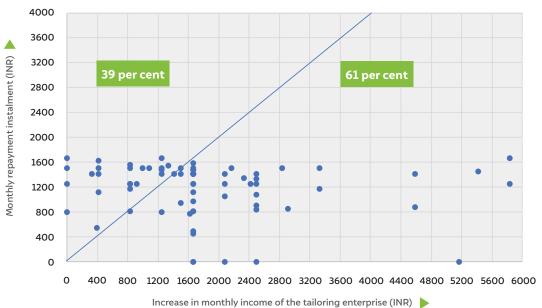
We also analysed the incomes and revenues of first-time entrepreneurs. First-time entrepreneurs experience greater difficulty in accessing loans from formal financial institutions, and therefore make for an important category to be discussed in the context of financing for solar-powered livelihood appliances. The first-time LSK entrepreneurs witness an annual income of between INR 1,600 and INR 32,000, with an overall median income of about INR 25,000 per annum.

The investment in these products seems attractive on average, with a simple payback period of 12-24 months on most occasions. The median payback period for sewing machines is just 11 months, whereas that for LSK is 15 months. However, there are exceptions, and not all entrepreneurs find the investment economically viable. Thus, each borrower needs to assess the economic viability as per their prevailing context before making the investment, similar to asset procurement in any other business. About 5-7 per cent of entrepreneurs using sewing machines have marginal to no increase in income. In such cases, the investment is not economically viable. However, the reduction in drudgery is appreciable,

^{1.} LSKs are digital solutions centres that provide comprehensive sets of solutions from single photocopy machines to multiple systems such as printer, laptop, photo camera etc., all powered by solar energy.

Even though we collected data from 100 sewing machine entrepreneurs, we only used the data of 77 of them due to inconsistencies.

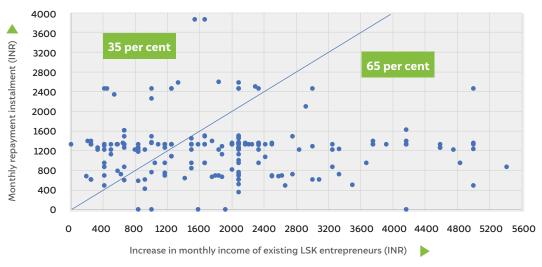
and the entrepreneur may have considered the switch because of the same. Similarly, our analysis shows that about 10 per cent of LSK entrepreneurs have a simple payback period of over 50 months. The median increase in the monthly income of these entrepreneurs is less than INR 500, which significantly increases the payback period. In such cases as well, the investment does not seem economically viable. However, the lack of availability of such services in the area and an indicative demand for it may have encouraged the entrepreneur to make the investment. Most of these enterprises have been in operation for under a year or for 1–2 years, and 50 per cent of the LSK entrepreneurs who have an estimated simple payback period over 50 months are first-time entrepreneurs. This could explain the lower levels of income, something that could potentially increase with time as the customer base improves.



ES 1:

61 per cent of tailoring enterprises are able to pay their loan instalments from the increase in their monthly income

Source: Authors' analysis



ES 2:

65 per cent of existing LSK enterprises are able to pay for their loan installments from the increase in their monthly income

Source: Authors' analysis

Based on the terms of the loan, we estimate the median monthly repayment amount to be around INR 1,416 and INR 1,328 for tailoring and LSK entrepreneurs, respectively. Our analysis suggests that over 60 per cent of both LSK and tailoring entrepreneurs are able to pay their loan instalment from the increase in income that they witnessed after adoption of the solution. Rest are paying more in instalments than the increase in income, but the instalment accounts for 30–50 per cent of their new overall income. However, in the case of LSK, many entrepreneurs have availed loans higher than the value of the product, which increases their repayment instalment amount. This analysis helps us understand whether the entrepreneurs can repay their loans while earning a sustainable income from the business, which would strengthen the case for financing such livelihood appliances. It is important to note that our estimates of income increase are conservative, given we assume that the entrepreneur did not account for loan repayment instalments while reporting the latest income.

The cash flows of these enterprises align with the repayment frequency of their loans.

Collection of loan repayments is scheduled weekly for almost all enterprises. While all the LSK enterprises receive cash daily, about 70 per cent of sewing machine enterprises have weekly cash flows. Given the lack of heterogeneity in our sample with regard to repayment frequency, it is difficult to assess the impact of various repayment frequencies on defaulting of loans.

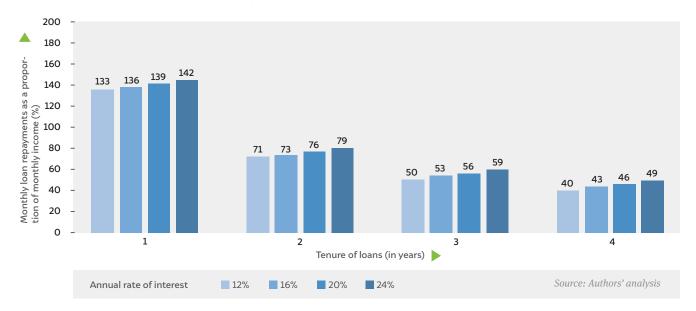
We also analysed entrepreneurs' growth plans and their perceived risks of business for the next five years. About 66 per cent and 51 per cent of the sewing machine and LSK entrepreneurs, respectively, are focused on increasing customer base for business growth. While no significant business risks are perceived by tailoring enterprises, more than 65 per cent of the LSK enterprises have cited lack of adequate demand for services as the biggest potential risk to the growth of their business.

The analysis of the income, loan, and cash flows of these enterprises shows that there is a significant increase in the entrepreneurs' incomes with the installation of solar-powered livelihood appliances. However, the degree of change in entrepreneurs' incomes and revenues depends on the type of business. Simultaneously, it is important to consider variations in repayment culture, income levels, overall indebtedness, and the asset ownership of entrepreneurs in each region as we replicate these models based on the findings.

Factors that improve the economic viability of financing for end-users

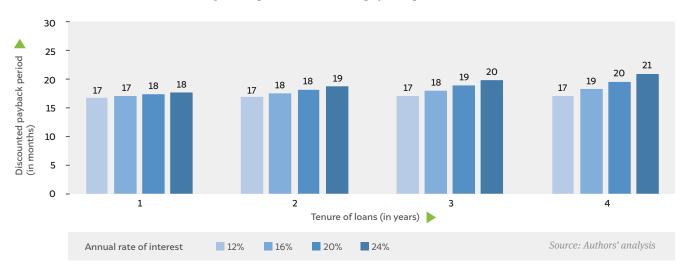
Our financial modelling suggests the impact of interest rates is marginal over the usual tenure (less than five years) of the loan for these products, while the actual length of the loan tenure is significant in determining the feasibility of repayment of these loans.

ES 3: Longer tenure improves feasibility of repayment despite greater rate of interest



While an extended loan tenure increases feasibility and ease of repayment for the entrepreneur (and reduces the likelihood of default), the extent of adverse impact on the economic viability (measured as discounted payback period) for the financier would be marginal.

ES 4: Increase in tenure has marginal impact on discounted payback period



Even at higher interest rates, a longer tenure makes it feasible for the borrowers to repay the loans by contributing a reasonable proportion of their incomes for the instalments. For relatively lower loan amounts [<INR 500,000 (5 lakh)], longer tenures would be beneficial, despite higher interest rates.

Existing policies that support end-user financing for livelihoods

Financing of solar-powered livelihood appliances could also be supported in the same ways as conventional livelihood solutions. In addition to banks and other financial institutions, government schemes also support entrepreneurship in many sectors, often through grants, but also by extending affordable credit and preferential treatment to small and micro enterprises. Some of these schemes could evolve to suit the emerging needs of the sector and include support for solar-powered appliances.

Schemes for small businesses and micro enterprises

Schemes focused on enhancing livelihoods such as *Pradhan Mantri Mudra Yojana* (PMMY) have expanded access to credit for small businesses and micro units, of which less than five per cent have access to formal credit institutions. Other schemes like the *Credit Guarantee Fund Trust for Micro and Small Enterprises* (CGFTMSE) reduce the burden of producing collateral for new and existing micro and small enterprises (MSEs). The Government of India also provides capital subsidy of up to 15 per cent for technology upgradation of MSEs (up to 25 per cent for MSEs owned by SCs/STs) in the specified 51 sub-sectors approved under the *Credit-Linked Capital Subsidy Scheme and Special Credit-Linked Capital Subsidy Scheme*. Under the *Prime Minister Employment Guarantee Programme* (PMEGP), the government provides margin money assistance to individual borrowers and groups for new self-employment ventures, projects, and micro enterprises. As energy is a core input for mechanisation in rural industries, such schemes could focus on solar-powered applications in a more holistic manner to enable more entrepreneurs to start small businesses.

Schemes with a focus on solar energy

Further, there are government schemes focused on solar-powered technologies. Such schemes have improved financiers' awareness and appetite for lending towards these products, often by reducing the price of the product through a capital subsidy. *Solar Energy Scheme for Powerlooms and Solar Charkha Mission* provide subsidies on the capital cost of solar-powered looms and *charkhas*. The *Scale Up of Access to Clean Energy Scheme* by the Ministry of New and Renewable Energy (MNRE) focuses on creating technology awareness and availability, establishing market linkages, and facilitating after-sale services for DRE-powered livelihood technologies. However, no implementation has happened under the scheme, so far. Similarly, the *Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan* (PM-KUSUM) scheme focuses on providing individual farmers subsidy support to install standalone solar agriculture pumps with capacities of up to 7.5 HP in areas where grid electricity is not available. Expanding the ambit of such schemes, or designing new schemes for other solar-powered livelihood appliances, could help improve the financing scenario for these products. We also note the importance of government schemes that focus on creating an enabling ecosystem for solar-powered products.

Schemes with possibility to include solar energy

There are other schemes that focus on livelihood technologies but not on solar-powered versions of the same. We recognise the potential to expand the ambit of such schemes for solar-powered products, helping more MSEs benefit from them. The *Pradhan Mantri Credit*



As energy is a core input for mechanisation in rural industries, such schemes could focus on solar-powered applications in a more holistic manner to enable more entrepreneurs to start small businesses



The definition of handloom needs to evolve to include hybrid (power and human driven) charkhas and paddle looms

Scheme for Powerloom Weavers and the National Handloom Development Programme provide margin money assistance and interest subvention on loans for technology upgradation to handloom weavers. However, to extend benefits of such scheme for solar-powered solutions, the definition of handloom needs to evolve to include hybrid (power and human driven) charkhas and paddle looms. The Entrepreneurship Development and Employment Generation scheme by the Department of Animal Husbandry and Dairying focuses on providing capital subsidies for upgrading to modern technologies like cold storage units and milking machines but does not include solar-powered technologies under its current scope. Their inclusion would open up avenues for financing solar-powered appliances.

Priority-sector lending (PSL) for renewable energy

Renewable energy has been included as part of PSL under the RBI, with a loan limit of INR 150 million (15 crore) for solar-based power generators, biomass-based power generators, wind mills, micro-hydel plants, and non-conventional energy-based public utilities such as street lighting systems and remote village electrification benefits the large players in the sector. The high cap of these loans leaves little scope of easy financing for small rural enterprises. There is a need to include separate sub-sectors and sub-categories within PSL for renewable energy that would allow for a greater availability of finance and mandate a greater flow of funds towards micro enterprises, thus creating livelihood opportunities in rural areas.

For loans under the individual households category, inclusion of examples of technologies which could be covered under this section would be helpful for accessing these loans. These technologies could include (but not be limited to) decentralised solar home systems, decentralised renewable energy-powered livelihood appliances, or appliances that improve productivity or reduce losses, or appliances that reduce drudgery of manual effort for workers.

Policy recommendations

The recommendations discussed below include the potential interventions that different stakeholders could undertake for improving access to affordable financing for end-users of solar-powered livelihoods. While some of these recommendations argue for improved implementation, others look at new ways of catering to the financial needs of various entrepreneurs.

Create awareness about solar-powered livelihood technologies and their economic value

New technologies require awareness and capacity building among various stakeholders to enable them to understand, assess, and support these technologies. Solar-powered livelihood appliances are no different. It is important to engage with influential stakeholders in the banking ecosystem like lead-district managers (LDM)³ and block-level managers to increase their awareness. RBI Townhalls⁴ at the state, district, and block levels are viable platforms for sector enablers to disseminate information about the value propositions of these technologies. These platforms should also support physical demonstrations of solar-



By expanding their networks of banking correspondents in rural areas, small finance banks could step in to benefit from this market

^{3.} As per RBI's Lead Bank Scheme, the Lead District Manager (LDM) of the district is the Chairman of the Block Level Bankers' Committee. All the banks operating in the block—including the District Central Co-operative Banks, RRBs, Block Development Officers, technical officers in the block such as extension officers for agriculture, industries, and co-operatives—are members of the Committee.

