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'KEEP YOUR CLIENTS CLOSE, AND YOUR SUPPLIERS CLOSER': INSTITUTIONAL PARTNERSHIPS FOR ACTIVISING SOLAR ENERGY ENTREPRENEURSHIP IN RURAL INDIA

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ABSTRACT

Renewable Energy Technologies have transformed rural lives in several developing and BRICs lands with a growing number of public, private, international and partnership model-based energy enterprises in the industry. This research investigates how solar energy entrepreneurs in rural India are supported, built and developed by a private renewables company which is structured with a highly interactive stakeholder management portfolio. Notwithstanding the standard description of social innovation, this research shows a 'for profit' company operating with a 'social motif' that incubates several other similar enterprises in its image instead of scaling up across lands and users/clients. The research additionally illustrates different types of income generating solar energy-based enterprises in rural India. The primary data collected from qualitative interviews with private renewables enterprises as well as rural solar energy entrepreneurs who are perceiving these emerging alternative technologies as an 'asset' rather than an 'add on' energy option. A systematic thematic analysis is used to evaluate the research data and the work concludes with implications for development practitioners and policy makers in alternative energy, entrepreneurship development and rural development; in addition to building empirical knowledge and understanding of renewables application in a leading BRICs land.

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INTRODUCTION

The objective of this paper is to investigate how Solar Electric Light Company of India, Private Limited (SELCO hereafter), a private renewables company effectively acts, reacts and interacts with several of its stakeholder in order to support and build solar energy-based entrepreneurs in rural India. For SELCO is both unique and representative in its role as a functionary as well as successful incubator since their philosophy has been not to mass scale up their business operations in India. There is a host of various other like-missioned renewables company that either mushroomed out of SELCO or incubated by the latter (e.g, ONergy Solar) in the image of their model across other parts of India. Therefore, to understand several such similar organisations in India (ranked 2nd by EY on the RAI) where solar energy technology adoption has exponentially grown in both rural and urban areas, it is crucial to capture the structure, strategy and operational model of SELCO of how they successfully built and supported solar energy entrepreneurship over the years.

This paper also illustrates how differently the company tend to perceive their working relationship with clients and the degree of closeness in partnership with suppliers for customised delivery of solar energy-based technologies. The nature and composition of the renewables market in India has changed dramatically over the years, drop in prices of solar technologies and adoption of the latter skyrocketing in rural India. This research adds to the knowledge of how the successful outcomes generated by SELCO could be better understood by firstly unpacking their organisational process and secondly, inspecting how they collaborate with several stakeholders for activising solar energy entrepreneurship in rural India.

Background

An entrepreneur is perceived as an individual who initiates, organises, manages and controls the affairs of a business unit. Entrepreneurship is invoked in an *ad hoc* fashion, when needed, to explain aspects of firm organisation (Knight, 1921), economic development (Schumpeter, 1934), market dynamics (Kirzner, 1973), and leadership (Witt, 1998a). The concept can

be understood also as a process by which individuals pursue opportunities without regard to resources they currently control (Stevenson and Jarrillo, 1990). While Say (1840) and Marshall (1961) put him as an organiser and speculator of a business enterprise, Schumpeter (1934) refers him as an innovator. Schumpeter's work has been far developed over time and the discussions around 'creative destruction' and then with 'destructive creation' had their recurring debates. Prior to Schumpeter's classic work (1949), Cantillon (1755) looked at entrepreneurial traits in renting out assets and leading the business from the centre of all activities. Dees (1998:15) defined that social entrepreneurs play the role of change agents in the social sector, by "*adopting a mission to create and sustain social value (not just private value), recognising the relentlessly pursuing new opportunities to serve that mission, engaging in a process of continuous innovation, adaptation, and learning, acting boldly without being limited by resources currently in hand, and exhibiting heightened accountability to the constituencies served and for the outcomes created*".

Isaak (2002) maintains that an *eco-preneur* is a person who seeks to transform a sector of the economy towards sustainability by starting business in that sector with a green design, with green processes and with the life-long commitment to sustainability in everything. Volery (2002) defines two types of *eco-preneurs*: a) 'Environment-conscious entrepreneurs', are individuals who develop any kind of innovation (product, service, process) that either reduces resource use and impacts or improves cost efficiencies while moving towards a zero-waste target. b) 'Green entrepreneurs', are those who are both aware of environmental issues and whose business venture is in the environmental marketplace. Such entrepreneurs pursue environmental-centered opportunities that show positive profit prospects. Entrepreneurial orientation to rural development, contrary to development based on bringing in human capital and investment from outside, is based on stimulating local entrepreneurial talent and subsequent growth of indigenous companies. This in turn would create jobs and add economic value to a region and community and at the same time keep scarce resources within the community. To accelerate economic development in rural areas, it is necessary to increase the supply of entrepreneurs, thus building up the critical mass of first-generation entrepreneur (Petrin, 1992), who will take risks and engage in the uncertainties of a new venture creation, create something from practically nothing and create values by pulling together a unique package of resources to exploit an opportunity. By their example they will stimulate an autonomous entrepreneurial process, as well as dynamic entrepreneurship, thereby ensuring continuous rural development.

This research focusses particularly on solar energy-based entrepreneurship in rural India. Rural entrepreneurship can be defined as a force that mobilises other resources to meet unmet market demand, the ability to create and build something from practically nothing, the process of creating value by pulling together a unique package of resources to exploit an opportunity (Jones and Sakong, 1980; Timmons, 1989; Stevenson, 1990). Globally, there has been an upward trend in renewable energy investment, currently worth \$244 billion (McCrone *et al*, 2013). Developing countries alone accounted for 45 percent of investment in 2012, up 19 percent from the previous year (Sargsyan, 2011). As the world moves toward greater renewable energy production, the US and India have

emerged as one of the leaders in renewable energy investment. With investment worth \$40.5 billion in 2012, together the two countries account for 16.5 percent of global investment in renewable energy. Ernst and Young (2011, 2018) ranks India as the world's second investment destination in the renewable energy sector, behind China and the US. In India, the renewable energy sub-sector is more attractive than other infrastructure sub-sectors, in particular fossil fuel power generation (Jena *et al.*, 2018). India has seen an annual growth rate of about 22% for renewable energy in the last decade. The production from non-conventional sources in India during 2013–2014 is about 53.22 billion units and the major contributors are wind and solar with 31.26 billion units and 3.35 billion units respectively (Barpatragohain, 2015).

