

A black and white photograph of three women standing in a field of tall grass. Two women on the left are wearing white headscarves and dark dresses, while the woman on the right is wearing a dark headscarf and a patterned dress. They are all smiling and holding small plants or sticks. In the background, there are solar panels mounted on a structure, and trees are visible. The bottom right corner of the image is covered by an orange curved shape.

State of the Decentralized Renewable Energy Sector in India - Insights from CLEAN






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FOREWORD

“ Resilience has been the way in 2021. Personally, and professionally, it's been a year filled with challenges. With millions of lives lost and businesses suffering heavily, the Covid-19 virus variants have only increased the misery of people and uncertainty of the situation. Yet, we witnessed the unflinching human attitude to survive. This grit also resonated in the way the DRE sector went about its business. Despite the roadblocks, there have been examples of new innovations and increased sales. These dimensions, which are reflected in this year's State of the DRE Sector in India Report are positive indicators of recovery.

Some of the Government measures were helpful in strengthening the confidence of DRE players. The announcement of PLI schemes for solar panels and battery manufacturing was much appreciated within the sector. CLEAN member enterprises strongly believe that once the DRE for livelihoods policy comes into action, it would be instrumental in scaling up the sector, creating a robust rural economy and helping realise the various goals set by the Government of India. As India strives hard to bring back normalcy with a stable economy, DRE solutions are emerging as necessary and appropriate to meet the end user needs. The case studies presented in this year's report showcase the diversified solutions, emerging innovations and scale of impact when opportunities are met with awareness generation, market access and finance.

The report findings in the report suggest that post covid, in-person trainings, came to a complete halt. These were previously imperative for technical training programmes, for formation of new workforce. The upside though is that it opened doors to online trainings, which has certainly extended the reach of these trainings. The report also brings

in focus the impact Covid-19 had on end user financing as well as the challenges faced by the sector in establishing linkages where the beneficiaries have not been introduced to formal lending mechanisms. The report also analyses the problems linked with consistent decline in benchmark costs for off-grid and decentralised solar PV systems.

The report this year too iterates that DRE businesses are driven by passionate and committed people who are trying to fulfil the energy requirements of the most under-served populations, with profits as a secondary though necessary consideration. We believe that the fifth edition of the State of DRE Sector in India Report will provide stakeholders with a three-sixty-degree view of the role of the sector in catalysing development, enhancing lives and enabling opportunities through DRE.

SVATI BHOGL
Chairperson
CLEAN



PREFACE

“ 2021 has been a year of hope, understanding, perseverance and grit. The world grappled with multiple challenges, however, it was encouraging to see an increased usage of DRE progressing across various applications.

DRE technologies have always played a pivotal role in achieving universal energy access by providing 24x7 reliable and quality power supply. DRE, I believe, is now well positioned to integrate into the mainstream energy mix and help in contributing to achieve India's ambitious renewable energy commitments. Ministry of New and Renewable Energy (MNRE) is working on a framework for Developing and Promoting Decentralized Renewable Energy (DRE) Livelihood Applications.

MNRE recognizes the potential of all forms of renewable energy and hence has established various programmes for promotion. Bio-energy has always been one of the important sources of energy for a large number of Indian households and bringing Bio-energy in the mainstream category signals growing importance of the resource. DRE technologies have great potential in generating employment in the country, as compared to other forms of energy - a facet that becomes particularly crucial in the current economic scenario.

I am pleased to share the fifth edition of the "State of the Decentralized Renewable Energy Sector in India - Insights from CLEAN" report, which presents an overview of the sector. technology deployments made, highlights the impact created by DRE initiatives and captures innovations that have leapfrogged development. All this in the backdrop of COVID-19 is commendable.

DRE sector has significant potential to enhance livelihoods, improve income, facilitate waste

management, and ensure better lives. This year, deployment of DRE livelihoods appliances has increased, which reiterates that the focus and need is shifting to energizing productive use applications.

I congratulate the CLEAN team for bringing out the enterprise level insights from the Decentralized Renewable Energy Sector to the fore. The report serves as an important instrument in terms of understanding the sector and crafting next steps.

DINESH JAGDALE
Joint Secretary,
Ministry of New and Renewable Energy



LIST OF ABBREVIATIONS

2G	Second-generation cellular network
AC	Alternating Current
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
BLDC	Brushless Direct Current
BOOT	Build, Own, Operate, and Transfer
CFC	Common Facility Center
CSO	Civil Society Organization
CSR	Corporate Social Responsibility
COVID-19	Coronavirus Disease 2019
CFA	Central financial assistance
DC	Direct Current
DRE	Decentralized Renewable energy
DAY-NRLM	Deendayal Antyodaya Yojana - National Rural Livelihood Mission
DAY-NULM	Deendayal Antyodaya Yojana- National Urban Livelihoods Mission
DPIIT	Department for Promotion of Industry and Internal Trade
ECLGS	Emergency Credit Line Guarantee Scheme
EPF	Employees Provident Fund
EPFO	Employees' Provident Fund Organization
FCO	Foreign and Commonwealth Office
FIG	Financial Institutions Group
FPO	Farmer Producer Organizations
FY	Fiscal Year
GeM	Government e-Market
GHE	Global Himalayan Expedition
GHG	Greenhouse Gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSM	Global Systems for Mobile Communication
GST	Goods and Services Tax
HP	Horsepower
Hrs	Hours
IC	Integrated Circuit
IEC	Information, Communication, and Education
IFHD	India Foundation for Humanistic Development
IGEN	Indo-German Energy Program
INR	Indian Rupee
IoT	Internet of Things
IREAP	India- Renewable Energy Appliances Portal
ISO	International Organization for Standardization

kg	Kilogram
KUSUM	Kisan Urja Suraksha Evam Utthan Mahabhiyan
kW	Kilowatt
kWh	Kilowatt hours
kWp	kilowatt peak
LOA	Letter of Allotment
LPG	Liquefied petroleum gas
LVDC	Low Voltage Direct Current
MFI	Microfinance Institution
MNRE	Ministry of New and Renewable Energy
MSME	Micro, Small, and Medium Enterprises
MT	Metric ton
NBFC	Non-Banking Financial Company
NGO	Non-Governmental Organization
NIWE	National Institute of Wind Energy
NTFP	Non-timber forest products
O&M	Operations and Maintenance
OEM	Original equipment manufacturer
OPEX	Operational expenditure
PAYGO	Pay As You GO
PCM	Phase Change Material
PE	Private equity
PMUY	Pradhan Mantri Ujjwala Yojana
PSB	Public Sector Banks
PV	Photovoltaic
PLI	Performance Linked Incentive
REC	Rural Experience Center
RBI	Reserve Bank of India
R&D	Research and Development
RE	Renewable Energy
ROI	Return on investment (ROI)
SAUBHAGYA	Pradhan Mantri Sahaj Bijli Har Ghar Yojana
SELCO	Solar Electric Light Company
SGST	State Goods and Services Tax
SHGs	Self Help Groups
SOFC	Solid Oxide Fuel Cell
SRLM	State Rural Livelihoods Mission.
SWP	Solar water pumps
USPC	Universal Solar Pump Controller
UT	Union Territory
VC	Venture Capital
WC	Working Capital
WiSH	Wind-Solar Hybrid
Wp	Watt peak
YTD	Year to Date

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With the government looking at energizing the country with renewable energy in a big way, the role and significance of Decentralized Renewable Energy (DRE) has increased manifold. While DRE has proven to be the most effective source of reliable and affordable energy for the underserved, last mile population, its productive usage is slowly but surely starting to boost livelihoods; along with associated economic and social benefits such as improved quality of life, higher incomes, etc.