^{4.} RBI Townhalls are conducted quarterly at the state, district, and block level, with participation from bankers of different commercial banks.

powered livelihood technologies, that has helped build trust and confidence in technologies in the past.

Improve after-sales repair and maintenance services

To improve the reliability of the technology, manufacturers and suppliers must ensure dependable after-sales services while building consumer capacity for effective utilisation of these appliances. Good quality technology with reliable after-sales services would help build the trust of financiers in these products as well as their deployers.

Account for seasonal variations in income

Businesses should be able to demonstrate how seasonal variations in income could be mitigated to avoid delays in loan repayments. For instance, diversification of products or customers in months of lean demand could be an effective way of gaining the lenders' confidence.

Adopt alternative and innovative loan collection mechanisms

Regular collection of loans at a frequency convenient for the borrower has been one of the key successes of MFIs in enabling repayments of loans. By expanding their networks of banking correspondents in rural areas, Small Finance Banks (SFBs) could step in to benefit from this market opportunity. Technology-enabled platforms such as payment banks could be leveraged for more frequent, flexible repayments, albeit with adequate training of the borrowers and financiers.

Focus on the loan tenure instead of the rate of interest

For loans which have a tenure of less than five years, a marginal increase in tenure has a significant impact in enabling repayment of the loan. While this makes it feasible for the entrepreneur to service the loan from the income generated from the product, it does not affect the economic viability of the proposition in any significant way. SFBs are the best placed to extend loans of three years or beyond, but their limited presence in rural areas may pose a challenge. In such cases, banking correspondents could support SFBs in reaching more entrepreneurs and benefiting from this market opportunity.

Extend targeted funding support for solar-powered livelihoods

All-India Financial Institutions like NABARD and SIDBI could set up a revolving fund for clean energy for both farm and non-farm micro enterprises which could be tapped into by RRBs. Alternatively, MFIs could also establish separate credit lines for farm and non-farm enterprises to acquire clean energy-powered livelihood appliances. Further, philanthropic organisations could pool in resources to support such a fund, which would facilitate an increase in the loan tenure for entrepreneurs or partially cover the risk of the loan to unlock financing from the lenders.



Ecosystem players, including sector enablers, should focus on enabling longer tenures loans for such products

Conclusion

With the decreasing share of farm incomes in India, there is a need to invest in value addition in rural areas to improve incomes. In most cases, the value addition is enabled by access to reliable energy in various forms. Clean energy-powered livelihood solutions could catalyse this value addition and boost rural incomes while reducing drudgery. However, given their capital-intensive nature, access to financing is imperative for the adoption of such solutions at scale.

Financiers perceive newer technologies as entailing higher risk because of their lack of awareness about the technologies and their economic viability. The absence of collateral and credit histories on the part of the borrowers (micro enterprises) further reduces financiers' incentive to extend loans to them. The evidence from at least two specific DRE-powered livelihood solutions suggests that these investments could be economically attractive. However, adequate assessment for each context is important before an entrepreneur decides to invest and a lender decides to lend.

Ecosystem players, including sector enablers, should focus on enabling longer tenures for loans for such products in addition to reducing interest rates. Both the public and philanthropy sectors could be particularly helpful in unlocking longer tenure loans for this sector. Beyond banks, MFIs and SFBs are particularly suited to extend loans for most DRE-powered livelihood products and should be engaged by sector enablers accordingly. Flexible repayment mechanisms could play an important role in maximising repayments.

A comprehensive approach encompassing awareness generation, capacity building, and engagement with financiers to address risks and enable longer loan tenures, and increased policy support through new schemes would ensure the financing of clean energy-powered livelihood solutions at scale. For most of these approaches, it is imperative to generate evidence of the financial viability and economic and social impact of such solutions. While this report is the first step in this direction, we would need continued endeavours to plug the critical gap in evidence and boost the confidence of all stakeholders to provide credit for a growing suite of clean energy-powered livelihood technologies.

1. Introduction



Two-thirds of the Indian population resides in rural areas. Even though agriculture remains the primary livelihood source for most rural Indians, its share in the Indian GDP is dwindling, and the shares of non-farm incomes are rising . According to the 73rd National Sample Survey in 2015–16, rural India is home to over 32 million unincorporated non-agriculture micro enterprises that are involved in various kinds of value addition—from agro-processing and custom tailoring to petty shops and restaurants, and many more. For most rural micro enterprises, reliable energy enables mechanisation, which in improves productivity and, consequently, incomes. Despite improvements in reliable electricity provision in rural India, gaps in the system have led to the emergence of a market for decentralised renewable energy (DRE)-powered livelihood appliances that stand to improve

the productivity of Indian rural micro enterprises (Waray, Patnaik, and Jain 2018). Livelihood solutions powered through DRE can help businesses increase their revenue or reduce drudgery. Such products include solar-powered sewing machines, looms, milking machines, printer and photocopy machines, flour milling machines, milk chillers, cold storage units, carpentry tools, welding machines, aerators, fishing boats, and many more. However, these businesses often struggle to generate the funds to cover the capital cost of the product, which is relatively high for renewable energy-powered appliances. Access to affordable finance is necessary to enable and scale the adoption of such solutions among cash-deprived rural micro enterprises.

Solar-powered innovations enable mechanisation, which in turn leads to improved productivity and an increase in incomes across a wide range of rural livelihoods. A recent study on clean energy-powered rural enterprises highlighted that about 20 livelihood appliances so far have been designed or repurposed to run effectively on solar (Waray, Patnaik, and Jain 2018). These innovations range from water pumps, milking machines, milk chillers, sewing machines, *charkhas*, cold storage units, and knapsack sprayers. Only a few of these innovations have been deployed at a commercially significant scale, apart from solar pumps, which have been implemented on a large scale due to high government subsidies (ibid.).

Financial institutions in rural areas play a critical role in providing credit to local entrepreneurs to finance the upfront costs of high-value assets. However, access to credit is a challenge for such enterprises due to a lack of markets, collateral, adequate lending, and collection capacity among bankers in rural areas, as well as unconducive legal and policy environments that still foster the inherent challenges of lending to rural micro enterprises (Nair and Kloeppinger-Todd 2007). Waray et. al. (2018) identify some of the major challenges to end-user financing for clean energy-powered livelihood appliances given the lack of an overarching policy or industry-wide mechanism to support the credit market; they are as follows:

- The high capital expenditure (capex) associated with solar is an impediment to adoption when compared with low-capex diesel- or electricity-powered equipment.
- Bankers' risk perceptions, owing to their lack of understanding of renewable energy-powered products and the inadequacy of after-sale support, is a major barrier to end-users gaining access to affordable financing.
- Poor access to energy often correlates with poor socio-economic conditions.
 Customers with relatively lower incomes are most likely to find solar-powered appliances remunerative, but they also have limited capital compared to their economically better-off counterparts. Thus, access to financing is particularly important to enable the adoption of these technologies.
- The capital-starved end-consumers' lack of collateral creates barriers to accessing loans, which limits adoption under the direct purchase model. There are currently no financial products that specifically cater to loans for solar-powered livelihood technologies.

Objectives of this study



Financial institutions in rural areas play a critical role in providing credit to local entrepreneurs to finance the upfront costs of high-value assets

The relatively novel nature of the technology also entails a lack of familiarity, and financial institutions perceive lending for solar-powered livelihood appliances as higher risk. Low lender confidence is further exacerbated by the lack of market data, including details on deployments, the performance of those deployments, history of credit for such products, servicing of loans for such products, etc. There is very limited documented evidence on the performance and impact of clean energy-powered productive-use appliances. In addition to bridging the awareness gap among financiers, there is a need to evaluate whether such technologies have successfully yielded an adequate additional net income for end-users across different contexts to effectively pay back the investment. Given these knowledge gaps, we aim to:

- Identify the challenges, including the perceived risks, that limit end-user financing for solar-powered livelihood appliances.
- Generate evidence on the impact of solar-powered productive-use technologies
 on the net incomes of end-users and their loan repayments, so that financiers can
 better understand the economic viability of these technologies.
- Assess prevailing policy solutions and provide recommendations to improve access to finance for end-users of such products.



2. Methodology

7e undertook this study in collaboration with SELCO Foundation, given their pioneering efforts in promoting solar-powered livelihood solutions in rural India. To achieve the research objectives, we analysed risk perceptions among financiers in two states—Odisha and Assam. We selected the two states based on the limited deployment of solar-powered technologies here, and the high barriers to accessing end-user finance by enterprises supported by the SELCO Foundation. Deployment in these states has been limited (less than 50 at the time of the study) due to challenges in accessing finance from banks and other financial institutions; therefore, it was important to understand the reasons pertaining to the lack of access. We also undertook consultations with bankers at the state and national levels to understand their perceptions around lending for such technologies. We conducted semi-structured interviews with representatives from key financial institutions—the Reserve Bank of India (RBI), All-India Financial Institutions [including Small Industries Development Bank of India (SIDBI) and National Bank for Agriculture and Rural Development (NABARD)], commercial banks, regional rural banks (RRBs), small finance banks (SFBs), and nonbanking financial institutions (NBFCs). We also interviewed government ministries and civil society organisations that are deeply involved in supporting income-generating activities in rural areas in these states. Informants were identified using purposive sampling, with the objective of obtaining maximum heterogeneity in responses. A total of 26 interviews were conducted across 18 stakeholders.

All-India Financial Institutions	>	RBI, NABARD (incl. district level officers), SIDBI
Government ministries/ state nodal agencies	>	Ministry of New and Renewable Energy (MNRE), Ministry of Rural Development, Odisha Renewable Energy Development Agency
Commercial Banks at the state level	>	Central Bank of India, UCO Bank, Vijaya Bank
Regional rural banks and small finance banks	>	Odisha Grameen Bank, North East Small Finance Bank, Ujjivan Small Finance Bank
Associations and MFI investors	>	Maanaveeya Development & Finance Private Limited, Sa-Dhan, Friends of Women's World Banking
Civil society organisations	>	Tata Trusts, PRADAN, Harsha Trust

Table 1:List of stakeholders interviewed

Source: Authors' compilation

The broad areas of discussion in the interviews included the following:

- The awareness level of bankers regarding solar-powered livelihood appliances.
- Risk perceptions and operational challenges in financing such emerging technologies, especially for first-time borrowers.
- Potential measures and recommendations to address the perceived risks and challenges.
- Alternate financial products, mechanisms, or institutions that could be leveraged for financing solar-powered livelihood solutions.

We also analysed the existing policy ecosystem for financing micro and small businesses to understand the supportive provisions (or their lack) in the prevailing policies.

We also analysed the evidence from existing installations of solar-powered sewing machines and digital solutions centre [also known as *Lok Seva Kendras* (LSKs)] deployed in Karnataka. We selected these two technologies for two reasons: (i) they have a relatively higher number of deployments compared to other clean energy-powered livelihood solutions; and (ii) they offer insights on two kinds of entrepreneurs. In the case of sewing machines, most of the entrepreneurs are already engaged in custom tailoring, but the solar-powered solutions help them improve their productivity and income. Whereas, in the case of LSKs, most of the entrepreneurs do not have experience providing such services before deployment; thus, it adds a new revenue stream. We selected Karnataka as the state to gather primary data, considering that more than 90 per cent of the deployment has been in the state so far, thanks to SELCO Foundation's extensive efforts at the state level.

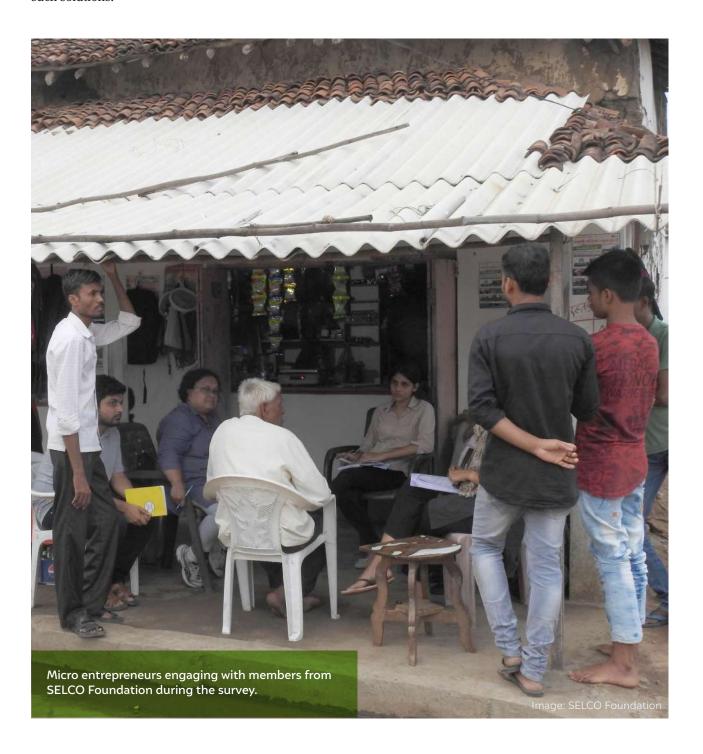
We designed a detailed questionnaire to gather primary data on the incomes, revenues, cash flows, loan repayments, and asset ownership of the entrepreneurs using the solar-powered sewing machines and LSKs. SELCO Foundation took the lead in collecting the primary data. It randomly selected 100 and 200 entrepreneurs from the total deployment of 385 and 1,000 solar-powered sewing machines and LSKs, respectively, in the state. The sample was selected from deployments across all districts of operation in Karnataka.