As stated in the National Action Plan for Climate Change (2018), deploying renewable energy has been a strategic priority for India. The current solar-based installed electrical capacity is approximately 1.4% of the total. Most parts of India receive 4–7 kWh of solar radiation per square meter per day with 250–300 sunny days in a year. Solar energy intensity varies geographically with Western Rajasthan receiving the highest annual radiation energy and the north-eastern regions receiving the least. Solar Energy can be used through the thermal route or the photovoltaic (PV) route. A few applications of the thermal route are water heating, cooking, drying, water purification and power generation. Through the photovoltaic route it can be used for applications such as lighting, pumping, communications and electrification of villages. Agriculture involves various time-consuming stages in processing, and drying is one of them. Drying in the open sun is not only time consuming but also unhygienic. Solar dryers can be used to dry crops and other products. They come in all shapes and sizes, and therefore they can be utilised for various domestic purposes as well as in agricultural processes. The disadvantages of these systems are that they are slower than the dryers using conventional fuels and that they can be used for drying only at 40–50 °C (UNEP, 2011).

Various examples of solar PV lighting systems have exponentially grown in usage in rural India such as portable lanterns, home-lighting systems (up to 4 lamps), and also street lighting systems. Most of these technologies are portable and cost around \$62–\$68, they typically provide light for 3–4 hours of light daily, normally comes with an autonomy of three days. Home Systems (SHS) provide comfortable levels of illumination in rooms of a house after dark, they support fans, phone charging (depending on capacity) and also a TV at home. The costs of different SHS models may slightly differ depending on capacity, nonetheless. Solar lighting systems can be used to illuminate streets or an open area in villages where community meetings, vendors selling fruits and flowers (perishable goods) can benefit from. The Ministry of New and Renewable Energy (MNRE hereafter) provides financial assistance for the promotion of these, among eligible categories of users.

Improving the uptake of renewable energy technologies (RETs, hereafter) in developing countries may be catalysed by certain policy measures and market incentives, but also by entrepreneurship and local enterprise creation. In particular, entrepreneurship has been touted as an important solution where fossil energy utilities remain an inherent, embedded feature of the institutional status quo. The risk-taking, innovative, and institution-changing features of entrepreneurial

endeavour are key ingredients needed to break the hold of incumbent fossil energies facilitates the spread of renewable energy technologies. Although entrepreneurship has been identified as an important solution for developing countries, the literature coverage of the challenges that may be faced by entrepreneurs working in the renewable energy space has been fragmented. Indeed, the prominence, effectiveness and unique business models offered by enterprises such as Grameen Shakti, Illumination Solar, and those under the Lighting Africa programme suggest the need for a body of research that focuses on the business models, success factors and challenges associated with renewable energy entrepreneurship, specifically in developing countries (Mukhopadhyay, 2017). Microfinance and micro-franchising schemes have supported the overall ease of doing business along with Government support (MNRE, as mentioned above) have been identified as contributing to the success of renewable energy start-ups in developing countries.

Although, big players by and large dominate the manufacturers in the solar sector, there is a significant presence of small and medium enterprises, particularly in manufacturing of rural energy devices like solar cookers and solar lamps. There is evidence of strong collaboration between different actors to promote the growth of renewable energy sources, several strategies have been formulated and implemented jointly by governments, local institutions, NGOs and private sectors. SELCO is a private US company with US, British, German and Swiss shareholders. SELCO India was founded to provide clean, reliable, safe, and affordable solar power systems to households and also businesses in areas where there exists a genuine shortage of electricity and other energy options. The company also aimed at improving overall well-being and productivity in rural communities by helping in replacing the use of kerosene lamps with solar energy technologies. In addition, SELCO home lighting systems contributes to capability building in rural households by supporting them to build income-generating enterprises that would market various forms of handicrafts thereby enhancing productive use for education and communication. Finally, SELCO also works with numerous rural banking networks, agricultural societies, and micro-credit institutions.

By partnering with small banks in rural India, the company brought electricity to more than 100,000 homes in Indian villages where no alternative energy options were made available. *"The fundamental (premise in founding SELCO) was how to balance social, economic and environmental stability at the same level. And to destroy myths like the poor can't afford technology, the poor can't maintain, and thirdly that you can't run a commercial venture while trying to meet social objectives"* (MNN, 2011). The company received international co-operation and collaboration from E+Co who became the investment partner for SELCO. The conventional myth that the poor can't manage smart technologies or repay a small loan to keep their power system running was broken by SELCO's model.

By designing and introducing an innovative financial support scheme, the company transformed the way how renewable energy-based start-ups in rural areas could be better supported. One innovative example would be to look at a village vendor who runs a market stall and she spends about INR 450 every month on kerosene, while the repayment rate of a solar panel costs INR 300 every month. The case is interesting because

given the daily cash outflow of this vendor; s/he can pay INR 10 everyday instead of making a monthly saving of INR 300 for repaying the solar panel loan. So SELCO's model allowed that to happen by arranging a daily loan of INR 10 instead of a monthly installment of a sum of INR 300. SELCO has succeeded not just for powering village households by solar panels but also commercial purposes like charging stations for mobile phones, used and managed by village hawkers/entrepreneurs. The lesson here is synchronising payment rhythm with income patterns.

Such innovative business practices by the company calls for a better understanding of its business model and operational design further. *Firstly*, SELCO provides customised solution to individual household energy problems and thus they have not been into product standardisation large-scale. They have strong interdependence with their partner local suppliers and product assemblers. *Secondly*, to make finance available to solar energy entrepreneurs without the necessary bank-hassle, they have ties with regional rural banks as well as nationalised banks – this significantly plays a big role in benefitting the clients who wouldn't be able to afford the RETs without this financial support from banks. They have ties with research thinktanks; both national and international, to develop and design better products over time. The company spends no money on marketing, and directs their resources on understanding the energy demand of individual households, so they have a very highly functional technical and effective sales team whose members makes regular visit to their target villages and speaking to local people. In effect, the clients are a key stakeholder with whom they work in order to better understand the nature of individual household energy demand and use. In some villages, SELCO India partners with NGOs and community organisations to access remote villages where sensitisation of these technologies are very important before they are introduced and subsequently adopted.