With COVID-19 severely impacting the socio-economic activities and impeding the access to health and well-being for millions, especially the poor, DRE has once more demonstrated its relevance through technology innovations focused at catering to the rural poor such as solar powered drives for machine operated loom industry etc.

Similar to the past four editions of the State of the DRE Sector in India reports, the fifth edition presents the findings of a market survey where insights of 70+ member enterprises were captured. DRE businesses amid the waves of Covid-19 pandemic, have shown a lot of resolve. The grit shown by DRE enterprises, coupled with innovative thinking has well and truly led DRE businesses to evolve and succeed.

However, there have been constant challenges and constraints along the way. This report showcases all this and other key developments from the sector, through the lens of CLEAN member enterprises across the realms of technology, markets, finance, policy, and skills and training.

Based on the responses to the survey questionnaire, analysis of inputs from various sources, and interaction with several stakeholders (both members and others), CLEAN has put together this year's "State of the DRE Sector in India – Insights from CLEAN" Report. The executive summary presents the main highlights of this report.

- The survey findings reveal that access to basic lighting and clean cooking methods continues to be a felt need. Government measures towards this are consistently being supplemented by DRE practitioners.
- To quantify the need, CLEAN members (limited by the number of responses) deployed more than 1.34 lakh improved cookstoves, 7000+ biogas plants and close to 2 lakh units of solar lights, fans and solar home systems of various configurations.
- An uptake in DRE livelihood applications were also recorded. More than 10000 dryers, 3500 solar water pumps and 5600 other livelihood applications were deployed.
- It was observed that there were increased intervention focussing on the health and well-being of rural communities. CLEAN members solarized 2500 health centres in the last FY.
- According to a GIZ supported CLEAN assessment, the most popular DRE livelihood applications under farm and non-farm categories are:

TABLE 1

FARM LIVELIHOODS	NON FARM LIVELIHOODS
Solar water pumps Solar refrigerator and freezer Solar rice huller and polisher, Solar/biomass cold storage rooms Solar atta chakki/flour mills	Solar sewing machine Agarbatti making machine Solar fence Puffed rice making machine Solar sugarcane juicer, Solar weaving looms

- Despite the Covid-19 pandemic, the sector did reasonably well in terms of financial performance and fund raising activities. It was observed that after the first wave and ensuing nationwide lockdowns, enterprises were, in general, better prepared to tackle uncertain business situations (even outside of Covid-19 and its aftereffects). Businesses quickly learnt to establish better financial control, thereby, instilling resilience in their business models.
- Out of the total responses received, it was observed that approximately INR 158 Crores of capital was raised by DRE enterprises (21 nos.) with more than 85% of funds raised through a combination of debt finance and private equity mode. Debt finance came out as the most popular form of fund raising adopted by DRE enterprises, fulfilled by private and public sector banks for FY21 and FY22 (Till October'21). This was followed by private equity, grant capital and CSR funds. The quantum of funds raised via private equity was significantly higher than that availed via debt finance among for-profit enterprises.
- It was observed that even though a stringent lockdown was not imposed by the government, enterprises still faced challenges of reduced demand from customers and supply chain disruptions - two key reasons why financial performance continues to be sub-optimal. The total number of organizations running into losses increased by 3.1% and those making profits decreased by 4% from FY20 to FY21.
- DRE enterprises continued to raise capital despite financial stress and economic slowdown. It can thus be inferred that enterprises which were successful in raising capital were able to demonstrate resilience and project financial strength to the lenders/investors. 20 for-profit social enterprises stated that they made no profit in FY20. 25% of these profited in FY21 on account of rural/community-level connections built by these organizations which helped them fulfil specific orders and maintain business continuity. Of the aforementioned (75%) organizations that suffered losses in FY21 as well, 40% were successful in raising fresh funds during

FY21 and FY22 (YTD) through a gamut of sources such as grant capital, debt finance and private equity.

- With demand picking up and businesses realigning their strategies for the new financial year, end user finance was one of the key requirements which businesses cited, in order to aid growth and scale up. However, creating end user financing linkages presents its own set of challenges in a sector wherein end user beneficiaries are unbanked and not exposed to formal lending mechanisms.

It is worthy to note some of the innovative structures designed by CLEAN members such as ONergy to address these challenges, where transformative impact was created by establishing end user financing linkages through banks supported by a first loss default guarantee and formation of Water User Groups (refer Case Study on Page 44 and 45 to know more).

- It was observed that across all product and price categories end users are willing to pay 23% to 30% of the product cost upfront as down payment. This is indicative of the gradually increasing confidence that beneficiaries have in DRE products. A separate independent small sample size survey recently carried out with 14 CLEAN members brought forth a requirement to create end user financing linkages through loans for 350+ end user beneficiaries.
- The PLI schemes announced for solar panel and battery manufacturing have received an overwhelming appreciation by the sector. A common emerging point was that support to local manufacturing in other renewable energy sectors such as wind, biogas and

pico/micro hydro should also be taken into consideration. Similarly, one year, according to small wind turbine suppliers, is a long time to evaluate the feasibility of the project for wind system installations. The sub-sector members advocated for the small wind turbine component manufacturing to be potentially included in the Production Linked Incentive scheme to support local manufacturing.

- It is predicted that the announcement of PLI schemes for energy storage manufacturing will contribute to lower energy storage prices and, as a result, lower DRE based project costs in specific.
- DRE sector companies have focused their R&D efforts on addressing difficulties at the grassroots level, improving end-user experience, and increasing application reliability. This includes modifications to enhance efficiency, small scale energy metering systems etc.
- It was observed that there was an emphasis on recognising and certifying renewable energy-powered applications. The common ask was that government should consider issuing tentative certificates to technological innovations, allowing businesses and products to apply for government programmes.

67% of the enterprises responded that they have not sought certification for their products. The key reasons for this included – lack of standards for their application/ product, lack of access to testing/ certification centers, high costs of testing/ certification, and lack of policy support for their product/application.

- The methods for lab testing of biomass cookstoves, as well as the BIS standards for biomass cookstoves, should include protocols for field measurements of biomass cookstoves in the clean cooking sector. In the next few years, solar-powered electric cooking is also likely to gain traction.
- According to CLEAN member enterprises, sales agents and joint promotions (partnerships with NGOs and MFIs) were the most effective marketing channels for them. It was found that the establishment of common facility centres also aided in sensitizing rural inhabitants and turning them into potential customers.
- The benchmark costs for off-grid and decentralized solar PV systems have seen a consistent decline over the years. This, against the background of increasing import duties and GST rates has created a financial burden on both enterprises as well as end consumers.
- 46% of the respondents stated that they have been able to leverage Central or State Government programs to deploy their products. A predominant number of these solutions were solar based, highlighting the need for policy support for other sub-sectors.
- It was observed that travel restrictions due to Covid-19 halted local job growth through DRE, as the supply chain remained disrupted.
- In FY 20-21, 36% of the respondents shared that they had increased their human resources. 42% shared that their

team strength remained unchanged, and 22% shared that they had to lay off staff to make it through the challenging time. Additionally, 42 DRE organisations offered a consolidated 392 new job opportunities, with 80 percent of new employees being men and the remaining 20% being women.

- It was observed that maximum training sessions were held online due to Covid-19. CLEAN member enterprises operating in the skills and training sector shared that the change to online training sessions enabled them to reach out to a wider stakeholder base across the country.