We could not analyse the primary data on installations in Odisha and Assam because of the extremely low number of deployments in these states. To ensure the accuracy and quality of the data, we undertook rigorous data checks by rooting out logical inconsistencies and verifying select data points through follow-up telephonic calls with 10 per cent of the respondents.

In the absence of baseline data (before the intervention), the changes in the incomes and revenues of enterprises were estimated based on the recall values articulated by the entrepreneurs during the surveys. Such an approach maybe inaccurate due to the respondents' recall bias. Additionally, the evidence from existing deployments are from Karnataka only, which may have a different context compared to other parts of the country, particularly the eastern and North eastern states of India such as Odisha and Assam. Thus, the findings pertaining to the impact of these solutions on micro enterprises should be interpreted in light of the geographical limitations of the study.



We designed a detailed questionnaire to gather primary data on the incomes, revenues, cash flows, loan repayments, and asset ownership of the entrepreneurs Given such gaps, it is important for the deployers of these solutions to undertake independent and adequately designed impact assessments of these solutions at a representative scale. Such assessments would help enhance the confidence of not just financiers, but also other stakeholders, such as distribution channel partners, to support such solutions.





3. Financiers' perspective on financing solar-powered livelihood appliances

In this section, we discuss the risk perceptions of financiers, predominantly commercial banks and RRBs, in Odisha and Assam, in extending loans to end-users (potential buyers) of solar-powered livelihood solutions. We also include insights from interviews with representatives of the RBI and SIDBI, and district officers of NABARD in Odisha and Assam. Civil society organisations working on improving livelihoods in these states also provided insights on challenges in accessing finance. The MFIs we interviewed did not particularly lend in these states, but they shared their perspectives on financing solar-powered products.

Owing to the high capital cost of these solutions and the limited capital availability among the rural population, many cannot afford to pay for these systems upfront and must rely on loans. However, there are challenges with respect to the sanction and disbursement of these loans at the financiers' end, which need to be tackled in order to improve end-users' access to finance. While challenges exist in accessing most rural livelihood loans, it is further exacerbated in the case of loans for emerging technologies like solar-powered livelihood appliances. The challenges faced in these cases are:

1. Lack of awareness of technology among financiers: Most financiers in Odisha and Assam have predominantly been exposed to solar-powered home lighting systems but not the use of solar for livelihood applications. Therefore, financiers across the value chain—from bank branch managers to officials from All-India Financial Institutions and the RBI—have limited knowledge of the range and applicability of solar-powered livelihood appliances. Owing to the policy and subsidy support rendered to both solar pumps and off-grid solar lighting, financiers across the board had much greater awareness of these technologies and their associated risks.

We find that bankers were sceptical of the techno-commercial viability of proposals for solar-powered livelihood appliances. This is partly due to the fact that the economic benefits of emerging technologies like solar-powered sewing machines or IT kiosks are yet to be documented and proven at scale. However, a more significant reason for this lack of confidence among financiers is their lack of familiarity and knowledge of solar-powered appliances beyond solar home lighting systems and solar pumps, in the absence of data and physical demonstrations.

- 2. Lack of awareness of technology among consumers: Bankers in both Odisha and Assam mentioned a lack of demand for such loans. Solar-powered livelihood technologies are still nascent, with very few suppliers in the market. This limits exposure to such technologies in rural areas, where they have the potential to render the maximum benefits by providing better access to energy. In the absence of adequate knowledge and demonstration, people remain largely unaware of solar-powered livelihood appliances.
- 3. Perceptions of reliability of the technology: Previous experiences with solar lanterns of inferior quality have led financiers to be sceptical of the reliability of solarpowered technologies, particularly that produced by less-known and younger brands. The lack of quality certifications and benchmarking processes has had an impact on the quality of the products that enter the market (Waray, Patnaik, and Jain 2018). Additionally, the lack of timely and efficient after-sales repair and maintenance services in remote rural areas also poses a major challenge to regular repayments. In our interviews, bankers in Odisha pointed out that solar-powered livelihood appliances require regular maintenance and repair, and the lack of reliable repair services by manufacturers could have a direct impact on end-user income. Variations in incomes increase the risk of defaulting on loans. Bankers have also emphasised the need for robust business plans with potential strategies to overcome the losses incurred during lull seasons. We found that bankers are keen to understand seasonal variations, if any, in businesses supported by solar-powered livelihood appliances, its impact on end-user incomes, and the borrower's ability to repay the loan. Further, bankers, particularly in the North-eastern states, have expressed apprehensions regarding the performance of solar-powered livelihood solutions during the extended monsoons and winters.
- 4. **Smaller loan size:** The average loan size for small solar-powered livelihood appliances are within INR 100,000 (1 lakh). This is a small loan with relatively higher administrative costs for banks. Collecting repayments in remote areas poses additional costs. In such circumstances, bankers prefer pursuing a single loan of INR 1 million (10 lakh), for example, rather than 10 loans of INR 1 million, each (Kumar 2018). In our interviews, we found that bank managers find it challenging to extend such small loans. This challenge is further exacerbated by inadequate staff at local branches, which limits their ability to process and collect loans. Our interviews suggest that bank managers are cautious about lending in areas with a large number of non-performing assets (NPAs).
- 5. Lack of credit history for first-time borrowers: The lack of collateral, a savings history, and a credit rating score among first-time borrowers discourages bank managers from sanctioning loans to them. Bank loans require a strong business proposal to prove the viability of the technology and the potential revenue to be sanctioned. Even if banks exempt collateral for loans, the need for a guarantor and margin money exist. These challenges are further exacerbated for women entrepreneurs due to socio-cultural biases as well as lack of assets in their name that could act as collateral for the loan. The lack of financial literacy among the end-users further exacerbates the challenges faced by financiers in sanctioning loans.
- 6. **Challenges in evaluation of the loan:** Banks in the rural areas currently do not have the human resource capacity or training to assess the viability of new technologies and business models to extend loans for solar-powered livelihood technologies. Bankers



Solar-powered livelihood appliances require regular maintenance and repair, and the lack of reliable repair services by manufacturers could have a direct impact on end-user income



Bank managers are cautious about lending in areas with a large number of non-performing assets have been evaluating product loans for solar-powered livelihood appliances on similar grounds as for any other livelihood appliance. Our interviews suggest that the bankers are not differentiating loan evaluations for solar-powered livelihood appliances and their electricity-powered counterpart. The high capex associated with DRE should be measured against its reliability and low recurring cost. Moreover, banks require businesses to provide an operational track record to provide loans, with some banks asking for about three years of proven business, regardless of the technology and the age of the enterprise, which could be a challenge for many new enterprises (Rai, Best, and Soanes 2015).

7. **Challenges in repayment of loan:** The cash flow of the entrepreneur using a solar-powered livelihood appliance do not always align with the frequency of instalment payment, which is typically scheduled at monthly intervals. In a rural economy, post-harvest or a daily/weekly collection of loan instalments could prove to be more effective. With limited capacity to collect the repayments, bankers face increasing defaults for these small-sized loans. During our interviews, bankers pointed out a regional variation in the repayment culture. Different states have varying financing ecosystems, where lending and collection strategies would have to be designed as per the repayment capacity and history of the region. In some states, subsidies and debt waivers from the government have created a dis-incentive for repaying loans. Such measures and consequential customer behaviour impact the risk perceptions of bankers.

To summarise, lack of access to affordable financing remains one of the biggest impediments to the commercialisation and scaling-up of solar-powered livelihood appliances. The lack of finance is due to factors pertaining to the novelty of the technology, the socio-economic profile of the customers, as well as the modalities of providing and collecting loans. Some of the key factors affecting access to end-user finance include the lack of capacity and knowledge among bankers to assess the techno-commercial viability of proposals related to clean energy powered livelihood appliances. In addition, when loan sizes are small (usually below INR 1 lakh), it becomes unattractive for banks to lend, owing to the high transaction cost of processing each loan. Banks also demand that businesses provide an operational track record to provide loans. Some banks ask for about three years of proven track record regardless of the technology and the duration of the enterprise, which could be a challenge for first-time micro enterprises. Lack of credit history of the borrowers and margin money usually becomes the major limiting factor for businesses. The intersection of the nature of these technologies and the socio-economic profile of the end-users further increases the risk perceptions of financiers with regards loans for these products. The government has tried to address some of these challenges through various schemes like Pradhan Mantri Mudra Yojana. However, evidence suggests that such schemes have not reached all needy entrepreneurs, indicating the need for a more targeted approach to power livelihoods in rural India.



The cash flow of the entrepreneur using a solar-powered livelihood appliance do not always align with the frequency of instalment payment



4. Evidence from existing deployment of solar-powered livelihood solutions

In this section, we analyse the financial data of micro enterprises in Karnataka that have installed sewing machines and LSKs to understand the change in their revenues, incomes, as well as their ability to repay the loans.

4.1 Analysis of evidence from existing deployment

Over the past five years, SELCO Foundation has piloted numerous livelihood-based interventions for rural areas using decentralised solar energy. So far, SELCO Foundation has designed/developed/re-purposed/supported over 65 livelihood technologies (SELCO Foundation, 2019). As mentioned earlier, in this study we have focused on two technologies—solar-powered sewing machines and solar-powered digital services (printers and photocopiers) referred to as LSKs—due to their relatively high number of deployments.

Traditionally, tailors in small cities and villages use human-powered sewing machines. In many parts of the country, local custom tailors are adopting motorised sewing machines to achieve higher productivity. However, in areas with poor or no grid electricity, custom tailors continue to rely on human-powered sewing machines. For such areas, solar-powered sewing machines could be particularly attractive. The technical specifications of a predominant model of solar-powered sewing machine designed by SELCO Foundation are as follows:

Components		Capacity
Solar module	>	60 Wp, 12V
Module mounting structure	>	60Wp
Charge controller	>	10A, 12V
Solar battery	>	60Ah, 12V
PMDC motor	>	60W, 12V, 3000 rpm

Box 1: Product specifications of solar-powered sewing machines

Source: (SELCO Foundation, 2010)

Due to poor accessibility, rural, tribal, and peri-urban populations expend a significant amount of time and money attempting to avail of digital services. Even if there is a digital facility in these areas, erratic power supply and voltage fluctuations disrupt the service, even damaging appliances. The digital solutions centre (LSK) provides a suite of solutions, from single photocopy machines to multiple systems, all powered by solar energy. They are available in three variants, as indicated by the table below.

	Printer + copier	Printer + laptop photocopy + LED	Printer + laptop photocopy + LED + camera + modem
>	40 Wp	60 Wp	250 Wp
>	40 Ah	120 Ah	180 Ah x 2
>	10 A	15 A	
>	50 W	150 W	800 W
>	100 copies/ day	300 copies/ day	300 copies/ day
	> > >	 copier 40 Wp 40 Ah 10 A 50 W 100 copies/ 	copier photocopy + LED 40 Wp 60 Wp 40 Ah 120 Ah 10 A 15 A 50 W 150 W 100 copies/ 300 copies/

Box 2:Product specifications of LSKs

Source: (SELCO Foundation, 2019)

Since 2016, SELCO India has deployed over 1,000 LSKs and 385 solar-powered sewing machines in Karnataka, of which SELCO Foundation collected the data for 200 randomly selected entrepreneurs using LSK and 100 entrepreneurs using sewing machines. We could only analyse the data of 77 entrepreneurs using sewing machines due to inconsistencies. We analyse the changes in the net incomes of the entrepreneurs and their cash flows, credit histories, and repayment periods.

We collected data on the cost and specifications of the deployed products and the associated loans from SELCO India's existing records; the data on incomes and credit histories come from a survey facilitated by SELCO Foundation between March and June 2019. The sample includes deployments in the past four years. More than 50 per cent of both tailoring and LSK units were deployed in 2018 (Figure 1).