So, the range of stakeholder and the private-private partnership model that can be seen in SELCO India's case include local suppliers, manufacturer and assemblers, banking and financial institutions, field-active technical staffs, user clients, NGOs and VOs. Till date, SELCO has sold solar lighting to more than 110,000 rural homes and to 4,000 institutions such as orphanages, clinics, seminaries and schools in the Indian state of Karnataka (UNDP, 2011). Moreover, SELCO's inclusive business model has led to the creation of employment not only for its own employees but also for several rural entrepreneurs who rent out solar lights to vendors and institutions. Renewable business scenario in India is moving away from policy driven to parity driven and more entrepreneurs are coming forward to with the vision to lighten India in eco-friendly way. For the development of renewable energy, the Jawaharlal Nehru National Solar Mission (JNNSM) aims to produce 10 per cent of its energy from solar-20 GW-by 2022. In order to gain from India's solar energy potential, several states have been pro-active in promoting solar by the way of separate state level policies and incentives norms. However, now a level of consolidation is taking place with several of the larger companies acquiring smaller ones and some of the inefficient players exiting the market. The scope of solar energy entrepreneurship and related energy-based enterprises that are better structured and nested can get more expansive than ever.

METHODOLOGY

The purpose of the paper is to analyse how solar energy entrepreneurs in rural India are supported by SELCO and how that is understood by the latter's close interaction with various stakeholders or simply its institutional arrangement. Considering this aim, an exploratory research strategy was adopted within a qualitative case study research design. This is in line with important recommendations in the literature (Dana & Dana, 2005, Dana & Dumez, 2015) pointing out the need for expanding research methodologies in the area of entrepreneurship beyond quantitative studies and thus embracing more inductive and holistic perspectives. An exploratory design is conducted about a research problem when there are a few or no earlier studies to refer to or rely upon to predict an outcome. Qualitative case study approach offers benefits such as being open-minded, flexible and allowing the collection of rich data for the purposes of exploratory analysis; they also offer distinctly capturing the interpretations, interactions and shared experiences and outcomes generated by the chosen actors. Different qualitative methods are useful in capturing the richness of diverse institutional contexts through in-depth interviews, field visits and participant observation, when focusing on the way actors adopt their strategies according to constraints in their institutional environment. The way in which people being studied "understands and interprets their social reality is one of the central motifs of qualitative research" (Bryman, 1988:8).

Generation of Codes and Thematic Analysis: Coding is the process of organising and sorting data since it serves as a way to label, compile and organize data. A 'good code' is one that captures the qualitative richness of the phenomenon (Boyatzis, 1998: 1) and encoding the information organises the data to identify and develop themes from them. While Boyatzis (1998: 1) defined a theme as "a pattern in the information that at minimum describes and organises the possible observations and at maximum interprets aspects of the phenomenon", Crabtree and Miller (1999) advises on using a template approach wherein includes the form of code from a codebook to be applied as a means of organising text for subsequent interpretation. For this research, several stages were systematically followed to work with subsequent connecting codes in the process of discovering themes and patterns in the findings. One of the keys in coding data, and in conducting a qualitative analysis more generally, is developing a storyline. Data generated from interview and participant observation were transcribed and prepared for data analysis by basing the discussion around themes. Second order themes were identified and grouped together that emerged across the case stories, collected from both primary and secondary data, to conduct an analysis. These themes included how a given institutional structure is formed, how many stakeholders are they nested with, their patterns of interaction and nature of involvement in the partnership. In linking data collection and interpreting the data, coding becomes the basis for developing the analysis.

Data analysis followed several stages. First, each interview transcription was scrutinised and themes were generated. This helped in creating first order codes. Second order codes were identified and grouped together in what emerged across the case stories (collected from both primary and secondary data) to carry out an analysis systematically. Eisenhardt (1989)

viewed that it is important that the data analysis process is based on both 'within' story and 'cross' story analysis. Since most of the themes were generated from collating responses that were pointing towards a common factor or a phenomenon, from a range of interview findings, an attempt was made to shift the analysis from the individual level to collective analyses. This enabled in drawing general conclusion and meaning to a given question if there were common themes generating due to repeat responses. The chosen qualitative approach for the paper has used a thematic analysis which Braun and Clarke (2006) views as a 'rigorous approach can approach can product an insightful analysis that answers particular research question'. In addition, this approach complemented the research questions by facilitating an investigation of the interview data from two perspectives: first, from a data-driven perspective and a perspective based on coding in an inductive way; second from the research question perspective to check if the data were consistent with the research questions and providing sufficient information. This research used a hybrid approach of qualitative methods of thematic analysis, and it incorporated both the data-driven inductive approach of Boyatzis (1998) and the deductive a priori template of codes approach outlined by Crabtree and Miller (1999). Fieldwork took place in the Indian state of Karnataka; the capital city of Bangalore along with villages in northern and eastern parts of the state since this region contain a wide variety of local institutions backed by state level government agencies working in parallel to support renewable energy-based entrepreneurship in the villages. Starting from street lighting, micro businesses and home lighting systems – solar energy technologies have a strong presence in this state of India. The research used both primary and secondary data sources for the purpose of data collection. Both these methods complemented each other in generating in-depth information about different solar energy initiatives and their overall impact. Several senior staffs at SELCO and their clients were interviewed to get a clear understanding of their institutional operational structure and stakeholder management model.