Post the trainings, the average employability of participants was around 87 per cent. A total of 2514 local experts were trained in the operation and maintenance of DRE products and services, as well as in the fabrication of solar lights, by 31 DRE firms and NGOs.



OVERVIEW OF RESPONDENTS

Conducive policy environment, market demand, availability of finance, adequate workforce, and continuous development of solutions through technology innovation play a key role in strengthening the ecosystem of the DRE sector.

The insights presented have emerged from CLEAN's annual survey with its members and key stakeholders (including enterprises, financial institutions, non-government

organizations, civil society organizations (CSOs), etc.)

79 CLEAN member organizations participated in this year's survey.

Through the survey, CLEAN has tried to capture insights on the following aspects: (a) market, (b) finance, (c) technology, (d) policy (e) skills and training.

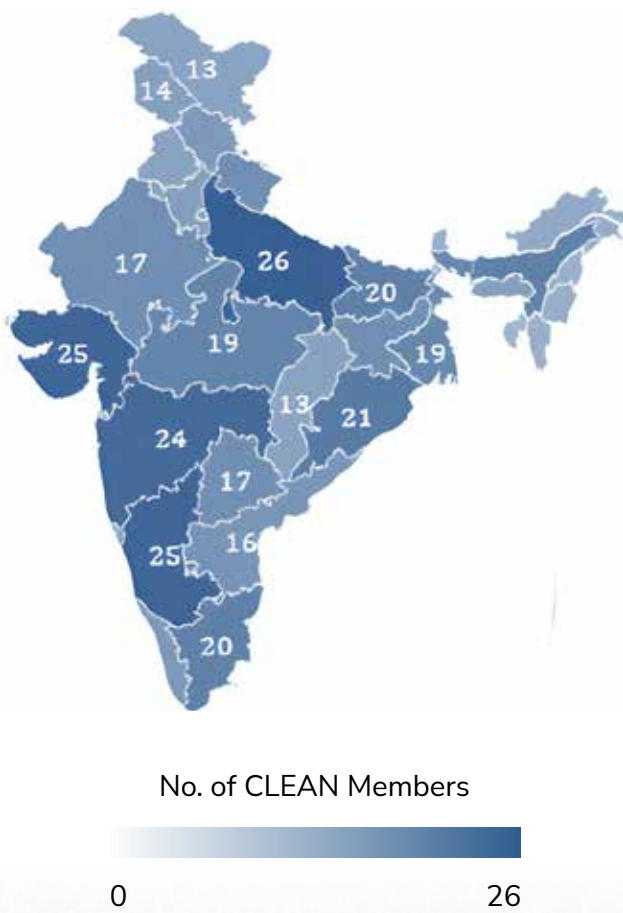


FIGURE 1: CLEAN presence in India. Sample Size: 79

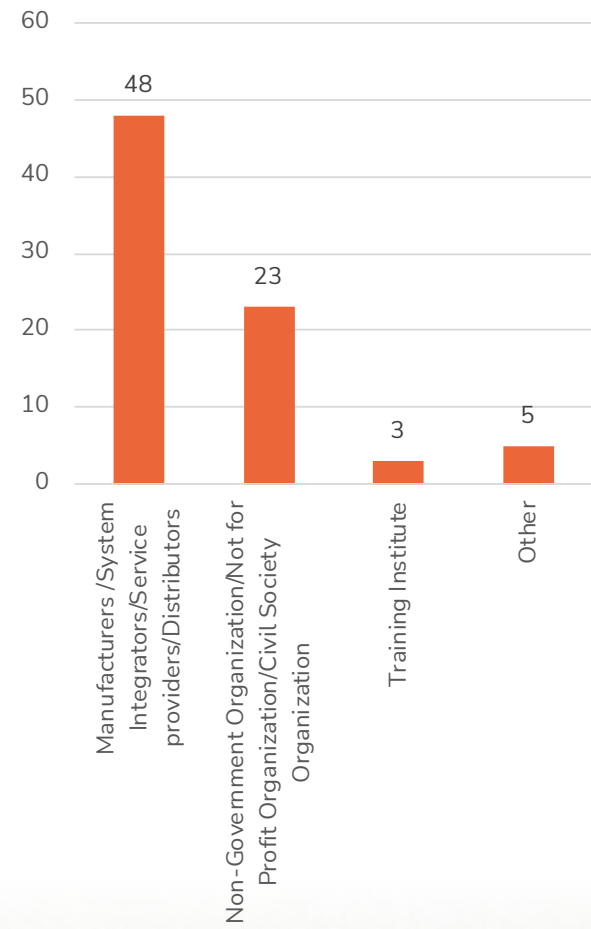


FIGURE 2: Breakup of Respondents; Sample Size: 79

1. Overview of the DRE Market in 2020-21

With a focus on livelihoods and income generation, India's Decentralised Renewable Energy (DRE) sector has become an enabler of economic growth, particularly in rural areas. The impact of the unprecedented COVID-19 epidemic on the Indian decentralised renewable energy sector, like others, was felt since the very beginning of the year 2020. While DRE businesses are still dealing with the issue, they have shown resilience.

This chapter provides an overview of the key factors driving the deployment of DRE technologies sales revenue, details of technologies deployed, market channels being utilized, challenges, and coping mechanisms being utilized.

1.1 Sales Revenue

Sales revenue figures shared by CLEAN members highlights that 44% of the DRE enterprises had annual sales revenue less than INR 50 lakhs in FY 20-21. Out of the 44% DRE enterprises, 13.33% had predicted an annual sales revenue between 1 crore to 5 crore, but had a sales revenue less than INR 50 lakh.

Micro enterprises which majorly sell livelihood appliances have reported sales revenue of less than INR 50 lakh. Newly formed DRE enterprises reported a similar revenue in sales.

Approximately 35% of the respondents had sales revenue between INR 1 crore and 5 crores. Two DRE organisations (a solar PV module manufacturer and a solar livelihood solutions provider) have reported an annual sales revenue between INR 50 crore to 100 crores.