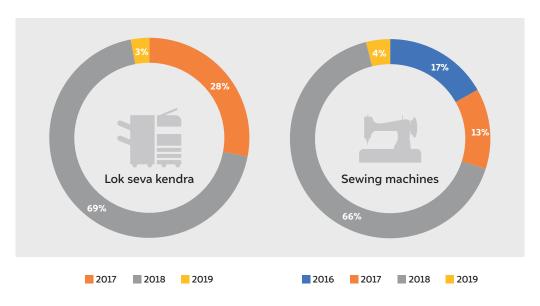


Figure 1:
A significant
proportion of sewing
machines and LSK
units were deployed
in 2018

Source: Authors' analysis

Note: The deployments in 2019 reflect the numbers for the first few months of the year Gender disaggregation of entrepreneurs





We found that owing to the nature of the business and women's easier access to loans through self-help group (SHG) networks or MFIs, there was a higher proportion of female entrepreneurs in our sample. The tailors operating sewing machines in local neighbourhoods are largely women. In most cases, they also take up LSKs as a business in addition to their existing tailoring shops.

a) Cost of the product and the value of the loan

The upfront cost of solarising an existing sewing machines ranges between INR 15,000 and INR 25,000, while for LSK the cost of solar and equipment (printer/photocopier) ranges between INR 10,000 and INR 35,000, depending on the model.

The loan amount for sewing machines include the cost of solar module and DC motor with back up. These are retrofitted on existing manual sewing machines, which is excluded from the product loan amount in our analysis. New entrepreneurs may have an additional investment to make to purchase the sewing machine.

While the loan amount for sewing machines varies only a little across entrepreneurs, we observe a greater variation among LSK loans. This is due to the number of possible combinations that an entrepreneur could avail for LSK. For instance, an LSK entrepreneur could also avail of a loan for a solar light in addition to their printer and photocopy machine. Some entrepreneurs may purchase larger battery storage to power other businesses in addition to the LSK. New entrepreneurs might buy the entire package, while existing ones may choose a single piece of equipment if they already have other machines.

About 44 per cent of LSK entrepreneurs have taken a loan greater than the value of the product, potentially to cover other costs associated with the business or other businesses. The solar equipment accounts for about 25–30 per cent of the product value; the balance amount is usually the cost of the printer and photocopy machine. An entrepreneur may extend an additional loan amount to meet the operational needs of this or any other business.

Median loan amount taken by entrepreneurs









Owing to women's easier access to loans through self-help group networks, there was a higher proportion of female entrepreneurs in our sample

Most of the loans were extended to the entrepreneurs by the *Shri Kshethra Dharmasthala Rural Development Project* (SKDRDP). It is a micro-credit organisation that lends primarily through SHGs and joint liability groups. It has a customer base of about 380,000 SHGs and 80,000 farmers' groups, with a credit portfolio of INR 95,000 million (9,500 crore). The rate of interest for these loans is about 16 per cent per annum, repayable in up to two years. While 94 per cent of entrepreneurs availed of the loan for sewing machines, a 100 per cent of LSK entrepreneurs made use of it.

First-time entrepreneurs

In our analysis, we also focus on first-time (new) entrepreneurs—those who did not own any business operations before the installation of sewing machines and LSKs. As opposed to older entrepreneurs, first-time entrepreneurs experience more challenges in accessing loans from formal financial institutions, therefore forming an important category of entrepreneurs in the context of financing for solar-powered livelihood appliances. About 14 per cent of our sample of sewing machine owners consisted of first-time entrepreneurs, while they made over 50 per cent of the LSK sample.

b) Incomes and revenues of existing enterprises:

Sewing machines

Before they adopted solar-powered sewing machines, the annual income of tailoring entrepreneurs ranged between approximately INR 20,000 to INR 140,000 with a median value of INR 65,000 (Figure 2). These enterprises experienced an average increase of 39 per cent in their annual incomes since the deployment of solar-powered sewing machines, with the median income increasing up to INR 90,000 (Figure 3). It is worth noting that enterprises with lower annual incomes experienced more proportionate increases in income than those with higher annual incomes (Figure 4). This indicates that the absolute increase in income for all entrepreneurs irrespective of their previous incomes is similar, potentially because of improved productivity from solar-powered machines.

In case of tailoring enterprises, we found about 14 per cent of the sample to be first-time entrepreneurs. They witnessed a much larger increase in their income (about INR 55,000 as median and average value), given that they started from a base of zero. Their income is reflective of not just improved productivity, but also of their entry into a new market. Given the low cost of operations for these businesses, their revenues also experienced a similar increase, with a reported median revenue of INR 100,000.



The rate of interest for these loans is about 16 per cent per annum, repayable in up to two years

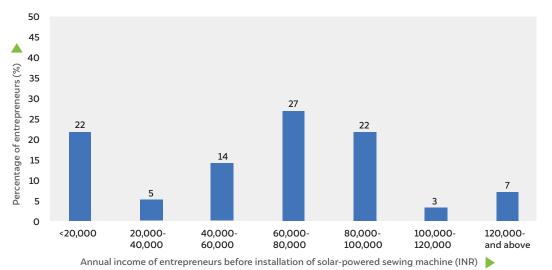


Figure 2:

About 20 per cent of existing tailoring enterprises had an income of less than INR 20,000 per annum before using solarpowered sewing machines

Source: Authors' analysis

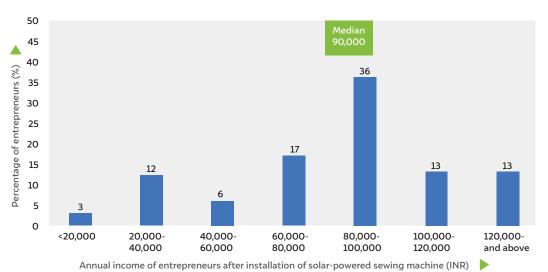


Figure 3:

Over 60 per cent of tailoring enterprises have an income of INR 80,000 or more per annum after using solar-powered sewing machines

Source: Authors' analysis

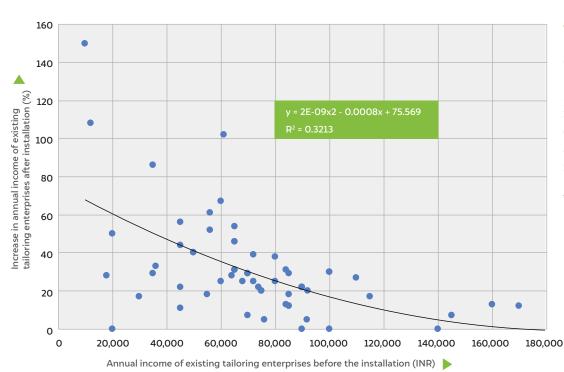


Figure 4:

Smaller entrepreneurs (by income) witness greater proportionate increase in income due to a similar absolute improvement in productivity

Source: Authors' analysis

towards consumables such as paper and cartridges.

LSKs

In case of LSKs, the existing entrepreneurs experience a median increase in income of INR 20,000 per annum (median income of INR 50,000). In case of first-time entrepreneurs, about half of them have an annual income between INR 1600–INR 32,000, with an overall median income of about INR 25,000 per annum. The median annual revenue for the first-time entrepreneurs is INR 36,000. The income to revenue ratio is lower for LSKs than for sewing machines, primarily because of the high input costs for LSKs,

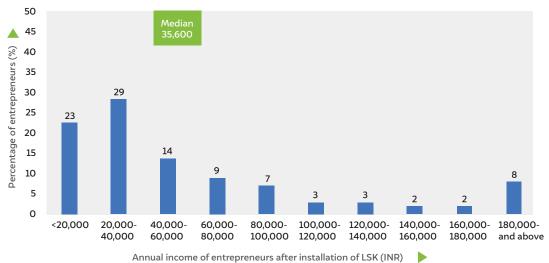


Figure 5: About 50 per cent of the LSK enterprises have an annual income of INR 40,000 or more

Source: Authors' analysis

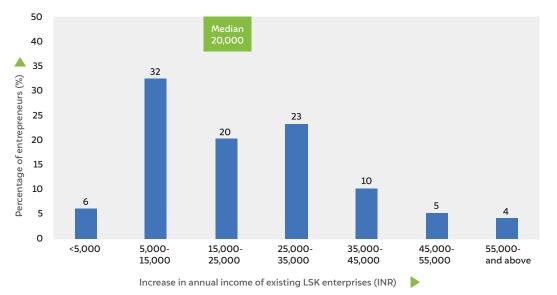


Figure 6: Existing entrepreneurs who installed LSK experienced median increase in annual income of INR 20,000

Source: Authors' analysis

c) Simple payback for loans

Sewing machines

We calculated the simple payback period for loans to estimate how long it would take entrepreneurs to recover their investment and reach the break-even point. We considered the increase in income to calculate the simple payback period as these enterprises were already generating an income through their previous tailoring businesses. Therefore, it would be fair to estimate the recovery period for their investment in solar-powered sewing machines based on the increase in their income. As per our estimates, the simple payback period for sewing machines would be around 11 months.



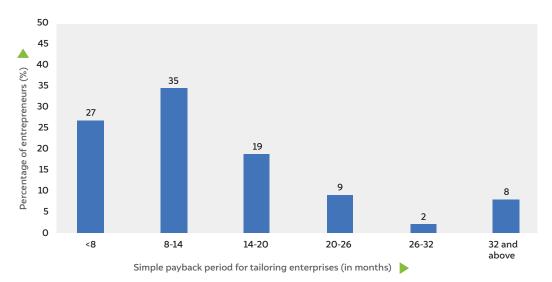


Figure 7:
Most tailoring
enterprises can
recover their
investment from
solarising their
sewing machines in
less than two years

Source: Authors' analysis

LSKs

As per our estimates, the simple payback period for the investment in LSKs, would be around 15 months. This differs for first-time entrepreneurs, whose overall income we factored into the calculation of the payback period; for existing entrepreneurs we considered only the increase in income.



⁵ While the old machines were operated manually, the new ones are motorised and run on DRE (solar).

⁶ The simple payback period is calculated by dividing the value of the product purchased by the increase in monthly income for all entrepreneurs. We assume that the increase in monthly income comes entirely from the product installed.

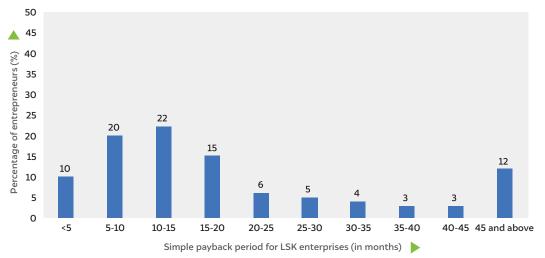


Figure 8:
About a quarter of
LSK enterprises would
take more than two
years to break-even
their investment on
LSK equipment

Source: Authors' analysis

Our analysis also shows that about 10 per cent of LSK entrepreneurs have a simple payback period of over 50 months. The median increase in monthly income for these entrepreneurs is less than INR 500, which significantly increases the payback period. In such cases, the investment is not economically viable; however, the unavailability of such services in the area and an indicative demand for it may have encouraged the entrepreneur to make such an investment. This points to a need for financiers and entrepreneurs to understand the context-specific value proposition of the product. Most of these enterprises have been in operation for less than one year or for 1-2 years, and 50 per cent of LSK entrepreneurs with an estimated simple payback period of over 50 months are first-time entrepreneurs—which could explain the lower levels of income, something that could potentially increase with time as the customer base improves. Nevertheless, we should also realise the role of such businesses in providing a livelihood for these entrepreneurs and catering to the need for such a service in their area. We therefore recommend that other forms of support be extended to make such investments economically viable for both the entrepreneur and the financier.

d) Median increase in monthly income vis-à-vis repayment of loan

Sewing machines

Tailors using solar-powered sewing machines availed a median loan of INR 17,800. The median increase in the monthly income of these enterprises is INR 1,667. Based on the terms of the loan, we estimate that the median weekly repayment amount is around INR 354, which translates to about INR 1,416 per month. The weekly loan repayments align with the frequency of cash flow for most tailoring enterprises.





Our analysis suggests that 61 per cent of tailoring entrepreneurs are able to pay their loan instalment from the increase in income that they witnessed after adoption of the solution (Figure 9). The remaining entrepreneurs, who are paying more in instalments than the

⁷ This is based on the difference between monthly revenue and income. The figure is a conservative estimate, since we assume the respondent did not account for loan repayment instalment while reporting the latest income.

increase in income, are able to pay the loan instalment with 30 per cent of their new overall income. This analysis helps us understand the economic viability of the investment for the entrepreneurs and assess if they can have sustainable incomes despite loan repayments.

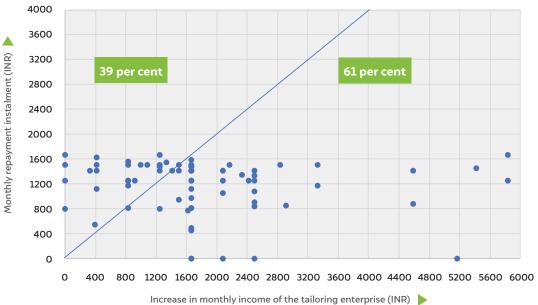


Figure 9:
61 per cent of tailoring enterprises are able to pay their loan instalments from the increase in their monthly income

Source: Authors' analysis

It is important to note that about 5-7 per cent of the entrepreneurs witnessed none to marginal increase in income. In such cases, the investment is not economically viable; however, the entrepreneur might have considered the switch since the reduction in drudgery is certainly appreciable. However, if an entrepreneur expected an increase in income that did not materialise, then it is a cause of concern for both the entrepreneur as well as the financier. It points to a need for both to understand the context-specific value proposition of the product. However, it is important to consider the greater productivity achieved through mechanisation, which frees up the entrepreneur's time for other activities.