FINDINGS

A. Structure and patterns of interaction with key stakeholders

SELCO works with a range of stakeholders whose roles are critical in both operational and business management aspects of their company model. In order to identify how they work with each other, it is important to firstly note who they are and what is the nature of their interaction. *Firstly*, SELCO have been working with regional rural banks (RRBs), credit cooperatives and microfinance agencies to arrange credit arrangements for their clients who purchase customised solar technologies. Bank loans can be a big challenge in rural areas because formal nationalised banks wouldn't come forward with a loan offer without satisfying the usual guarantor, mortgage and margin money requirements. This is where SELCO comes in as a guarantor and more like a facilitator to arrange funding for a solar based micro enterprise and supporting an entrepreneur. While directly involving in finance is against SELCO's mission, they do however offer 'bridging loan' in exceptional cases of poorest of the poor clients. One of biggest reasons why banks would hesitate is due to the recollection mechanism, especially in rural areas where the repayment pattern and preference would be either daily or weekly and not monthly. This increases transaction and

operational costs on the side of the bank. However, for most micro enterprises where an entrepreneur has purchased any solar product from SELCO, the latter have arranged for a loan via the bank.

Secondly, SELCO relies solely on local suppliers and these are domestic companies. The company sources all its electronic items from Anand electronics located in Mangalore, Karnataka. This is a big difference between SELCO and other large scale RET producers (e.g., TATA Power Solar), the latter's technology is designed for European conditions and more standardised, for obvious large-scale sale implications. For rural India and to offer customised technologies based on individual household needs, SELCO needed electronic components that were rugged, even if that meant making trade-off in technical sophistication. SELCO have regular meetings and discussion on design innovation with local suppliers to improvise existing products as well as for new product development.

"We go back to the drawing board with our suppliers to even make small modifications based on client feedback on our products. For example, if we could do something with the weight of the battery or to make it look more portable"

Thirdly, not all innovation (at least, product innovation) is made possible only by working with their suppliers and so SELCO partners with several NGOs and community-based organisations. For example, SELCO partners with Self Employed Women's Association (SEWA) and several community-based/Voluntary organisations (VOs) in different rural areas. This is important because it would be very difficult for SELCO to penetrate into villages without local knowledge that community organisations could provide who they partner with. The importance of sensitisation, particularly to introduce new technology, cannot be emphasised enough in a rural context. It is even more important because SELCO's products are custom-made based on clients' need and feedback so it is essential that the SELCO staff can actually speak to the prospective customers/entrepreneurs. Therefore, this is where the role of local organisations comes in as a key stakeholder for SELCO.

Fourthly, the two other groups of stakeholders that are very important for SELCO are the entrepreneurs themselves along with SELCO's sales and R&D team. As mentioned above, product and design innovation are based on feedback coming in from the entrepreneurs themselves (SELCO calls them 'clients'), so it is very important that SELCO maintains a regular communication with them and also develop different ways to support their business by improving the solar based technologies to suit a specific issue or purpose. Also, another aspect is that SELCO doesn't spend any money on marketing and advertising for their products; instead their technical staff spends all their time talking to village clients and understanding the latter's needs and demand. So, there is a constant loop of information and knowledge sharing between the clients and SELCO.

B. Stakeholder Management and Outcomes generated

By looking at SELCO's operational model and the extent to which they regularly interact with a broad range of stakeholders - mainly clients or end users, suppliers, sales and R&D team, research think tanks - it is important to understand

their patterns of interaction and what outcomes, benefits or externalities, are generated from the same to support solar based entrepreneurial initiatives. Figure 1 illustrates the stakeholders that SELCO partners with. Codes are identified in each of these sections that would help in carrying out a thematic analysis. Looking at the range of services that SELCO offers to their clients, the following patterns of interaction can be observed as discussed below.

I. Continuous interaction with clients and feedback loop to customise demand-based products and services: The lighting solution provided by SELCO's solar lights are configured keeping in mind the needs of the customers and their capacity to pay the loan in instalments. Thus, it is very common that the solar RETs are demand tailored and customised - this happens after the sales and R&D team understands what the client needs are by studying a household's need carefully in great detail.



Figure 1. Identification of SELCO's Stakeholders

The research shows that SELCO doesn't follow the model of offering standardised technology solution to household with a goal of saving cost as evident from the following quote. In addition to this, SELCO's regular communication with clients/entrepreneurs provides them with a strong word-of-mouth communication channel of marketing so the company doesn't spend any money on advertising and other conventional marketing purposes. This word-of-mouth, a powerful communication tool to spread news in rural areas, brings in newer clients over time after the utility of the solar technologies in both household and business purposes becomes prominent.

"When it comes to the poor, everyone wants to standardise solutions to save cost, but not us. Thus, we have a significant amount of pre-sales activity, all of which is done by the technicians because they are in the best position to understand the context as well as the solution that can meet the requirement. We do not have any marketing budget. We put all our efforts into pre-sales and post sales service, which is marketing for us...We encourage them to interact with the neighbors, the local community so that they

have a deep understanding of the problems that the people face”

SELCO makes an initial estimate of monthly loan instalment capacity of a prospective client. For example, the client might be procuring INR 50 worth of kerosene every month and with the additional hours of work that SELCO lights can provide the family (SELCO India, 2009). There will be intangible benefits in terms of better health, increased hours of study for the children as well as saving time that is spent in procuring kerosene and forest wood. Adding all of these, the customer might probably be in a position to pay INR 150 per month as loan instalment. This would allow him to procure a two-light system. But his need is for a minimum of four lights, one each for the kitchen, bedroom, living room and cowshed (UNDP, 2011). A deeper and clearer understanding of his lifestyle reveals that while the user needs these four rooms to be lighted, all the rooms need not be lighted simultaneously. The wife of the rural user, who looks after the cows and cook food, needs lights either in the kitchen or in the cowshed at one point of time. It is also unlikely that the family would need lights in the bedroom and in the living room at the same time. So, while the system (a four-light system which typically costs around INR 250) with four points is fitted in that household, the customised technology supplies only a two light system that would be far more tailored to that particular household. The family can use the lights at points depending where the need is at a given time.

“A particular solar entrepreneur started with 30 lamps and put the solar charging station on the roof of his house that would charge the batteries used in these lamps. He would charge the batteries daily and rent the lamps to the vendors at 5.30pm. Around 9.30-10pm, he would collect the lamps back and INR 12 per lamp that was rented out. The vendors this way would save INR 2-3 per day since they were earlier paying INR 15 to buy kerosene. Soon he purchased another 30 and then another lot of 30...Then one day he came back to us saying that his technicians are getting fatigued lifting up so many batteries daily – it would be of help if we could make the batteries lighter.”