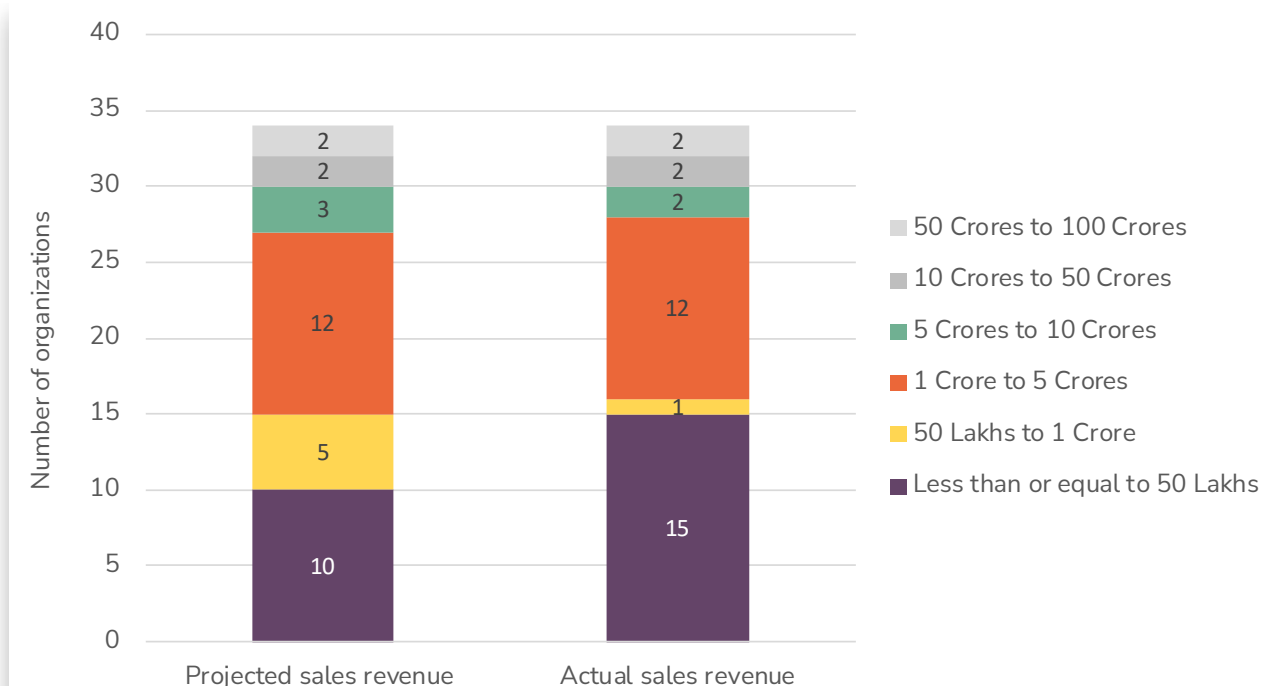


FIGURE 3: Sales Revenue (Actual vs Projected) in FY 20-21. Sample size: 35

1.2 Deployment of DRE Technologies

After the covid lockdown restrictions were lifted, the CLEAN members implemented several DRE based projects in order to contribute to clean energy access and rejuvenation of rural economy.

1.2.1 Sales details for FY 20-21

Solar lights, solar home systems, and improved cookstoves were the top three DRE appliances sold in the previous fiscal year, according to survey respondents. This confirms that the need for basic lighting and clean cooking methods persists, and that government's various initiatives on energy access are complemented by these efforts.

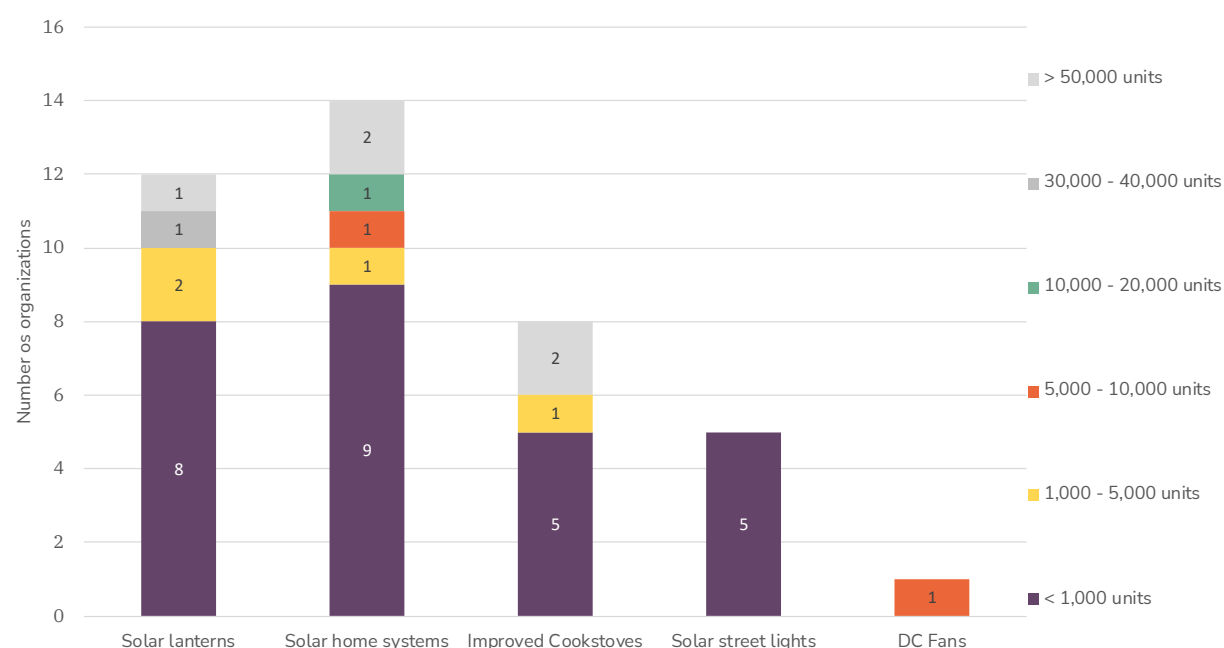


FIGURE 4: Unit sales analysis of small ticket size DRE appliances in FY 2020-21. Sample size: 18

1.2.2 Highlight of DRE deployments done by CLEAN members in FY 20-21

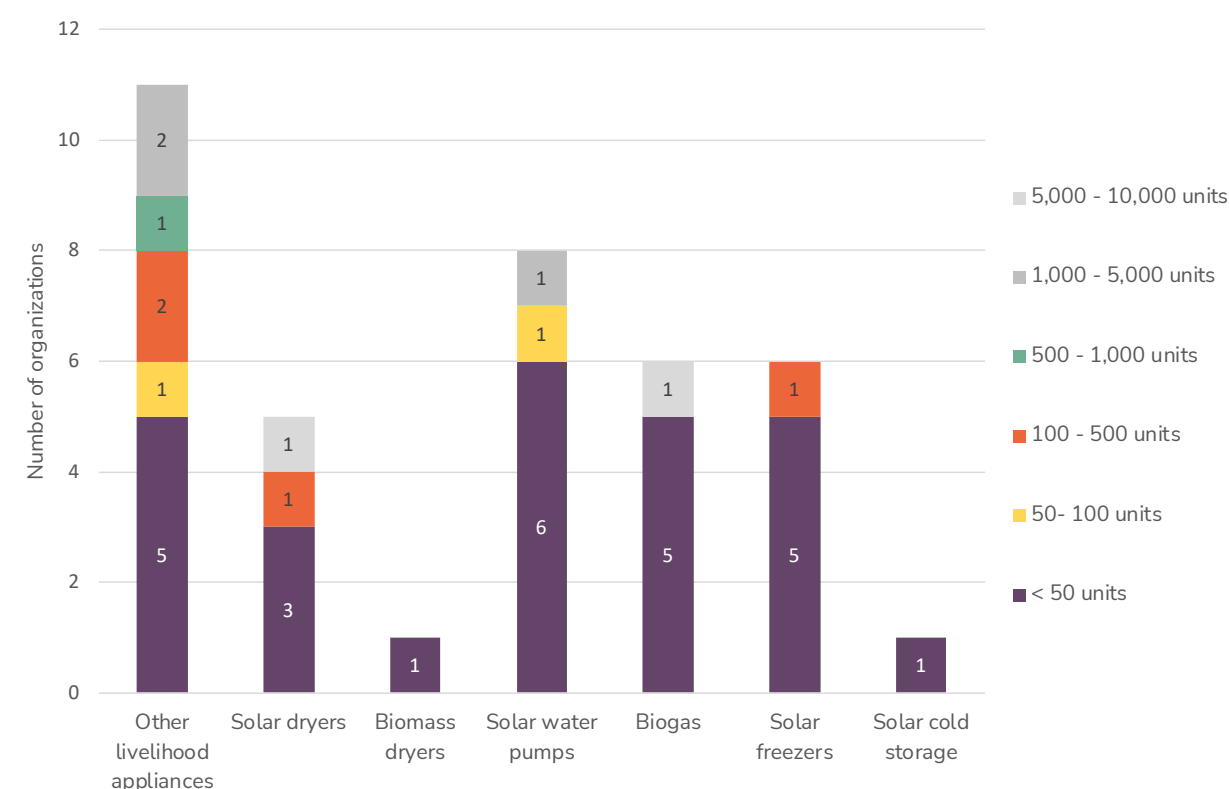


FIGURE 5: Cumulative numbers of livelihood appliances installed by CLEAN members in FY 20-21
Sample Size: 34

(Note: The figures in the following section include ONLY deployments made by CLEAN members who participated in the survey)

CLEAN COOKING:

Under the clean cooking sub-sector, 8 CLEAN members altogether have sold more than 1.34 lakhs energy efficient biomass cookstoves and 6 members have installed 7000+ biogas plants, majority of which are of capacity 2cu.m.