LSKs

The median loan for LSKs is INR 29,500, and the median increase in the monthly income of these enterprises is INR 1,854. Based on the terms of the loan, we estimate the median weekly instalment to be around INR 332, translating to about INR 1,328 per month.

Our analysis suggests that 65 per cent of the existing LSK entrepreneurs are able to pay their loan instalment from within the increase in income that they witnessed after adoption of the solution (Figure 10). Rest are paying more in instalments than the increase in income, but the instalment accounts for 30–50 per cent of their new overall income. However, in case of LSKs, many entrepreneurs have availed loans higher than the value of the product, thus increasing

Median increase in monthly income



All
First-time
Existing



their repayment instalment. So, while the entrepreneurs are able to repay their loans and generate an income, those that have to pay 50 per cent of their income as repayment could find it challenging to sustain this level of pay-out, depending on their absolute income. This should be an important consideration for both entrepreneurs and financiers while determining the loan amount.

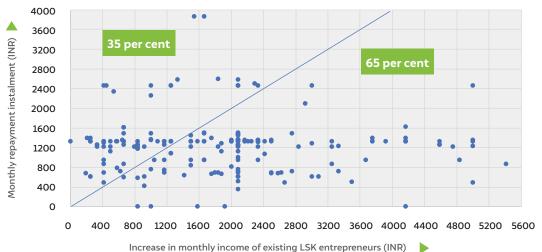


Figure 10:
65 per cent of existing
LSK enterprises are
able to pay for their
loan installments
from the increase in
their monthly income

Source: Authors' analysis

e) Cash flows of entrepreneurs are aligned with their loan repayment cycle

The cash flows of these micro enterprises could influence their ability to repay loans on time. While most commercial banks expect monthly loan repayments, this usually does not align with the cash flows of these entrepreneurs . While all the LSK enterprises receive cash daily, about 70 per cent of sewing machine enterprises have weekly cash flows. The loans extended by SKDRDP have weekly collection of repayments, aligning with the cash flows of all entrepreneurs.

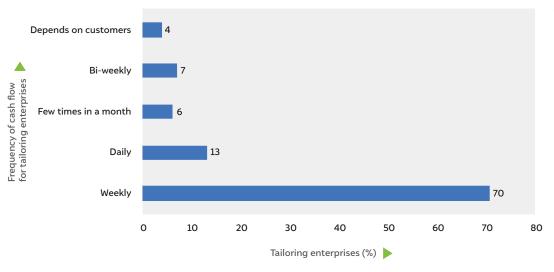


Figure 11: A majority of tailoring enterprises receive cash weekly

Source: Authors' analysis

f) Plan for growth and entrepreneurs' perceived business risk

Plan for growth for the next five years

We also analysed the entrepreneurs' business growth plans for the next five years. About 66 and 51 per cent of the sewing machine and LSK entrepreneurs, respectively, are focused on expanding their customer base to boost business growth in the next five years.



Perceived business risks in the next five years

The survey also tried to understand perceived risks that could affect the entrepreneurs' businesses in the next five years. More than 65 per cent of LSK enterprises cited insufficient demand for services as the biggest potential risk to the growth of their businesses, while tailoring enterprises do not perceive any significant business risks.

	Lok Seva Kendra	Sewing machine
Sample size of entrepreneurs considered for analysis	200	77
Price of the product (in INR)	10,000-35,000	15,000-25,000
Proportion of entrepreneurs availing a loan	100%	94%
Median loan amount (in INR)	29,500	17,800
Most common frequency of cash flow	daily	weekly
Loan instalment per month (median value in INR)	1,328	1,416
Annual revenue after installation of the system (median value in INR)	60,000	100,000
Annual revenue after installation of the system (modal value in INR)	30,000	100,000
Annual income before installation of the system (median value in INR)	14,600	65,000
Annual income after installation of the system (median value in INR)	35,600	90,000
Annual income after installation of the system (modal value in INR)	25,000	110,000
Median increase in annual income for existing enterprises (in INR)	20,000	20,000
Annual income after installation of the system for first-time entrepreneurs (median value in INR)	25,000	55,000

Table 2: Summary of entrepreneurs' net incomes, cash flow, and repayment periods

Source: Authors' analysis

4.2 Factors that improve the economic viability of financing for end-users

We also assessed which factors influence the economic viability of loans at various levels of loan value and income. We assume an average product value of INR 50,000 and a monthly income of INR 3,000 (based on a portfolio of various solar-powered livelihood appliances). These values are only meant as a representative case; the underlying insights from the analysis do not vary significantly for loan or income. We found the impact of interest rates for these products to be very marginal over the usual loan tenure of less than five years, while the actual length of the loan tenure is significant in determining the feasibility of making regular loan repayments. Even at higher interest rates, a longer tenure makes it feasible for the borrowers to repay the loans by contributing a reasonable proportion of their incomes for the instalments. For relatively lower loan amounts [<INR 500,000 (5 lakh)], longer tenures would be beneficial, despite higher interest rates

Monthly loan repayments as a proportion of monthly income (%) Tenure of loans (in years) Annual rate of interest 12% 16% Source: Authors' analysis 20% 24%

Figure 12: Longer tenure improves feasibility of repayment even at higher rates of interest

While an extended loan tenure increases feasibility and ease of repayment for the entrepreneur (and reduces the likelihood of default), the extent of adverse impact on the economic viability (measured as discounted payback period) for the financier would be marginal.

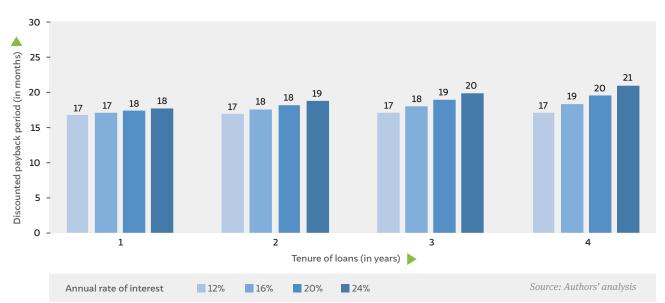
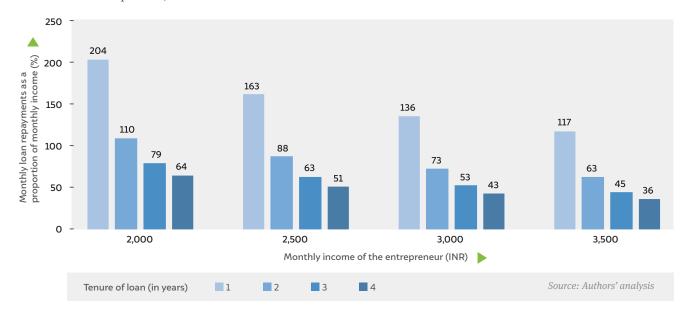


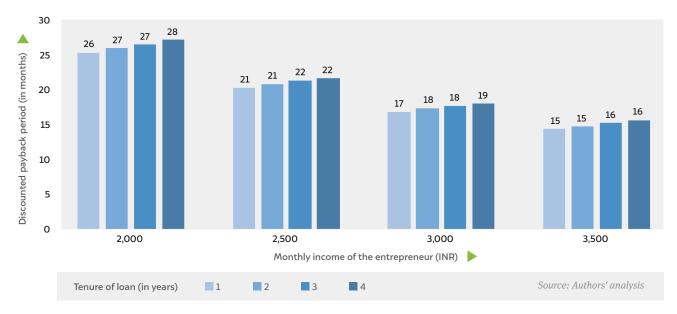
Figure 13: Increase in tenure has marginal impact on discounted payback period

Figure 14: Increasing the tenure of a loan could make repayment feasible for an entrepreneur, even at low levels of income



The impact of tenure in reducing instalment amount and easing repayment is significant at all levels of income. Even at low incomes, increasing the tenure by just a year can significantly improve the repayment ability of an entrepreneur.

Figure 15: High tenures affect discounted payback period only marginally across different levels of income



Most MFIs that provide loans for livelihood appliances currently offer tenures of 12–24 months. However, SFBs now offer individual businesses loans of up to INR 200,000 with tenures extending to three years. This could be an opportunity for them to expand their portfolios and invest in micro enterprises. Such banks could also accept deposits and therefore use the savings history of first-time entrepreneurs to provide them larger loans than MFIs offer today. RBI guidelines further mandate that such banks provide 75 per cent of their net credit to the priority sector, which includes micro credit; loans for small business and service enterprises; loans for beneficiaries of other financial inclusion schemes launched by the government; and loans for the renewable energy sector. This creates an opportunity for this category of lenders in an upcoming sector, which is likely to provide an income to millions in rural parts of the country. The reach of such institutions could be expanded to rural areas through collaboration with banking correspondents, MFIs, or both.

To summarise, an analysis of incomes, loans, and cash flows shows that there is a significant increase in the income of entrepreneurs after the installation of these solar-powered appliances. However, the degree of change in the incomes and revenues of end-users depends on the type of business and its access to markets. The cash flow of an enterprise also depends on the nature of the business. For instance, some entrepreneurs experience an increase in income that is lower than the instalment of their loan. Nonetheless, all entrepreneurs are able to pay off the instalments within a reasonable proportion of their overall income, thus reducing the risk of NPAs for banks.

It is important to note that such products reduce drudgery for entrepreneurs by replacing manual operations with motorised applications. It also offers them the flexibility to work at their convenience instead of depending on an erratic electricity supply. First-time entrepreneurs gain the opportunity to earn a livelihood in an environment with limited resources. Most entrepreneurs in the current sample, and in Karnataka in general, took loans from the same organisation—SKDRDP. As a micro-credit organisation, SKDRDP allows for flexible weekly loan repayments that align with the entrepreneur's cash flow. While this model has been successful in Karnataka, it is important to consider variations in repayment cultures, income levels, overall debt, and asset ownership across regions of interest.

Evidence of the financial performance of micro entrepreneurs in Karnataka helps alleviate some of the concerns that financiers have when lending to new entrepreneurs. Despite the high upfront cost of solar-powered livelihood appliances, the subsequent increase in income allows these entrepreneurs to conveniently repay any loans they may have taken to purchase the product. A prominent concern with lending towards the purchase of solar-powered livelihood appliances is that as first-time borrowers lack a credit history, bankers perceive a greater risk of NPAs among them. However, the evidence from existing installations suggests that these first-time entrepreneurs generate enough income after the installation to repay the product loan. The median loan amount for these products is less than INR 30,000. Since bankers incur high administrative costs for small loans, an additional push from the government would be necessary to draw attention to them. Existing policies like MUDRA are attempting to do this by providing loans up to INR 50,000 for livelihood solutions. Additionally, SFBs and MFIs could enable access to finance for rural end-users. In order to evaluate end-user loan and their credit history, banks need to leverage their network of banking correspondents in rural areas. In our analysis, we found that even though entrepreneurs had other business and personal loans, their overall income allowed them to easily repay the loan.



Evidence of the financial performance of micro entrepreneurs in Karnataka helps alleviate some of the concerns that financiers have when lending to new entrepreneurs



Existing policies to support end-user financing for solarpowered livelihoods

Energy is increasingly becoming an important aspect in the mechanisation of livelihoods. While the government has focused on providing grid electricity to households, the reliability and quality of supply remains an issue. Solar-powered appliances can support rural livelihoods by increasing incomes through uninterrupted power supply and reduced drudgery. Financing of solar-powered livelihood appliances could also be supported in ways similar to conventional livelihood solutions. In addition to banks and other financial institutions, government schemes have also supported entrepreneurship in many sectors, often through grants, but also by extending affordable credit and preferential treatment towards small and micro enterprises. Some of these schemes could evolve to suit the needs of the emerging solar-powered appliances sector and its enterprises.

This section analyses existing schemes and policies focused on end-user financing for enterprises. We include schemes that already focus on renewable energy and those that can potentially include it. Each scheme in the policy repository is mapped against the challenges perceived by banks in financing solar-powered livelihood appliances.