The use and application of solar lamps also requires a clear understanding to provide timelier and more relevant product and services to target users. For example, SELCO realised that apart from its widely used home lighting systems in rural households, the use of solar lamps is typically done by street vendors or hawkers who generally use it in the evenings to sell vegetables, fruits or flowers. So, SELCO sells the lamps to entrepreneurs who would rent to the vendors daily. In some cases, the rent model works as well when an entrepreneur runs a bigger business model. The initiative to create entrepreneurs based out of these technologies is as equally important as the wider application of the technologies for household use. As evidenced earlier, there is a constant feedback loop and knowledge sharing both-ways between clients and SELCO, this helps not only in considering new design input but also building rapport between a customer and SELCO staff while supporting the entrepreneur both from the finance as well as technology fronts.

II. Partnering with banks to offer innovative financial support to clients

The financial innovation that SELCO has introduced to the Renewable Energy (RE, hereafter) market have changed the

way banks approach RETs based businesses and entrepreneurs in rural areas. The origin of this idea can be seen as a direct consequence of the company's in-depth understanding of the household needs and capacity to pay. Considering the occupation of most of the targeted clients, be it entrepreneurs who are renting out solar lanterns on a daily basis, or street sellers and vegetable vendors who purchase/hire solar lamps/lanterns/home lighting systems, these individuals are more comfortable with daily cash repayments due to transactions occurring all day instead of saving up an amount and paying an amount monthly. SELCO tapped into this understanding and have offered loans that can be offered either daily, weekly or bi-weekly with the daily and weekly options to be very popular at the moment. This however, involves a variety of risk in the sense that no conventional financial institution would initially come forward to offer loans to these clients of SELCO because firstly, these prospective clients don't have collateral, guarantor and other standard loan requirements and secondly, the cost and difficulty in securing the repayments on a daily and weekly basis is pretty high and unusual for any commercial bank's regular approach towards banking operations. However, SELCO earned the trust of these commercial banks that they decided to collaborate with and thus firstly, the villagers have now regular banking practice and secondly, the innovative financial model of providing energy loans becomes operational.

“One of the best financial lessons that I learnt was from a street vendor who told me that she can afford to pay INR 10 (US 20 cents) a day, but would find it difficult to pay INR 300 (US\$6) every month! This was when I realised that to sell solar lights, the poor needs to be provided with a doorstep financing that ensured that payback patterns were synchronised with their income patterns”

III. Continuous and interactive relationship with suppliers:

The actors and their nature of patterns of interaction create a solid interdependency. A solar light comprises of four key components – the solar photovoltaic module (solar cell/module), battery, charge controller, and lighting system (lamps and fan). The source of a vast majority of electronic items that SELCO requires come from local suppliers, mainly from Mangalore. These are largely small and medium enterprises (SMEs, hereafter), willing to work closely with a dealer who would customise their products on regular basis. Clearly the benefits of using a local source goes a long way. In addition to strengthening regional economy and long-term benefits, the small-scale unit of these suppliers enables them to not pay excise duties which significantly affects the overall cost breakdown analysis and also having a strong willingness to take risk and work closely with SELCO to work on new design and product development.

“Our frequent interaction with the suppliers and their product design improves our delivery mechanism and further innovation of the products and service that we offer to the clients; even if the issues and improvements are minor – be it the weight of the batteries to the shape of the lamps, our suppliers are always keen to have a constructive conversation when needed and called for...”

SELCO maintains a high degree of transparency with all its suppliers and they are ready to back one another in case of constraints and challenges. Integration of stakeholders would make the market more mature, such collaboration and business

understanding between partners at both local and regional levels enhances the scope and sustainability of the business, and as a consequence benefits the clients of SELCO both directly and indirectly in the long run.

IV. Partnering with community organisations for new product development: It can be observed from SELCO's operational model that it engages with a variety of key stakeholder (see Figure 1), each of them contributing to the continuous refinement and development of the product and services that the company offers to its clients. It is also important to be pointed out that the clients aren't only street sellers and vegetable vendors, but also midwives, flower pickers, manual laborers and masons, women using the technologies for both household and vendor cooking. Most women in rural India do not have access to hospitals and use the services of midwives for delivery in their homes. In their absence of grid electricity, such deliveries are often done with the help of a mirror that reflected the sun's rays to the place of delivery. This improvised arrangement was of course not possible during night or on a cloudy day when the midwife would use a kerosene lamp or a candle. SELCO designed several solar products in consultation with SEWA (Self Employed Women's Association); the latter also helps SELCO to penetrate into such regions where the latter don't have any prior experience. This included solar lanterns for the vegetable and fruit vendors who could use it for extending their working hours as well as using it at home, head lamps for midwives and flower pickers, solar camps for laborers and masons, and a smokeless stove for cooking. Another situation where there is a strong need of light after dark is to support child birth delivery process in villages. SELCO designed a solar headlamp for the midwives to assist in the delivery process. The following quote elucidates further.

"We sat with midwives for two to three days to understand the complete delivery process. They taught us to cut the umbilical cord. People were laughing at us, but we told them that we needed to know the process well to design the energy intervention. There are usually only two women at the time of delivery – the one who is pregnant and the midwife. The midwife has a candle or a lantern, which balances with one hand during the delivery. We therefore decided to design the solar head lamp so that both her hands are free and enough light is generated for the process"

Further on, SELCO worked with flower pickers, who collected flowers from midnight till 3 am. It was difficult for them to balance both the flower basket and a lantern in one hand and pluck flowers with the other hand. It is both clumsy and also inadvertently reduces efficiency. With solar-headlamps they were able to pluck double the quantity of flowers in the same time. SELCO would appoint an entrepreneur who would rent out the solar lamps to the midwives and the flower pickers on a daily or an hourly basis, ensuring higher usage of the lamps and larger income generation. The entrepreneurs, who now rent out solar headlamps, have identified a new demand in the market. Most flower pickers are workers of a vendor who sells the flowers generally in the morning market in a village. They have higher stock now while cost of paying the flower picker stayed the same. As with other solar RETs, the entrepreneurs charge the lamps during the day and rent it out after 8pm to the clients. Moreover, SELCO's business model has led to the creation of employment not only for its own employees but

also for several rural entrepreneurs who rent out solar lights to vendors and institutions.