SOLAR HOME SYSTEMS:

In the solar home systems and household-based products, CLEAN members have sold 8000 Brush Less DC fans. Most of the sales were made for government projects related to rural electrification under SAUBHAGYA scheme.

Solar lanterns are one of the highest sold appliances. More than 90000 Solar lanterns were deployed by 12 DRE organisations.

Due to growing aspirations of customers, the enterprises have also reported to have sold more solar home systems compared to Solar lanterns. 14 DRE enterprises who participated in the survey recorded solar home systems sales in excess of 1.3 lakhs units.

LIVELIHOODS:

Under the livelihood sub-sector, product suppliers with a dedicated product line for solar dryers have cumulatively sold 10000 solar dryers of various types and sizes.

Out of these, a small quantity was deployed by established DRE service providers who have started expanding their businesses in the productive end use market.

A total of 15 biomass dryers have been commissioned as per the one CLEAN member. 263 solar freezers were deployed in the last FY. Majority of the sales were from DC freezer manufacturers directly.

In the last FY 20-21, 9 DRE manufacturers and service providers have installed 3560 solar water pumps of which 3000 were implemented under KUSUM scheme. Till December 2020, 372,999 Solar Water Pumps

have been deployed under Component B of KUSUM scheme [2].

14 Solar Cold Rooms of the capacity 5MT (Solar PV capacity- 7kWp) and 3 bulk milk chillers were deployed by CLEAN members who took part in the survey.

Miscellaneous, a total of 5600 units livelihood appliances such as solar powered sewing machines, solar weaving looms, solar yarn making machines, solar pottery wheel, solar rope making machines, solar blacksmith blower, solar roti making machines, solar weaving looms, solar yarn making machines, solar egg incubators, solar animal repellent, food processing machines, solar drinking water solutions, power hammer etc. have been deployed by 11 DRE service providers. Majority of the installations were done by SELCO and Resham Sutra (approximately 5000).

Out of the 5600 livelihood appliances, approximately 300 vertical fodder growing stations, 75 solar animal repellents, 3 pellet making plants have been commissioned.

Mini grid providers have powered livelihood anchor loads such as carpentry shops, oil expellers, sewing machines.

Few DRE enterprises have offered energy as a service to a total of 750 vending carts, barber shops, grocery shops and agri-processing centres.

HEALTHCARE AND EDUCATION INFRASTRUCTURE

DRE service providers have energised education and healthcare infrastructure (Primary Healthcare centres, Anganwadi centres), and panchayat buildings with DRE solutions. CLEAN members have powered more than 2500 such centres in the last FY.

The sizing of health centres varies from 2kW to 8kW depending upon the size and the population the health centres are supposed to cater.

MINI GRIDS

The cumulative capacity of mini grids installed by 9 service providers in the FY 20-21 is 1.32 MW. Few DRE service providers reported that

the mini grid installations have reduced due to logistical and lack of reduced financial strength of the consumers as well as movement of funds towards efforts against COVID.

1.3 Popular DRE Enabled Livelihood Products

In a separate demand mapping study supported by GIZ India under its IGEN- Access II Programme, CLEAN identified the top 5 farm and non-farm livelihood appliances in India. An online questionnaire was circulated among various stakeholders within the DRE ecosystem

such as State Nodal Agencies, State Rural Livelihood Missions, System Integrators, Last Mile Distributors, NGOs and CSOs. Based on the 120 responses received during the survey, the identified top five farm and non-farm livelihood appliances are listed below.

TABLE 2: Popular DRE Enabled Livelihood Products

FARM LIVELIHOODS	NON FARM LIVELIHOODS
Solar water pumps	Solar sewing machine
Solar refrigerator and freezer	Agarbatti making machine
Solar rice huller and polisher,	Solar fence
Solar/biomass cold storage rooms	Puffed rice making machine
Solar atta chakki/flour mills	Solar sugarcane juicer, Solar weaving looms
Solar/Biomass dryer	

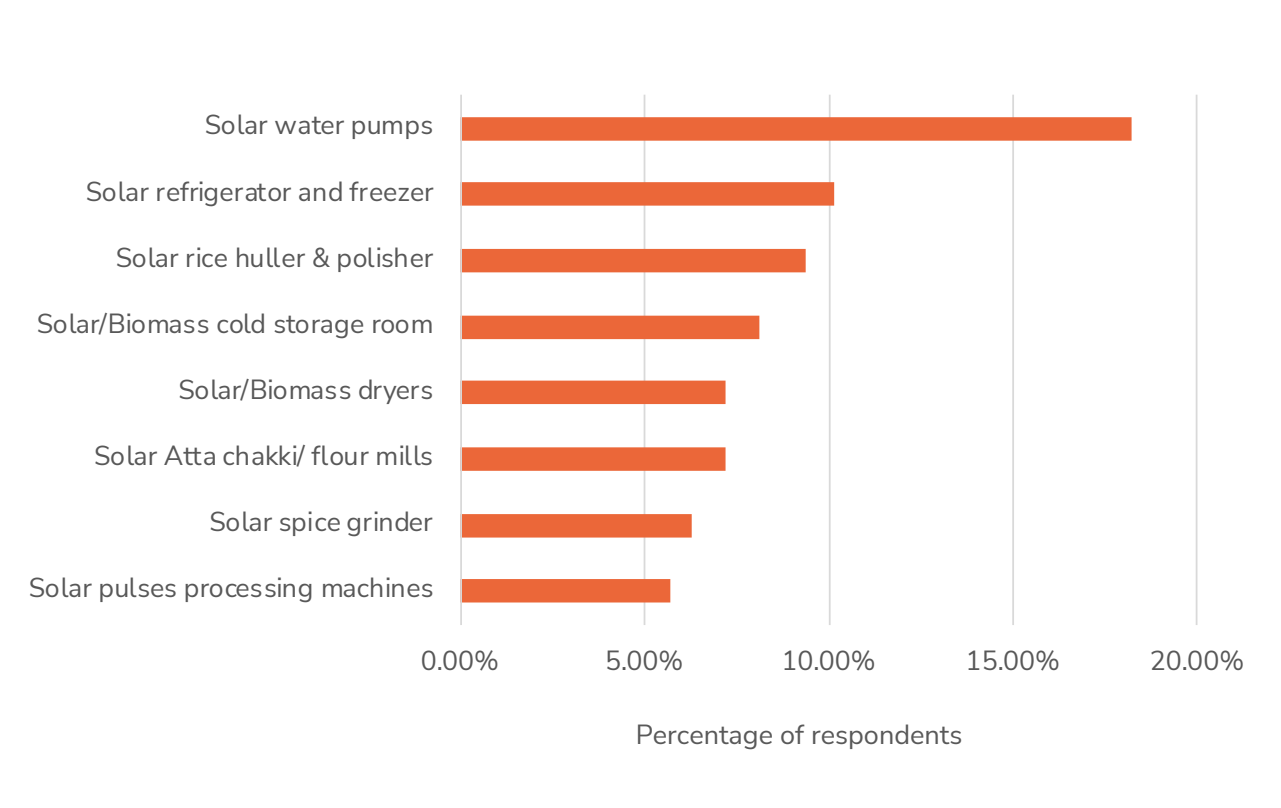


FIGURE 6: Top 8 DRE powered farm livelihood appliances in India. Sample size: 120