Solar-powered appliances can support rural livelihoods by increasing incomes through uninterrupted power supply and reduced drudgery

5.1 Schemes for small businesses and micro enterprises (SMEs)

Pradhan Mantri MUDRA Yojana (PMMY)

Less than five per cent of the 57.7 million (5.77 crore) small businesses and micro units in India have access to formal credit institutions (MUDRA 2018). The PMMY, launched in 2015, aimed to bring them under the formal credit system. It offers loans for working capital, equipment, and transport vehicles for agri-allied and non-farm income-generating activities. By virtue of its policy design, PMMY has the potential to address multiple existing challenges in the financing of solar-powered livelihood appliances. The scheme promotes loans to first-time entrepreneurs under three categories – *Shishu*, *Kishore and Tarun*⁸. The repayment period for *MUDRA* loans has been extended to up to five years. As per the data for FY2019, among the three categories, *Shishu* had the highest share of accounts (89 per cent) and sanction amount (42 per cent) (MUDRA 2018). The scheme also provides refinancing for scheduled commercial banks, NBFCs, RRBs, SFBs, and MFIs. Additionally, while all *MUDRA* loans are exempt from collateral security, most banks also waive upfront fees and processing charges for *Shishu* loans. The *MUDRA* website provides an extensive list of activities that can

⁸ Shishu category consists of loans less than INR 50,000, loans of INR 50,000–500,000 under the Kishore category and loans of INR 500,000–1,000,000 under the Tarun category

be supported through MUDRA loans. However, there is no specific mention of solar or other decentralised renewable or energy-efficient technologies.

Even though *PMMY* loans tend to address some key challenges, such as the lack of collateral and credit histories for first-time borrowers, our interviews with bankers suggest that a significant number of these loans turn into NPAs. In FY2019, there was an increase in the number of NPA accounts under the scheme from about 1.8 million on 31 March 2018 to about 2.9 million on December 31, 2018 (Kumar 2019). During the first nine months of the FY2018–19, there was an increase in the number of bad loan accounts under the *Shishu*, *Kishore*, *and Tarun* categories by 58.3 per cent, 70 per cent, and 45 per cent respectively (Kumar, 2019). The lack of collateral for such loans means that the banks do not have any assets to protect their own interests. While the *Credit Guarantee Trust Fund for MUDRA* loans was instituted to reduce the credit risk of lending institutions, it provides guarantees on a portfolio basis to a maximum of 50 per cent of the default amount. Further, the public banking system in India is not equipped to collect repayments for small loans. While *PMMY* could prove to be beneficial for financing solar-powered livelihoods, these challenges have made bankers apprehensive of lending new loans under *MUDRA*.

Credit Guarantee Fund Trust for Micro and Small Enterprises (CGFTMSE)

To reduce the burden of providing collateral, the Ministry of Small and Medium Enterprises (MSME) and SIDBI have been operating a *Credit Guarantee Fund Trust for Micro and Small Enterprises* (CGFTMSE), which provides partial collateral coverage for business loans extended to new and existing MSEs. This fund has the potential to mitigate collateral risks through guarantee covers for small-scale, solar-powered livelihood enterprises. For loans less than INR 500,000 (5 lakhs), the guarantee could cover up to 85 per cent of the loan value. The scheme also makes a special 80 per cent guarantee cover for MSEs owned by women entrepreneurs and all loans up to INR 5 million (50 lakhs) in the Northeastern states (MSME, 2008). In FY2018, 71 per cent of the total number of guarantees approved were for loans below INR 500,000 (5 lakhs), out of which 28 per cent were for loans below INR 100,000 (1 lakh) (CGFTMSE, 2018). However, for MSEs that are not engaged in manufacturing, services, and retail trade are disqualified for coverage under the scheme. Group lending models like SHGs are also not eligible for this credit facility.

Credit Linked Capital Subsidy Scheme (CLCSS) and Special Credit Linked Capital Subsidy Scheme (SCLCSS)

The high capital cost of solar-powered livelihood technologies proves to be a major challenge for rural enterprises. The Government of India provides a capital subsidy of up to 15 per cent for technology upgradation by MSEs—and up to 25 per cent for MSEs owned by SCs/STs—in the specified 51 sub-sectors approved under the *Credit Linked Capital Subsidy Scheme* (CLCSS) and *Special Credit Linked Capital Subsidy Scheme* (SCLCSS) (MSME 2006). Currently, the scheme covers a list of well-established and improved technologies under each sub-sector. The only solar-powered technology approved under the schemes is a solar dryer in the paper industry. The list of products/sub-sectors has been expanded over time with the induction of new technologies, products, and sub-sectors under the approval of the competent authority—the Technical Sub-committee and Governing and Technology Approval Board (GTAB)—which includes the secretary and additional secretary of MSME (MSME 2006). Including solar-powered livelihood technologies across sub-sectors under the existing CLCSS and SCLCSS could help borrowers overcome their high upfront costs.



Currently, the only solar-powered technology approved under CLCSS is a solar dryer in the paper industry

5.2 Schemes that focus on solar energy

There are schemes that provide support for the purchase of solar-powered technologies across farm and non-farm sectors. In the textile industry, two schemes, *Solar Energy scheme for Powerlooms and Solar Charkha Mission* provide subsidies on the capital cost of solar-powered looms and *charkhas* (Ministry of Textiles 2017a; KVIC 2018). This provision could be replicated or extended to small-scale sewing machines as well.

Off-grid and Decentralised Solar PV Applications Programme Phase III

This scheme by the MNRE focuses primarily on providing energy access solutions to rural and remote areas. It grants a subsidy of 85 per cent to school-going students from backward and remote areas in Northeastern states and districts affected by left-wing extremism (MNRE 2018a). To overcome the challenge of poor after-sale services, the government ensures that vendors provide sufficient tools and spares and authorise a local person in every block for the maintenance and upkeep of solar study lamps. While the scheme thus far has focused on lighting solutions (like solar streetlights and solar study lamps), introducing solar-powered livelihood appliances within its ambit could help create demand for these technologies among potential end-users.

Scale up of Access to Clean Energy Scheme

This scheme by MNRE is operational in Assam, Madhya Pradesh, and Odisha. It focuses on the development and deployment of renewable energy technologies for supporting rural livelihoods (MNRE 2018b). To address issues on the supply side, selected equipment manufacturers, dealers, and local entrepreneurs receive support for developing business plans and setting up supply chains across different districts in the target states. The scheme focuses on creating technology awareness and availability, establishing market linkages, and facilitating after-sale services for solar-powered livelihood technologies. However, no implementation has happened under the scheme, so far.

Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan (PM-KUSUM)

This scheme focuses on providing individual farmers subsidy support to install standalone solar agriculture pumps with capacities of up to 7.5 HP in areas where grid electricity is unavailable. While the central government is providing a 30 per cent upfront cost subsidy, the state government will provide an additional 30 per cent. The remaining 40 per cent has to be borne by the farmer, for whom the government has assured the availability of bank loans. Thus, the farmer has to pay only 10 per cent of the cost; they can pay up to 30 per cent of the balance amount through a loan. The combined central and state government subsidy can go up to 80 per cent in the Northeastern states, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Lakshadweep and Andaman and Nicobar Islands (MNRE 2019). Government support for solar pumps has increased the awareness and adoption of this technology. In our interviews with financiers, we found that bankers are far more aware of solar pumps than any other productive use technology.

Priority-sector lending (PSL) for renewable energy

Renewable energy is a part of PSL under the Reserve Bank of India, with a loan limit of INR 1 million (10 lakhs) per borrower for individual households, whereas the loan cap is



Government support for solar pumps has increased bankers' awareness of this technology unlike other solar livelihood products INR 150 million (15 crore) for purposes like solar-based power generators; biomass-based power generators; windmills; micro-hydel plants; and non-conventional energy-based public utilities, such as street lighting systems and remote village electrification (Reserve Bank of India 2018). The high cap for PSL loans for renewable energy benefits large players, leaving little scope for the easy financing of SMEs. There is a need to include separate sub-sectors and sub-categories within PSL for renewable energy to allow for greater availability of finance to micro enterprises.

For loans under the individual households category, inclusion of examples of technologies which could be covered under this section would be helpful for accessing these loans. These technologies could include (but not be limited to) decentralised solar home systems, decentralised renewable energy-powered livelihood appliances, or appliances that improve productivity or reduce losses, or appliances that reduce drudgery of manual effort for workers. It would be of great value to include the aspects of drudgery reduction and increased productivity to highlight the importance of reliable energy access for livelihoods to the bank officers.

5.3 Schemes with future potential to focus on solar energy

Pradhan Mantri Credit Scheme for Powerloom Weavers and National Handloom Development Programme (NHDP)

In our analysis, we found that some existing schemes in the textile sector can be leveraged in support of solar-powered looms. These scheme provide margin money assistance and interest subvention on loans for technology upgradation (Ministry of Textiles 2017b, 2017a). The NHDP targets handloom weavers, both within and outside the cooperative fold, including SHGs. These schemes can be leveraged to access credit-linked financial assistance for purchasing solar-powered looms and sewing machines. However, to extend benefits of such scheme for solar-powered solutions, the definition of handloom needs to evolve to include mechanised *charkhas* and paddle looms.

Technology and Quality Upgradation Support to MSMEs (TEQUP)

This scheme was discontinued in 2017, and is currently under revision. It is aimed at increasing awareness of, and the financing available for, energy-efficient technologies across manufacturing sectors. Although it had a provision for a 25 per cent upfront cost subsidy, a budgetary analysis showed a high percentage of unutilised funds (71 per cent). The scheme itself constituted less than one per cent of the overall budget of the ministry (Biswas, Sharma, and Ganesan 2018).

Entrepreneurship Development and Employment Generation (EDEG) scheme

These schemes by the Department of Animal Husbandry and Dairy Entrepreneurship and Development provides capital subsidies for technology upgradation to improve production and productivity (Department of Animal Husbandry 2014). While the schemes covers modern technologies like cold storage units and milking machines, it does not explicitly include solar-powered versions of these technologies. Including them would open up avenues for financing solar-powered appliances. The subsidy amount should be designed keeping in mind that the upfront cost of a solar-powered cold storage/milking machine is higher than its electricity-driven counterpart, but the recurring cost of use is much lower.

Prime Minister Employment Guarantee Programme (PMEGP)

Under this scheme, the government provides margin money assistance to individual



While EDEG covers cold storage units and milking machines, it does not explicitly include solar-powered versions of these technologies

borrowers and groups for new self-employment ventures, projects, or micro enterprises. It provides assistance on the project cost, which includes capital expenditure and one cycle of working capital. The subsidy amount is routed by KVIC through identified banks for eventual distribution to the beneficiaries' bank accounts. The scheme has been utilised by sector enablers like SELCO Foundation to provide margin money assistance to entrepreneurs for loans related to solar-powered livelihood appliances.

General Credit Card (GCC)

While we discussed government support for SMEs in the previous section, there are other schemes that focus on increasing the access and flow of credit to individuals for incomegenerating activities. The RBI launched a GCC for bank customers in rural and semi-urban areas to support entrepreneurship in the non-farm sector. It provides quick and hassle-free credit to rural customers based on an assessment of their cash flow without insistence on security or declaration of the purpose or end use of the credit (Reserve Bank of India 2013). However, the scheme is applicable only to existing customers of the bank, which has the flexibility to fix the credit limit based on the income and cash flow of the entire household. The maximum credit limit offered under the scheme is INR 25,000, which may not cover the entire cost of many solar-powered livelihood appliances. Nevertheless, in case the entrepreneur is covering a part of the capital cost of the machine, the GCC can cover the remaining amount.

Stand-Up India

Among rural end-users, marginalised groups like SC, ST, and women entrepreneurs, due to their disadvantaged status, face far greater challenges in accessing finance from the formal sector. The *Stand-Up India scheme* facilitates bank loans for first-time entrepreneurs from these groups, ranging from INR 1 million (10 lakhs) to INR 10 million (1 crore) (Ministry of Finance 2016). Most solar-powered livelihood appliances cost far lesser, and therefore fall outside the ambit of this scheme. However, collectives or institutions that pool multiple endusers through an innovative business model would be able to benefit from such a scheme.

Differential Rate of Interest (DRI)

Under this scheme, banks provide finance up to INR 15,000 at a concessional rate of interest of four per cent per annum to weaker sections of the community for engaging in productive and gainful activities (Reserve Bank of India 2017). While the loan limit under DRI is small, the loan bracket under *Stand-Up India* is much higher. There is a need for differential support for marginalised communities for medium-sized loans (INR 25,000–500,000), which can cover the upfront cost of many solar-powered livelihood solutions.

Some of these existing policies, like CLCSS, *Solar Charkha Mission*, NHDP, EDEG have a specific focus on women and SHG groups. These policies facilitate improved access to finance for women entrepreneurs. Several policies (including SCLCSS, DRI, Stand Up India) constitute special provisions and support for marginalised sections like SCs and STs.

The entrepreneurs using the products of SELCO India accessed loans under the MUDRA, Synd Mahila, and PMEGP schemes. While many of these schemes have been useful for the entrepreneurs supported by the SELCO Foundation in Karnataka, accessing the benefits under these schemes required efforts at the Foundation's end; most successful instances are due to regular follow-ups or trust the organisation built over the years. SELCO Foundation has also worked with banks to set targets under the MUDRA and Synd Mahila schemes, but in most cases, entrepreneurs played significant roles in accessing the benefit. Often, entrepreneurs were assisted by the local partners of SELCO Foundation, such as a local NGO or clean energy enterprise, in addition to the champion bankers with whom the Foundation forged and nurtured relationships.