"One of the obvious ways to scale is to put aggressive targets on the sales team. Such targets would instinctively make them chase low-hanging fruits – they will go after customers who will buy faster and who will buy larger systems...But, SELCO exists to provide solar lights to the poor – the ones who can probably afford a small system and that too on credit. If one mixes the social objective with the commercial objective, it is most likely that the commercial objective will dominate..."

When it comes to scaling, SELCO has been rather conservative even if it is in Karnataka – this is because the company believes that pressure to scale might be subordinate to the social objective of the organisation. The institutional arrangements that SELCO has, as noticed above, has led to the creation of employment not just for its employees but also for several new rural entrepreneurs who are renting out solar lights to vendors and also local businesses. There is partnership made at each stage – one could argue that at each level there is a social value that is created both intrinsically and extrinsically. In other words, at the local level, the institutions are better linked and integrated which could actually lead to developing the market maturity of this industry considering there are major players at the regional and national level where support is available but a developed framework to reach out to the rural population is missing.

DISCUSSIONS

A. Knowledge sharing and feedback loop between SELCO and clients to better capture individual lighting needs

Evidently, SELCO's attention to individual demand for lighting needs and how important client input is for product design comes to the forefront from their daily operational considerations. References to interview responses as well as secondary data provides an understanding that the lights are used for critical activities, not only for household lighting but also for renting out RETs which is income generating, and that would determine clients' daily lives. As a result, a great level of focus is laid on the quality of the products and services offered. It can also be seen that there is generation of a business model around the solar RETs that provides income to both entrepreneurs and also the regularly in business street vendors, sometimes they can be the same person.

B. Faster and frequent New Product Development as well as quicker response to Client Issues: The key benefits of working with a local supplier and also sourcing from a small company for customisation have product development, repair and servicing benefits. It is also essential that these relationships are maintained over a period of time, one thing that can be noticed here however is that these suppliers are not big in size and they are not in direct business relationships with major RETs manufacturers (e.g. Kotak Urja, TATA BP in India). Therefore, their association with SELCO provides a security and market edge for the latter. It would appear unfeasible to manage the same level of costs and innovativeness while delivering customised products and services at the same time, if SELCO has to change and swap suppliers frequently. Also, the contractual security and long-term relationship comes as a consequence due to the continual

Table 1. The impact of switching to solar technologies

Information collected on	Switching to alternatives	Impact of the switch
Hours spent using kerosene	Solar lantern	a) No threat of respiratory diseases, b) Save time in sourcing forest wood
Amount spent on buying kerosene	Do	c) Increased hours of study for the kids, b) save financial resources

Table 2. Data Analysis Structure for SELCO India

Patterns of interaction and outcomes	First order codes	Second order codes	Themes
1. Providing customised products and services, tapping into specific household need	1. Products are customised based on household needs 2. Continuous feedback loop and knowledge sharing 2. Word of mouth communication 3. Interaction between clients and SELCO staff 4. Faster response to RET product issues	1. Regular communication between clients and SELCO staff 2. Considering the nature of lighting needs at the household level	Knowledge sharing, feedback loop between SELCO and clients, understanding individual lighting needs
2. Developing a financial innovation in offering solar lights	1. Banks interacting with villagers 2. Banks offering loans to solar based businesses 3. Banks receiving repayments on daily and weekly basis 4. SELCO providing bridging loan 5. SELCO connecting entrepreneurs with bankers	1. SELCO arranging bank loan facilities to their client 2. formation of clients and bank relationship	Availability of start-up finance for solar based enterprises, developing banking practice
3. Ongoing interactive relationship with suppliers	1. Working with local suppliers 2. Suppliers are flexible and source locally 3. Suppliers working on design innovation based on SELCO's client input 4. Experimenting with new product and design and allowing trial and error	1. ongoing product refinements tailored to client needs 2. faster response to customer service	Faster new product development, quicker response to client issues
4. Partnerships for Innovation and new product development	1. Identifying new needs 2. Working closely with the prospective clients 3. New product development 4. Working with a voluntary organisation 6. Working on a sensitive issue, helps to nurture trust with the community in the long run	1. partnering with community level organisations and VOs 2. engaging in activities that are considered sensitive to the community in an attempt to get closer to them	Working with local communities, creation of new needs, trust building in networks

interaction between SELCO, their suppliers and related auxiliary stakeholders in addition to benefits such as ensuring consistent product quality and service. As evidenced in this paper, the regular feedback collected back from the clients are used to continually improve the product design and service quality model of SELCO – this in effect have a regular impact on the supplier and technology designers at the same time. This pattern of interaction enables the selected take holders to continuously refine their products and quality of service while also maintaining the strong relationship and interdependency between them. It is also a great opportunity for the solar based entrepreneurs to refine their products from time to time upon minor modifications that SELCO can respond to speedily.

C. Working with Local Communities, Creation of New Needs, Trust Building across Networks: The research findings suggested evidence of both product and design innovation. SELCO have also worked with NGOs and community organisations because it would otherwise be difficult to penetrate the market in a rural area without any local knowledge. The example of developing a solar headlamp, in particular, is useful in this context because issues around childbirth and traditional practices are sensitive in traditional communities considering some of the regions in Karnataka are

conservative and resistant to allow changes in traditional practices (e.g., midwives delivering kids). Another thing to consider is the nature of risks and amount of community involvement required in the entire process. The research evidences that the headlamps benefitted the society in various different ways and also the fact that it is welcomed in the community without much resistance (ordinarily which can be quite a challenging thing in rural societies). This has to do with community participation that SELCO triggered from the very beginning knowing that gathering the amount of knowledge that it needs and the technological side of things required in the process. As an end outcome, this has brought about a big change and benefit to the society for both midwives and also flower pickers. Besides these tangible benefits, there is also an element of trust building that was a part of this activity since SELCO worked closely with the community on a sensitive issue as discussed above. Further, in terms of the institutional arrangements, these innovation and changes were possible not by SELCO alone but as a result of their partnerships with a) Self-Employed Women's Association (SEWA) and other VOs, b) Local people from the communities where they introduced the solar technologies. *Firstly*, without SEWA it would be very difficult for SELCO to penetrate a village area and study a sensitive topic such a child birth delivery and that too for