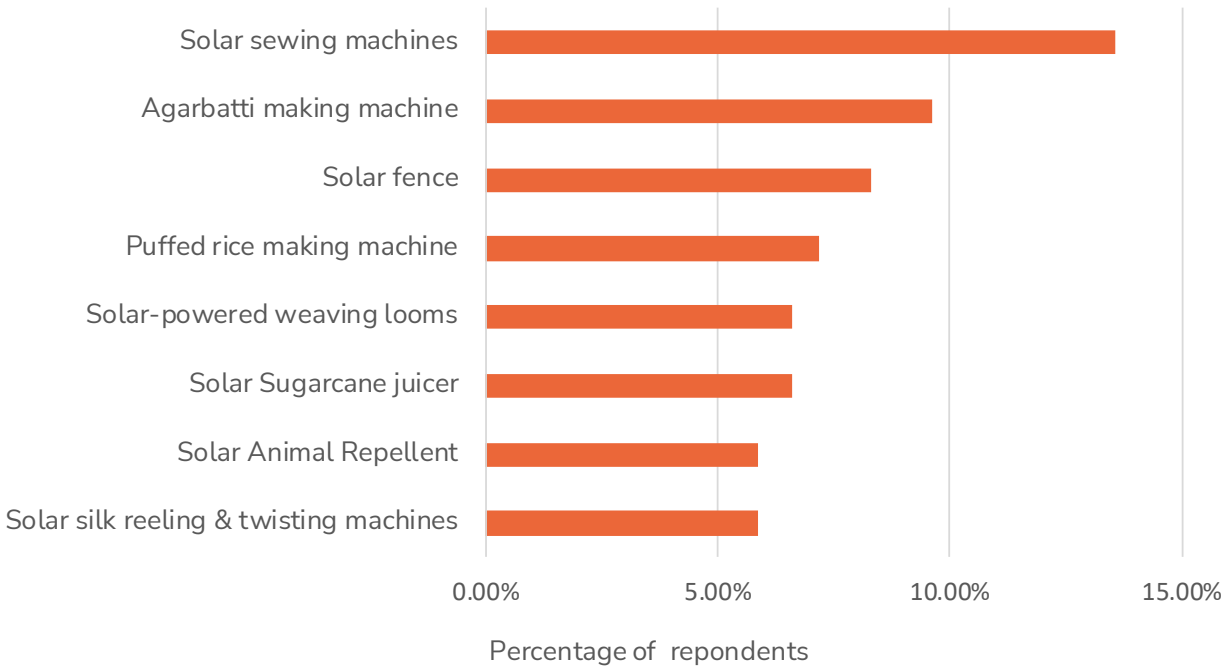


FIGURE 7: Top 8 DRE powered non-farm livelihood appliances in India. Sample size: 120

1.4 Market Channels and Promotional Techniques

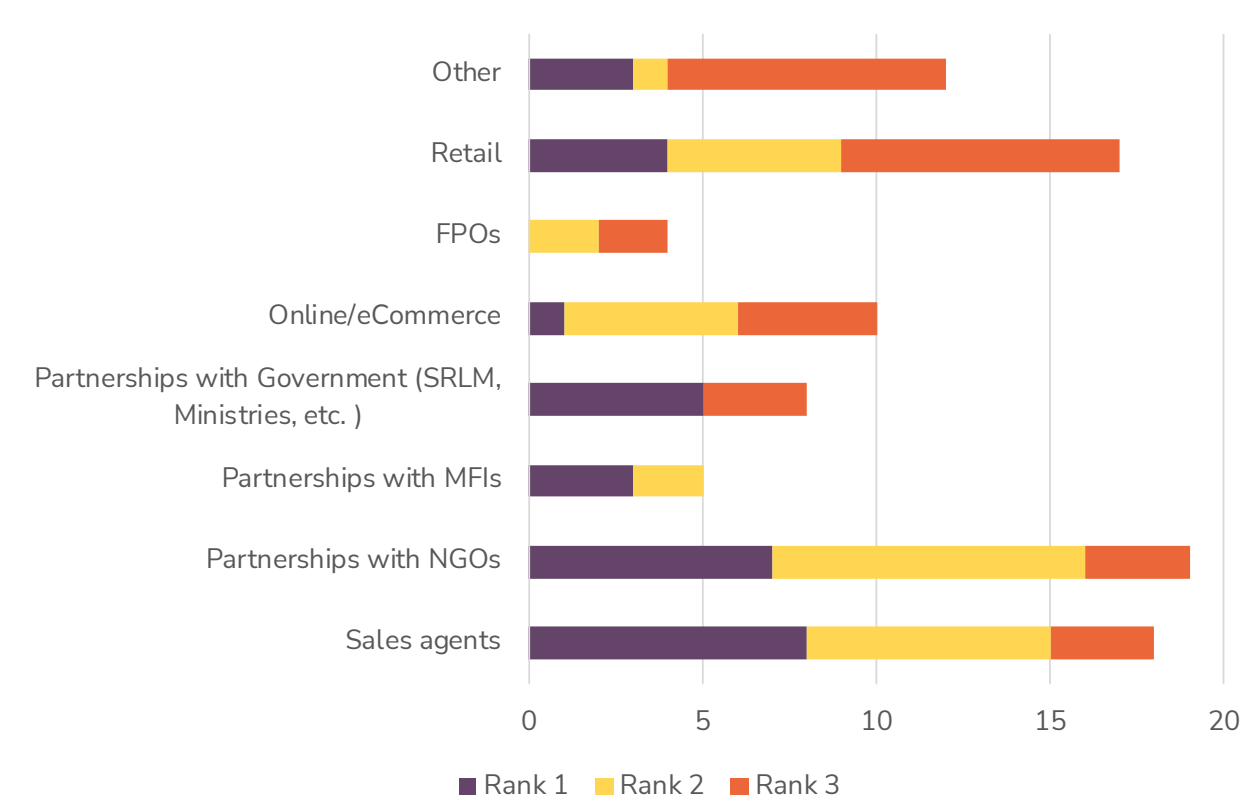


FIGURE 8: Market channels used by DRE organizations. Sample size: 20

- DRE organisations use multiple marketing channels to promote and sell DRE appliances. Sales agents, partnerships with NGOs and retail shops are the three most popular marketing channels as per the survey. Sales agents usually have strong relationships with the local population. They also contact potential customers through cold calls.
- The respondents highlighted that the Women entrepreneurship model - where the local women from the village are trained is one of the successful models. Through this model the customer engagement is high and the women entrepreneurs instil confidence in villagers.
- ‘Other’ marketing channels used by DRE organisations include Government e-Marketplace (GeM), distributor partnerships with other micro grid providers, and wholesalers.

BOX 1: Common Facility Centers by Selco Foundation

COMMON FACILITY CENTER MODEL

SELCO Foundation has worked with India Foundation for Humanistic Development (IFHD) on developing a Common Facility Center (CFC) model. In Parna FPO, a CFC model has been established. Since horticultural and agricultural produce are seasonal in nature, many processing centers catering to single or a few select produce remained unutilized during off seasons.