Box 3:

Government policies leveraged for access to finance by SELCO Foundation-supported entrepreneurs

Source: SELCO Foundation (2019)

Table 3: Existing policies that could be leveraged for end-user financing of solar-powered livelihoods				
Government scheme and year of inception	Implementation ministry and agency	Target beneficiaries		
For small businesses and micro enterprises				
Special Credit Linked Capital Subsidy Scheme (2016–2020)	MSME	For MSEs owned by SCs and STs		
Pradhan Mantri MUDRA Yojana (2015)	MSME, SIDBI	Income-generating small businesses and micro enterprises		
Credit Linked Capital Subsidy Scheme for Technology Upgradation (2000–2001)	MSME, NABARD, SIDBI	MSEs—sole proprietorships, partnerships, co- operative societies, private and public limited companies in the small-scale industries sector. Priority shall be given to women entrepreneurs		
Credit Guarantee Fund Trust for Micro and Small Enterprises (2000)	SIDBI & MSME	MSEs		
Focused on solar energy				
Pradhan Mantri Kisan Urja Suraksha Evem Utthan Mahabhiyan (2019)	MNRE/SNAs	Farmers		
Off-grid and Decentralised Solar PV Applications Programme Phase III (2018)	MNRE	Rural areas		
Scale up of Access to Clean Energy Scheme (2018)	MNRE, State Renewable Energy Development Agencies and State Rural Livelihood Missions (SRLMs)	Assam, Madhya Pradesh, and Odisha		
Solar Energy Scheme for Powerlooms (2017)	Ministry of Textiles	Powerloom units with up to eight looms; the units should have shade free roof top/area		
Solar Charkha Mission (2008)	MNRE, Khadi and Village Industries Commission (KVIC)	Women and SHGs		
With the potential to support solar energy				
Pradhan Mantri Credit Scheme for Powerloom Weavers (2017)	Ministry of Textiles	Under PMMY, existing individual power loom units or new individual/group enterprises involved in weaving activities Stand-Up India—only new power loom units established by SCs/STs or women entrepreneurs		
National Handloom Development Programme (2017)	Ministry of Textiles, NABARD	Handloom weavers, both within and outside the cooperative fold, including SHGs and NGOs		
Entrepreneurship Development and Employment Generation Scheme (2014)	Ministry of Fisheries, Animal Husbandry & Dairying, Department of Animal Husbandry & Dairying, and NABARD	All eligible entrepreneurs - farmers, individual entrepreneurs, NGOs, companies, cooperatives, groups from the organised and unorganised sector, including SHGs and joint liability groups (JLGs).		
Dairy Entrepreneurship Development Scheme (2004)	Ministry of Fisheries, Animal Husbandry & Dairying, Department of Animal Husbandry & Dairying, and NABARD	Farmers, individual entrepreneurs, NGOs, companies in the organised and unorganised sectors, SHGs		
Prime Minister Employment Generation Programme (2008)	MSME, KVIC	Any individual above 18 years of age; SHGs; institutions registered under the Societies Registration Act, 1860; production cooperative societies; and charitable trusts		
Technology and Quality Upgradation Support to MSMEs (Discontinued in 2017)	MSME	MSEs		
General Credit Card (2008)	RBI, scheduled commercial banks, RRBs	Bank customers in rural and semi-urban areas for all non-farm entrepreneurial credit		
Differential Rate of Interest Scheme (1972)	RBI, scheduled commercial banks, RRBs	SCs/STs		

Budget sanctioned*	Nature of support
Overall investment of INR 10 million (1 crore) without any restriction on the sector; part of the INR 4,900 million (490 crore) outlay scheme of the National SC-ST Hub (NSSH)	Direct capital subsidy on high upfront cost, especially to marginalised communities
INR 571 trillion (INR 5.71 lakh crore) for three years from FY15 to FY18	Collateral-free, small loans for first-time entrepreneurs
Total subsidy amount for FY19 is INR 9.8 billion (980 crore)	Direct capital subsidy on high upfront cost
INR 75 billion (7500 crore) for FY18	Partial collateral risk coverage for loans
INR 344, 220 million (34,422 crore)	Subsidy support on upfront cost and increased access to bank loans
INR 6.56 million (656 crore)	Upfront cost subsidy and after-sale services
INR 700 million for FY19 and FY20 (70 crore)	Technology awareness and availability; after-sale services, establishing the value chain and market linkages
NA	Collateral-free, small loans for first-time entrepreneurs
INR 5.5 billion (550 crore) for FY19 and FY20	Subsidy on upfront cost, interest subvention
INR 200 million (20 crore) for a period of three years from FY18 to FY20	Margin money assistance and interest subvention
Budget based on state-wise tentative targets of new block-level clusters	Addressing existing loan NPAs, interest subsidies, credit guarantees, and margin money assistance
NA	Capital subsidy on upfront cost
NA	Capital subsidy on upfront cost
INR 23.2 billion (2327 crore) for FY20	Margin money assistance
INR 200 million (or INR 20 crores) in FY17	Technology awareness and upfront cost subsidy
NA	Collateral- free access to loan up to a fixed amount
Banks have a target of one per cent of total advances under the DRI scheme; this also falls under PSL	Low interest rate, making repayments easier



6. Recommendations for financiers, the private sector and sector enablers

Acomprehensive approach including awareness generation, capacity building, engagement with financiers to address their concerns and enable longer loan tenures, and policy support through the evolution of schemes would ensure the financing of clean energy-powered livelihood solutions at scale. In this section, we discuss the potential interventions that different stakeholders could undertake for improving access to affordable financing for end-users of solar-powered livelihoods. While some of these recommendations argue for improved implementation, others look at new ways of catering to the financial needs of various entrepreneurs.

Create awareness around solar-powered livelihood technologies and their economic viability

New technologies require awareness generation and capacity building for various stakeholders to understand, assess, deploy, and support them. Solar-powered livelihood appliances are no different. It is important for financiers, in particular, to understand the value proposition of a product as well as the emerging business models that enable the deployment of these technologies. From our interviews, we gathered a few efficient ways of leveraging existing communication channels to inform and engage bankers at all levels. Respondents emphasised the need to illustrate the economic value that solar-powered products add to the business in comparison with their manual, diesel, or electricity-run counterparts. It is important to engage influential stakeholders, such as lead district9 and block-level managers, to increase awareness among financiers. Sector enablers-industry associations, research organisations, and non-profit and civil society organisations—could also help inform financiers about these technologies. RBI Townhalls¹⁰ at the state, district, and block levels—which have participation from various commercial banks—are viable platforms for sector enablers to disseminate information concerning the value of such technologies. Physical demonstrations of solar-powered livelihood technologies to bankers have, in the past, helped build their trust and confidence in the technologies.

⁹ As per RBI's Lead Bank Scheme, the lead district manager (LDM) is chairman of the block-level bankers' committee. All banks operating in the block—including district central cooperative banks, RRBs, block development officers, and technical officers in the block, such as extension officers for agriculture, industries, and cooperatives—are members of the committee.

¹⁰ RBI Townhalls are conducted quarterly at the regional, district, and block levels, and involve bankers from different commercial banks.

Awareness camps and demonstrations have the potential to inform financiers and endusers about prospects for these livelihood solutions. Training programmes could also work as platforms for bankers, policymakers, NGOs, entrepreneurs, and end-users to discuss different financing models, and how to leverage available financing schemes. Local banking correspondents are critical channels between banks and customers. Awareness building programmes should target local banking correspondents to ensure that they enable financing for such solutions.

Selco Foundation's experience in southern parts of India have shown that workshops and meetings with financiers to demystify the technology are critical to creating new financing channels and institutions. Additionally, it is useful to engage former bankers, who have actively financed the sector previously, to discuss reducing or mitigating risks, innovations in financing, and promoting the financing of newer, productive technologies (Hande, Rajagopal, and Mundkur 2013).

Box 4:

Past experience of sector enablers in creating awareness around solar-powered livelihood appliances

Improve after-sales repair and maintenance services

To improve the reliability of new technologies, manufacturers and suppliers must ensure dependable after-sales services, while building the capacity of customers to effectively utilise these appliances. Good quality technology with a reliable after-sales service network could build trust among financiers in the products and their deployers. Training local workers to provide maintenance and repair services could facilitate timely and efficient up-keep of the technologies, and avoid potential disruptions to incomes that could increase the risk of NPAs. Moreover, energy enterprises could partner with local financial institutions to improve access to finances in rural areas.

Account for seasonal variations in income

Financiers mention inconsistencies in monthly incomes as a critical risk. Seasonal variations could be caused by fluctuating demand in the market or by the limited performance of solar photovoltaic systems in months with relatively less solar irradiation. Businesses should be able to demonstrate how such risks can be mitigated so that they may make timely loan repayments. For instance, the diversification of products and/or customers in months with low demand could be an effective way to gain the trust of lenders.

Extend targeted support of funds for solar-powered livelihoods

All-India Financial Institutions like NABARD and SIDBI could set up revolving funds for clean energy for both farm and non-farm micro enterprises, which RRBs could tap into. Additionally, MFI credit lines could offer financial support for farm and non-farm enterprises to acquire clean energy-powered livelihood appliances. Further, philanthropic organisations could pool resources to support such a fund, which would facilitate increasing loan tenures for entrepreneurs, or partially cover the risk of loans to improve the economic viability for lenders. In Cambodia, this model has succeeded in financing solar-powered pumping equipment; the fund acts as a de-risking mechanism for the local financial market and financiers until the technological and financial viability of the products is established (IRENA 2017).

Create credit or savings histories for entrepreneurs

Creating a credit history for individual entrepreneurs in the absence of collaterals could help increase lenders' willingness to extend credit. For first-time entrepreneurs, credit worthiness could be assessed through their savings history. Alternatively, bank transaction histories or Kisan Credit Cards could be used as proxies for an entrepreneur's financial status. Clustering entrepreneurs in associations could also enable joint credit histories akin to those of SHGs, and help to assure that bankers lend them money.

Adopt alternative and innovative loan collection mechanisms

Regular collection of loans at a frequency suitable to the borrower has been a key success of MFIs. By expanding their network of banking correspondents in rural areas, financiers such as SFBs could benefit from this market opportunity. Repayment schedules should be flexible with regard to entrepreneurs' cash flow. In some cases, it is easier for micro enterprises to pay smaller amounts at frequent intervals instead of lumpsum monthly amounts. In other cases, such as with agro-processing enterprises, repayment schedules are linked to harvesting seasons. Technology-enabled platforms, such as payment banks, could be leveraged to create higher frequency, flexible repayment plans; however, borrowers and financiers would require relevant training.

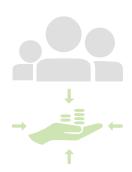
Focus on loan tenure instead of interest rates

For loans on these products, which usually have a tenure of less than five years, even a marginal increase in tenure can have a significant positive impact on the repayment of the loan. While it improves feasibility for entrepreneurs to service loans from the income generated by the product, the impact on the economic viability of the proposition is not significant. For instance, increasing the tenure for a loan of INR 20,000 would not affect the discounted payback period by more than a month, but it would significantly improve the feasibility of repayment. MFIs can start increasing the loan tenures for such products from one to two years and, if possible, from two to three years for higher value products. SFBs are best placed to extend loans for three years or more; however, their limited presence in rural areas may pose a challenge. As such, banking correspondents could help SFBs reach more entrepreneurs and benefit from this market opportunity. Our analysis suggests that entrepreneurs with a single source of income would benefit more from increased loan tenures than those with multiple income sources.

Adopt alternate end-user financial models

Where the basic financing model of commercial banks is unviable because of high-risk customers—those with low repayment ability, migrant or undocumented communities, or those without land titles and collaterals—bankers' perceptions of risk can be changed by adopting innovative financial models (Hande, Rajagopal, and Mundkur 2013). Tailored financial solutions are more likely to increase communities' access to livelihood loans, align repayment plans with cash flow, and improve credit conditions for end-users.