bringing in renewable energy technologies – to this end, SEWA's involvement in the arrangement benefitted the larger outcome of the process. *Secondly*, considering the end users would be the community – it benefitted the outcome further by involving the midwives into the process from the beginning. Once again, the two things can be repeatedly observed is a) targeting the end users to be a participant in the process from an early stage and b) studying the nature of demand and the need very much in-depth - these two can be applied also for home lighting systems, solar lamps, lanterns and other RE technological innovation that SELCO offers. The level of interaction that SELCO staffs have with the clients and the amount of detailed knowledge collected in the process is something that this research would like to highlight once again.

The very scenario where a staff member is precisely calculating how much an individual household spends on kerosene every month and calculate how many additional hours of work that SELCO light can provide for the same amount demonstrates their level of attention to detail and willingness to go far with the 'customisation' of the technology along with the funding model. This is clearly a value addition, also their measurement of the non-quantifiable benefits in terms of improving health, saving time in sourcing forest-wood and increased hours of study for the kids. These considerations are crucial for the clients who are using the RETs (solar lamps, batteries or lanterns) because they are using the technologies to increase their business working hours. Each solar lantern, for example, can give an extra 3-4 hours of light after dark and the staffs are found constantly studying how each entrepreneur uses the light, whether the latter uses it all up for business purposes or saves up an hour for using it at home for any paperwork or use by other family members. The staffs are also found to teach the entrepreneurs regarding how to service or maintain the technologies. Though these details may seem simplistic for a regular urbanite but getting even the basics of these technologies right could be initially a challenge for villagers. Clearly a) *customisation* and b) *improving health*, saving time in sourcing forest-wood and increased hours of study for the kids won't be visible in the outcomes unless the patterns of interaction are stressed, maintained and generates expected results.

D. Activising Solar Energy-based Entrepreneurship: There are a number of ways in which SELCO supports and enhances effects, social and personal, of solar energy entrepreneurship.

Firstly, the guaranteed visits (two times every year and also responding to one emergency call) and also the regular field visits to ensure that the use of the technology is made for the purpose it was originally designed and delivered for. This is an important lesson because it could have two implications – one is the monitoring & evaluation of the technologies that runs on an ongoing basis and secondly, overseeing the nature of consumption pattern of the solar technologies. It should also be noted that there's always a SELCO local office within a range of 30 km from a client's place/village. This could save them the time taken to visit the households and instead use the time to address an issue and possibly solve a problem. *Secondly*, the staff is also known for responding to 65% of the client calls within 24 hours and that 80% of the issues are resolved within the time frame. This is more than just reassuring the fact they have a strong operational efficiency but also giving a lot of intrinsic trust and confidence to the clients in the villages.

These factors act strongly as determinants to support solar energy entrepreneurship, since the enterprises such as the one where an entrepreneur rents out the solar lamps, lanterns or home lighting systems, operates daily and there is a regular cash flow reality. So, sooner they get a technical support the better in terms of smooth continuation of their operations. Also, having a good communication and support system are always a plus for entrepreneurial initiatives irrespective of the scale. Finance plays a major part in renewable energy-based start-up ventures, in both models of rent and ownership of the RETs. The arrangements that SELCO has with other stakeholders from the financial institutions market such as regional rural banks, credit cooperatives and microfinance agencies are particularly useful – firstly, this is key to arranging the provision of credit to SELCO's clients without getting into financing themselves and secondly, it is supporting the development of rural 'villager – banker' interaction and relationship which was missing before SELCO came into the picture of rural Karnataka and other states where they now operate. For a village entrepreneur, having a support system that not only provides customised technology as required, responding to technical issues immediately, but also making credit facilities available from a financial institution plays a vital role in terms of security, foresight as well as confidence.

The rural development implications are largely visible at various levels. Both knowledge sharing and capacity building can be seen from research findings. Entrepreneurs who are using SELCO's solar technologies to build their micro enterprises benefit from the relationship with the banks – this builds their credit credibility and good rapport for any future approach that they have to make to the banks again for either business or personal purposes. Also, the credit repayment mechanism that SELCO started, weekly or daily repayment patterns, ensures that the entrepreneurs develop a good credit habit and also business sense. Research data shows that a vast majority of them ends up paying the loans on time and also sometimes paying two or three instalments in one go. This can be seen as a success, not just for the entrepreneurs but in regards to achieving SELCO's objectives of developing entrepreneurial spirit and improving villager-banker relationship in the long run. Knowledge sharing is a bonus in the relationship between SELCO and clients, the constant feedback loop enriches product design and applicability, and this level of user-provider integration is a support system for entrepreneurs whose livelihood depends on the technologies on a regular basis. In addition to these, the entrepreneurs being a key stakeholder and knowledge point to SELCO ensures provision of confidence that provides intangible benefits to an enterprise. The steady and long-term relationship with the suppliers, who are largely local and community based, helps SELCO in designing and producing items to their exact specification, and that includes experimenting with new product design.

This allows quite a lot of innovation space as well as joint risk-taking capability. Their healthy relationship with other stakeholders, for example bankers and credit cooperatives also help the suppliers develop a solid confidence about SELCO's market and operational credibility when it's on a market development mode. This is a bonus for them on both market and non-market forces side. For entrepreneurs, it is a good sign because at most times, when they need to call SELCO staff for any repair or technical assistance, the staffs are equipped with the resources that they need to solve an issue on the spot. This

could reduce risk, time of waiting as well as operational costs, e.g., if a visit is required to a site more than once, and it may not be the same staff member visiting every time - therefore, the staff who visits to identify and review a technical problem, and the staff who visits to resolve the issue may be different individuals due to staff time-table and scheduling issues; since each one of them are following their own timeline of projects and deadlines. This pragmatic approach in managing staff routine and customer care efficiency appears sustainable. The multiple stakeholder engagement and institutional arrangements that SELCO has got at various levels boost the credibility and sustainability of the model. SELCO works with NGOs, local financial institutions, education institutions and social enterprises. These institutions can be seen as both direct and indirect stakeholders of the company - interacting, acting and reacting on a daily ongoing basis in order to ensure the continued operations and offering services to the rural entrepreneurs and clients. Each one of them has a defined set of deliverables while at the same time they work together and collectively adds up to the final service that the clients receive in the end.