By developing a CFC which can cater to a wide variety of produce, the facility center now remains functional throughout the year. IFHD facilitated discussions between FIGs and SHGs to identify a common facility center which can be convenient for everyone. Presently, 7 enterprises use the CFC. It was also leased out to other private entrepreneurs on a job work basis.

Parna FPO has 525 members who are engaged in the cultivation of paddy, coconut, arecanut, pepper, turmeric, mango, cashew, jackfruit, and NTFP produce. The FPO has a share capital of 5.8 lakhs and its members are also part of FIGs and SHGs.

Clean energy enterprises dealing with areca leaf plate making, herbal soap extraction, turmeric powder, banana chips making, kokum extraction, and pickle making were set up. DRE solutions such as biogas, solar PV system, and dryers were installed. Solar PV system cost was around 5 lakhs, the machinery cost was around INR 4 lakhs, biogas systems cost was around INR 50000.

A common solar infrastructure with Solar PV capacity of 7.5 kWp was installed by SELCO Foundation to power the machinery.

A term loan worth INR 2.24 lakhs at 8 % rate of interest was facilitated by IFHD from Mensi Coop society. The grant money from SELCO Foundation was approximately 5.73 lakhs and the FPO contribution was 1.7 lakhs. Out of the total revenue of 5.8 lakhs, 45% of the revenue was generated through the CFC.

The processing and transportation overheads have reduced due to inhouse processing and lower dependency on external parties. With mechanization, the drudgery involved in manual processes have been eliminated. Since the CFC is situated in a heavy rainfall area, there were frequent power outages due to rain. Post deployment of solar PV infrastructure, uninterrupted power supply has been ensured.

Sources of financing assets cost (in Rs. Lakhs)

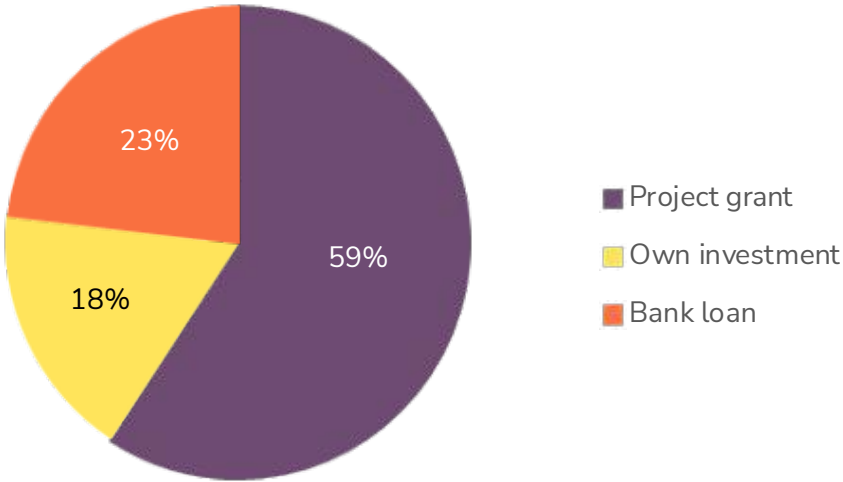


IMAGE 1: Sources of Financing Asset Cost (in INR Lakhs)



IMAGE 2: Common facility center at Parna FPO. Image courtesy: IFHD

RURAL EXPERIENCE CENTERS

Resham sutra has set up rural experience centers for Solar silk processing machines in Chhattisgarh and Assam. A Rural Experience Center (REC) serves as a hub for clusters of villages practicing sericulture. RECs also serves as a hub for decentralized production of yarn and a channel for selling the machines of Resham Sutra. The villages lie at the end of the spokes wherein the beneficiaries reside. The raw material is procured from the villages. At Rural experience centers, the raw material is converted to yarn by using the solar silk processing machines in the center. Through the buyback model, Resham sutra procures the yarn and then identifies potential customers to sell it.

Currently REC, as a sales channel accounts, for 8% of the total sales of the machine segment for Resham sutra and is expected to grow up to 10% in the next two years. For the yarn segment, it is expected to account for 12-15% of the total sales. Resham sutra partners with Self Help Groups in the region and creates awareness regarding the benefits of Solar powered silk processing machines. The beneficiaries become indirect sales agents for Resham Sutra by advocating for these machines. To facilitate the credit for buying the machine, Resham Sutra connects beneficiaries with the local financial institutions. RECs also engage in the skill development of beneficiaries that helps in encouraging entrepreneurship in the area. The center also provides advisory services to the beneficiaries in business planning skills that helps them in building forward linkages in the value chain and sale of yarn to potential customers.



IMAGE 3: Rural Experience Sharing center. Image courtesy of Resham Sutra

1.4.3 Partnerships

DRE organizations sell/deploy products through partners such as NGOs, State Rural Livelihoods Society. Solar lighting manufacturers and biomass cookstoves manufacturers sell products via their MFI network. Organizations supplying energy monitoring and remote monitoring systems often have partnerships with mini grid and microgrid players.

1.4.4 Promotional tools used by DRE Organizations

According to a survey by Boston Consulting Group [1], almost 70% of rural population access social media. Based on the survey carried out by CLEAN, live community demonstrations stood first and social media being the second most popular approach for promoting DRE appliances. DRE service providers work with rural marketing agencies to promote their products. Given the popularity of this approach, rural marketing campaigns need to realign and evolve continuously through better and effective targeting of rural consumers since the market, products and end customer are ever evolving.

- Ecosense uses Instagram, Facebook and their website for lead generation.
- Raheja Solar shares success stories in LinkedIn and Facebook. Leads are generated in LinkedIn and Indiamart. They also contact FPOs via LinkedIn and cold calls.
- A government school teacher in Nagaland posted in social media about the lack of electricity in the Shinnyu village of Mon district. His post connected him with the Global Himalayan Expedition (GHE). GHE coordinated with the teacher and district administration and deployed mini grids in the village.
- Community demonstrations is the top promotional technique used by DRE organizations.