SHGs and JLGs under the National Rural Livelihood Mission (NRLM) also have the ability to mitigate the risks involved with lending to individuals. During the interviews we conducted for the study, bankers expressed that social collaterals, peer pressure, and group dynamics in these models help to maintain regular interest collection. With fewer instances of NPAs and timely repayment of loans, banks are more willing to lend money using group-



Entrepreneurs with a single source of income would benefit more from an increased loan tenure than those with multiple income sources

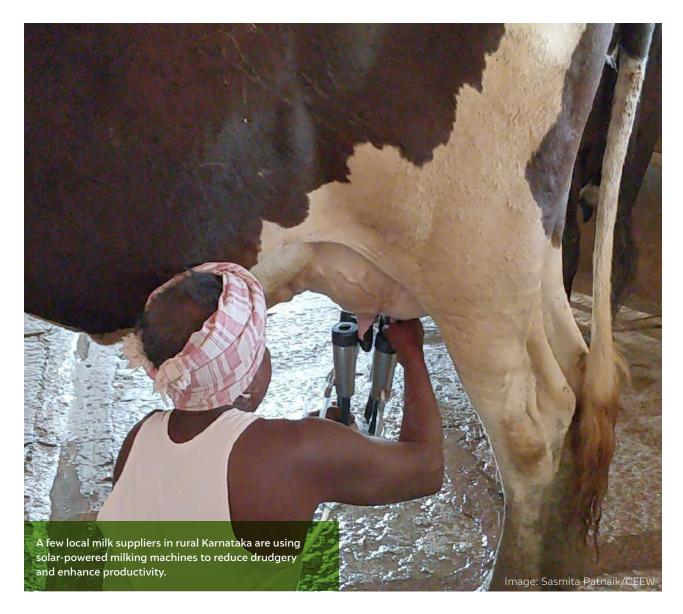
based models, especially to first-time borrowers. Many farm-based activities, including rearing livestock and sericulture, and forest-based livelihood activities, depend on producer companies. NRLM plays a crucial role in financing producer companies, that could adopt some livelihood appliances—particularly those associated with agro-processing and value addition. This would help to reduce the risk. Models which involve group lending, leasing, warehouse receipts, and those based on grants could also help to address the challenges associated with financing solar-powered livelihood appliances, and lead to increased income and reduced drudgery for rural micro entrepreneurs.

NABARD has supported group lending through cooperative banks and primary agricultural cooperative societies (PACS) since 2010 with the help of the PACS Development Cell (PDC). PDCs undertake credit and non-credit related activities to strengthen group lending systems in rural areas. Additionally, NABARD has leveraged the SHG network in order to implement the SHG-Bank Linkage Programmes. The DAY–NRLM Policy has mandated that all women SHGs are eligible for interest subvention on loans extended by RRBs for up to INR 3 lakh at 7 per cent interest per annum. Further, SHGs are given an additional 3 per cent subvention in cases of timely loan repayment (NABARD 2017). Since being linked to formal financial institutions, SHGs have engaged in internal lending based on the demands of members, while ensuring the timely repayment of loans and proper bookkeeping practices (ibid.).

Box 5:

Existing government schemes supporting group-based financing for livelihoods

7. Conclusion



With decreasing share of farm incomes in India, it is necessary to invest in value addition in rural areas to improve incomes. Most value additions necessitate access to reliable energy in various forms. Clean energy-powered livelihood solutions could catalyse this value addition and boost rural incomes while reducing drudgery. However, given their capital-intensive nature, access to financing is imperative to enable the adoption of such solutions at scale.

The inability of enterprises to access affordable financing remains one of the biggest impediments to the commercialisation and scaling-up of solar-powered livelihood appliances. Our research, including consultations with financiers, suggests that the lack of

financing is due to factors pertaining to a lack of familiarity with the technology, its economic viability, the socio-economic profiles of borrowers (micro enterprises), lack of collaterals and credit history, and the lack of adequate modalities for the collection of loans. A key factor hindering access to end-user finances is the lack of capacity and relevant knowledge among bankers to assess the techno-commercial viability of several solar-powered livelihood related proposals. Additionally, it is unattractive for banks to sanction small loans (usually below INR 1,00,000) because of the high transaction costs associated with processing and recollection. Banks also demand an operational track record or credit history from the micro enterprise in order to process loans; some banks ask for around three years of credit data regardless of the technology and age of the enterprise, which could be challenging for new products or first-time micro enterprises. As such, the absence of a credit history and margin money is usually a major limiting factor for businesses. The combination of the relatively unestablished technologies and the socio-economic profile of the end-users' compound financiers' risk perceptions associated with extending such loans.

Systematic evidence on economic viability, the track record of the technology, and the rate of repayment success on loans for such technologies could help build the confidence of financiers. Data from about 300 micro entrepreneurs using solar-powered sewing machines, printers, and photocopiers in Karnataka indicate a significant increase in their incomes since the use of these appliances. However, the degree of change in the incomes and revenues generated by the micro enterprises depends on the type of business and their immediate markets. Typically, investment in these products have a payback period of 18–24 months. Most of the enterprises spend about 20–40 per cent of their incomes on loan repayments, which makes the financing of such solutions highly viable. However, there are certain enterprises (about 5-10 per cent) in the observed sample which have long payback periods or who find such investments economically unviable. Thus, as with every business venture, it is important for potential adopters of products and their lenders to assess the value proposition of solutions (financial and non-financial) in their prevailing context.

It is important to note that some products reduce drudgery, as entrepreneurs shift from manual to motorised applications. In some cases, the products offer entrepreneurs the flexibility to work at their own convenience instead of having to depend on an erratic electricity supply. In cases where adopting the solution does not significantly increase income, the entrepreneur and lender should recognise that such an investment is being made to enhance productivity and reduce drudgery and the repayment would be feasible by partially of fully covering it from other existing sources of income.

As part of our analysis, we find that given the usual tenure of loans for livelihood products, the interest rates of loans do not impact its economic viability significantly; instead, loan tenures are more important in determining the feasibility of repayment for the entrepreneur. As loan tenures increase, even with higher interest rates, borrowers can more conveniently repay the loans, thereby reducing the risk of default. While extended tenure increases the feasibility and ease of repayment for the entrepreneur, the adverse impact on the economic viability of the investment is marginal.

To enable greater access to financing for rural livelihoods, it is essential to improve access to mid-size loans—smaller than what a bank would typically lend but in the range of, or higher



Government
schemes could
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emerging needs
of enterprises and
include support
for clean energypowered appliances

than, what an MFI could offer. The allocation of funds by NABARD and SIDBI to provide loans with higher tenures to enterprises would enable more entrepreneurs to operate and scale their businesses. Philanthropic organisations could also pool resources to cover risks that lenders face when financing newer technologies, while enabling longer loan tenures. Further, developing after-sales services and aligning the frequency of loan collection with enterprise cash-flows through innovative mechanisms, such as payment banks, would improve repayments and reduce risk of default against loans for such products. With an expanding network of banking correspondents in rural areas, new financiers such as SFBs could help to bridge the credit gap and benefit from this market opportunity. Finally, as with any new technological paradigm, it is important for sector enablers and civil society actors to engage with influential stakeholders, such as lead district and block-level bank managers, to increase financiers' awareness.

Financing solar-powered livelihood appliances could also be supported in ways the conventional livelihood solutions have received support. In addition to banks and other financial institutions, government schemes have supported entrepreneurship in many sectors—often through grants, but also by extending affordable credit and preferential provisions for small and micro enterprises. Some schemes could evolve to suit emerging needs of the sector and enterprises, and include support for clean energy-powered appliances.

A comprehensive approach including awareness generation, capacity building, engagement with financiers to address their concerns and enable longer loan tenures, and policy support through the evolution of schemes would ensure the financing of clean energy-powered livelihood solutions at scale. For most of these approaches, evidence of the financial viability, and the economic and social impact of such solutions, is imperative. While this report represents a step in this direction, we need continued endeavours to fill the gaps in the research, and to boost the confidence of stakeholders who provide loans for the propagation of clean energy-powered livelihood technologies.

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Annexure

Existing policies that could be leveraged for end-user financing of solar-powered livelihoods

Special Credit Linked Capital Subsidy Scheme: To facilitate the purchase of plant and machinery by providing a 25 per cent upfront capital subsidy to existing and new SC/ST-owned MSEs on institutional finance. The objective of this scheme is to promote new enterprises and support existing enterprises in their expansion for enhanced participation in public procurement.

Pradhan Mantri MUDRA Yojana: To provide loans up to INR 1 million to non-corporate, non-farm SMEs to increase the entrepreneurial activities of existing small business and encourage first-generation entrepreneurs. Commercial banks, RRBs, SFBs, microfinance institutions, and NBFCs provide these loans. The government has also created a Credit Guarantee Fund for MUDRA loans.

Credit Linked Capital Subsidy Scheme for Technology Upgradation: To facilitate technology upgradation by providing a 15 per cent upfront capital subsidy to small-scale industrial units on institutional finance for the purchase of well-established and improved technologies in the specified sub-sectors/products approved under the scheme.

Credit Guarantee Fund Trust for Micro and Small Enterprises: To allow guarantee cover for the portion of credit facility not covered by collateral security. To improve the availability of bank credit without the hassles of collaterals; to enable the lender to give importance to project viability and extend credit purely on the primary security of the assets financed.

Pradhan Mantri Kisan Urja Suraksha Evem Utthan Mahabhiyan: To install 1.75 million standalone solar agriculture pumps, the central government will provide 30 per cent of the benchmark cost or the tender cost, whichever is lower. Additionally, the state government will give a subsidy of 30 per cent; and the farmer will cover the remaining 40 per cent. Bank finance may be available, so the farmer can pay 10 per cent of the cost and source the remaining 30 per cent from a loan.

Off-grid and Decentralised Solar PV Applications Programme Phase III: To create a solar capacity of 118 MWp by 2020 through off-grid solar PV applications. To install 300,000 solar street lights; to provide 2.5 million solar study lamps to school-going children in the Northeastern states and districts affected by left-wing extremism.

Scale up of Access to Clean Energy Scheme: To enhance the use of reliable and affordable renewable/ clean energy for rural productive uses/livelihoods by:

- a) Encouraging innovation in addressing market needs and promoting sustainable business models
- b) Ensuring a suitable supply chain for RE technology packages and support for capacity building, awareness campaigns, and human resource development

Solar Energy Scheme for Powerlooms: To provide financial assistance/capital subsidies for the installation of on- or off-grid solar PV plants for small powerloom units in order to give a thrust to renewable energy. To provide eligible subsidies is based on the combination of the number of looms installed and the entrepreneur category—for instance general (50 per cent), SC (70 per cent), and ST (90 per cent). The cap on any subsidy under the scheme is INR 855,000.

Solar Charkha Mission: To ensure inclusive growth by generating employment through solar *charkha* clusters in rural areas; to provide capital subsidies of 35 per cent for solar *charkhas*. The scheme also proposes a ceiling of eight per cent of interest subvention on working capital, irrespective of interest rates charged by banks for a period of six months.

Pradhan Mantri Credit Scheme for Powerloom Weavers: To provide financial assistance such as margin money subsidies and/or interest subvention against the credit facility (term loan) availed under PMMY/Stand-Up India to the decentralised power loom units/weavers. To provide margin money subsidies of 20 per cent of project costs, with a ceiling of INR 100,000 and an interest subvention of six per cent per year, both for working capital and term loans, up to INR 1 million (or INR 10 lakhs) for a maximum of five years.

National Handloom Development Programme: To create loan waivers and recapitalise handloom weavers' cooperative societies and individual weavers. To provide interest subsidies and credit guarantees for new loans and margin money assistance up to INR 10,000 per weaver.

Entrepreneurship Development and Employment Generation Scheme: To cover all the activities required to ensure quantitative and qualitative improvement in livestock production and capacity building of all stake holders. To encourage entrepreneurship development and technology upgradation to improve production and productivity; to provide cold storage units for poultry products at 25 per cent government subsidy with a ceiling of INR 500,000.

Dairy Entrepreneurship Development Scheme: To generate employment opportunities in rural and urban areas of the country by setting up new self-employment ventures/projects/micro enterprises, the maximum cost of the project/unit admissible under the manufacturing sector is INR 2.5 million and under business/service sector is INR 1 million. Beneficiaries of the general category can receive margin money subsidies of 25 per cent of project costs in rural areas and 15 per cent in urban areas. For beneficiaries belonging to special categories, such as SC, ST, and women, the margin money subsidy is 35 per cent in rural areas and 25 per cent in urban areas.

Prime Minister Employment Generation Programme: To generate self-employment and provide infrastructure to the dairy sector; to set up modern dairy farms for the production of clean milk. To purchase milking machines with 25 per cent (or 33.3 per cent for SC/ST) of project costs as back-end subsidies, subject to a ceiling of INR 500,000 for general category beneficiaries and INR 662,500 (or INR 6.625 lakhs) for the SC/ST categories; to provide cold storage facilities with back-end subsidies of 25 per cent (33.3 per cent for SC/STs) of project costs up to a ceiling of INR 825,000 for the general category and INR 1.1 million for the SC/ST category.

Technology and Quality Upgradation Support to MSMEs: To encourage the manufacturing MSME sector to use energy-efficient technologies and manufacturing processes so as to reduce production costs and GHG emissions. To create awareness and encourage MSMEs to acquire product certifications or licences from national or international bodies.

General Credit Card: To provide hassle-free credit to bank customers based on the assessment of their cash flow without insistence on security and declaration of the purpose or end use of the credit. The total credit facility for an individual should not exceed INR 25,000.

Differential Rate of Interest Scheme: To provide finance up to INR 15,000 at a concessional interest rate of four per cent per annum to weaker sections of the community in order for them to engage in productive and gainful activities.