Conclusion

The institutional arrangements that SELCO has, as can be seen above, has led to the creation of employment not just for its employees but also for several new rural entrepreneurs who are renting out solar lights to vendors and also local businesses. There are partnerships made at each stage – one could argue that at each level there is a social value that is created both intrinsically and extrinsically. Close working with the suppliers offers multiple benefits at both organisational level for SELCO as well as personal level of the solar entrepreneurs as they develop their operations over time. Evidence from this research shows that at the local level, the institutions are better linked and integrated which could actually lead to developing the market maturity of this renewables industry considering there are major players at both regional and national levels in India. The nature of multi-nested partnership with various stakeholders of SELCO brings in various sustainable development benefits that has been discussed and evaluated, this included building of social trust in communities, instilling a steady banking habit in villagers, knowledge building and perception development of solar technologies in poor communities, amongst others. Further research can look at similarly structured organizations that works towards developing solar energy entrepreneurs in other regions of India. While SELCO's choice of not choosing scalability provided a particular organisational design, partnership model and specific outcomes generated for rural communities and solar entrepreneurs, it would be equally useful to study another organisation with similar goals and model but that chooses to scale itself nationally. This would provide a more holistic vision of how a larger group of stakeholders and different set of institutional arrangements could boost solar entrepreneurship across the vast lands of rural India where energy challenge still deter life on many fronts.

REFERENCES

- Anwar, S. 2018. National Action Plan on Climate Change (NAPCC), Jagran Josh, India
- Barpatragohain, J. 2015. Alternate Energy: Strategy to address energy security in emerging India. In: Proceedings 3rd South Asian Geosciences Conference & Exhibition, New Delhi January 2015, pp.11-14.
- Boyatzis, R. 1998. Transforming qualitative information: Thematic analysis and code development, Thousand Oaks, CA: Sage.
- Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative research in psychology*. 3(2), 77–101.
- Bryman, A. 2008. *Social research methods*. Oxford University Press.
- Bryman, A. 1988. Quantity and quality in social research, London: Unwin Hyman.
- Cantillon, R. 1755. *Essai Sur la Nature du Commerce en General*, H. Higgs, ed. and trans. London: Macmillan, 1931
- Crabtree B. F., and Miller, W. L. 1999. *Doing Qualitative Research*, New York: Sage.
- Dana, L.P. & Dana, T.E. 2005. "Expanding the Scope of Methodologies Used in Entrepreneurship Research," *International Journal of Entrepreneurship & Small Business* 2 (1), 2005, pp. 79-88.
- Dana, L.P. & Dumez, H. 2015. "Qualitative Research Revisited: Epistemology of a Comprehensive Approach," *International Journal of Entrepreneurship & Small Business* 26 (2), October 2015, pp. 154-170.
- Dees, J. G. 1998. Enterprising non-profits. *Harvard Business Review*. 76 (1), 54-67.
- E & y 2016. EY Renewable energy country attractiveness index.
- E&Y 2011. Renewable energy country attractiveness index.
- Eisenhardt, K. M. 1989. Building theories from case study research. *Academy of Management Review*. 14(4), 352-550.
- Isaak, R. 2002. The Making of the Ecopreneur. *Greener Management International*. 38, 81-91.
- Jena, L.P., Meattle, C., Shrimali, G. 2018. Getting to India's Renewable Energy Targets: A Business Case for Institutional Investment, Climate Policy Initiative, India
- Jones, L., & Sakong, I. 1980. *Government Business and Entrepreneurship in Economic Development: Korean Case*, Cambridge, MA: Harvard University Press.
- Kirzner, I.M. 1973. *Competition and Entrepreneurship*, Chicago: University of Chicago Press.
- Marshall, A. 1961. *Principles of Economics*, London: Macmillan.
- McCrone, A. 2013. *Global Trends in Renewable Energy Investment 2013*. Frankfurt: UNEP Collaborating Centre
- Mukhopadhyay, B. 2017. *Solar Energy Entrepreneurship for Rural Development: Analysing Institutional Arrangements that Support Solar Entrepreneurs in India*. *Doctoral Thesis*, University of Sussex
- Petrin, T 1992. Partnership and Institution Building as Factors in Rural Development. In: FAO/ECA Working Party on Women and the Agricultural Family in Rural Development, Innsbruck, Austria 13-16 October 1992.
- Say, J. B. 1840. *Cours Complet d'Economie Politique Pratique*, Paris: Guillaumin.
- Schumpeter, J. 1934. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Transaction Publishers.
- Schumpeter, J. 1949. *Theory of Economic Development*. Harvard University Press, Cambridge, Massachusetts.
- Solar Electric Light Company of India Private Limited (SELCO) (Available online: <http://www.selco-india.com/>)
- Stevenson, L.A. 1990. Some methodological problems associated with researching women entrepreneurs. *Journal of Business Ethics*. 9, 439-46.

- Timmons, J. A. 1989. *The Entrepreneurial Mind*, Andover: Brick House.
- Turner, Chris 2011, *In rural India, Solar energy is the cheap and easy option*, MNN
- UNDP 2011, *Growing Inclusive Markets: SELCO: Solar Lighting for the Poor*, India
- UNEP 2011, *Towards a Green economy—Pathways to Sustainable Development and Poverty Eradication*
- Volery, T 2002. Eco-preneurship: Rationale, current issues and future challenges. In: *Conference Papers of Swiss Research Institute of Small Business and Entrepreneurship*, St. Gallen (Switzerland) June 2002, 541-553.
- Witt, U. (1987). How transaction rights are shaped to channel innovativeness. *Journal of Institutional and Theoretical Economics*. 143, 180-195.