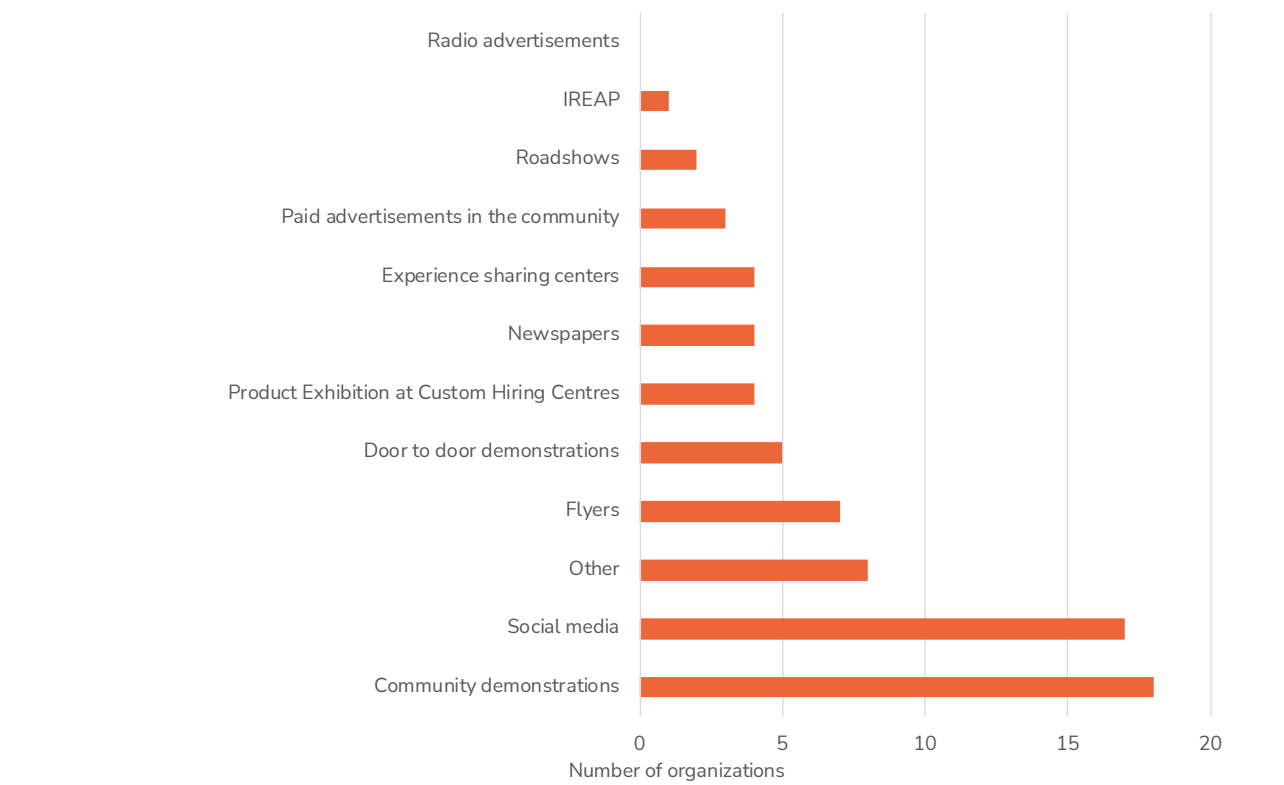


FIGURE 9: Promotional tools and techniques used by DRE organizations. Sample size: 25

BIHAR SRLM - SOLAR SHOPS



PROBLEM:

Bihar has been ranked as one of the poorest states in India consistently. To address shortage of electricity access in Bihar, various grant and subsidy linked models were brought to state in the form of solutions. On the other hand, there was also a gradual shift in private and individual models who wanted to work on generating and distributing electricity through independent and decentralized systems or otherwise as retail stand-alone products. But there were loopholes which needed to be addressed. First, due to lack of technical knowledge there was no after sales service and absence of spares-bank to replace damaged goods made clean energy products less trustworthy. Second, value added resellers, operating on a small scale, fixed configurations of products only they sourced and were not equipped to customize energy systems to suit specific household energy needs, making their offerings limited in scope and responsiveness. Third, these situations also lead the value-added resellers to stock cheaper equipment that allowed them to sell product at higher rates.

Therefore, it became vital to design a market-based approach that supports the need of renewable energy products and services for

Below Poverty communities. To implement the project, TERI in partnership with JEEViKA, picked Purnia as one of the first places to begin with. Purnia is one of the most poverty-stricken districts of Bihar. 89 per cent of the households, only 8 per cent have access to electricity and the district holds a network of over 40,000 women SHGs or self-help groups (BRLPS 2015a). Each group on an average has membership of 10–20 women. TERI concluded Dhamdaha block would be the most apt area for intervention.

INTERVENTION:

Market creation was an evident and important step. It was mainly achieved in three stages, namely, seeding, base building, and growth and consolidation. In Purnia, TERI developed indicators, basis which JeeVika picked villages for implementation. Field surveys highlighted the apparent need of energy solutions that would meet basic requirements in communities such as lighting and mobile handset charging. TERI then, to address the specific needs of Damdhaha block, designed and tested a customized solar home lighting system (SHLS). The system comprised of two LED luminaries and a socket for mobile charging that were powered by a battery charged through a solar panel. To solve the ineffectiveness of SHLS in seasonal variations, TERI built a custom SHLS 12V system that required a 10 Ah lead-acid tubular battery. The aim was to convert demand to actual purchase, JEEViKA agreed to facilitate up to 60 per cent of the hardware cost as a loan to its SHG members. TERI's clean energy partnership with DFID led to the extension of viability gap funding of upto 40 per cent of the hardware cost. Together with soft loans this led to successful purchase of SHLS by SHG members.

In Purnia, TERI aided the formation of the

ecosystem that comprised of enterprise-based delivery model and institutionalization of last mile EEs or Uttam Urja Kendras. EE was the key business unit between a manufacturer and end user as it ensured supply of quality products to the end user.

The EE entrepreneur operated from a brick-and-mortar structure that was sometimes build inside the village and at times on the outskirts. EE operated as a micro-enterprise and lived close to target audience to interact with them on daily basis. The network of EEs is an important factor to increase after sales service delivery of clean energy products to the remote areas. Institutionalizing and operating EE requires relatively small ticket funding and EEs operate at relatively lower business risks. As the last step, TERI placed orders to manufactures and vendors to facilitate the growth in the village. In the more later and mature stages, EE will place the orders (at times) under supervision from TERI. More than 30 men from the SHG families were incentivised to gain technical training at the EE during the course of implementation.

IMPACT:

With support from JEEViKA and DFID, TERI facilitated access to clean lighting to over 13,000 self-employed women or SHG members of JEEViKA. Since commencement of JEEViKA-TERI partnership, three EEs14 have been working closely with SHG members. Independent of TERI, together, these EEs have undertaken sales of over 0.15 million since institutionalization and have scaled up their product/service portfolio that includes sales of standalone solar systems and assembling, installation, and commissioning of higher specification products in rural areas of Bihar. This has also attracted interest of external players in the solar business. With relatively

lower business risks, EEs are able to provide customized renewable energy-based solutions to rural consumers and that too on terms that are mutually agreeable upon between the EE and buyer.

ABOUT THE ORGANIZATION

BRLPS is community-based organization working with 11.7 million rural women of Bihar with the aim of holistic development of community. JEEViKA is working on various sector like Health, Financial inclusion, Capacity building, Livelihood, Social development, enterprise devpment etc. Community enterprise development is one of key activity of JEEViKA to strengthen and ensure livelihood of rural community members and the idea is to open 3000 solar energy based enterprises in Bihar in all 38 districts and 534 blocks with an aim to localize solar energy services at village/ community level.



1.5 Challenges Faced by DRE Organizations

A majority of CLEAN member organizations reported supply chain management and local warehousing as the key challenge faced by them due to the COVID-19 pandemic.

The outbreak of COVID-19 in 2020 had halted the pace of growth in the sector. Even after the withdrawal of curbs and initiation of activities, players faced challenges in the transportation and movement of DRE appliances.

A strong need that has emerged from the CLEAN member community is that there is a need in the sector to streamline the movement of DRE goods by partnering with other organizations which in turn is likely to reduce the transportation cost borne by

DRE manufacturers and system integrators. Development of a platform for aggregate level purchase, transportation and shared warehousing services will be useful for the sector.

In addition to the above, micro enterprises working on newer technologies such as the solar hydroponics system, bioethanol-based stove, among others have had difficulty in achieving convergence with government schemes. This was attributed to a lack of supportive policy measures for their respective technologies.

The other challenges cited by DRE organizations include:

- Uncertainty due to repeated lockdowns
- Reduced paying capacity of end consumers and thereby a lack in demand
- Lead acid battery manufacturers faced challenges in procuring lead due to fluctuating costs.
- Other than conventional DRE appliances like solar home systems, skill gaps exist in service and repair of livelihood appliances.

Establishments of shared service centers for a pool of DRE appliances should be promoted between DRE practitioners operating in the same region.

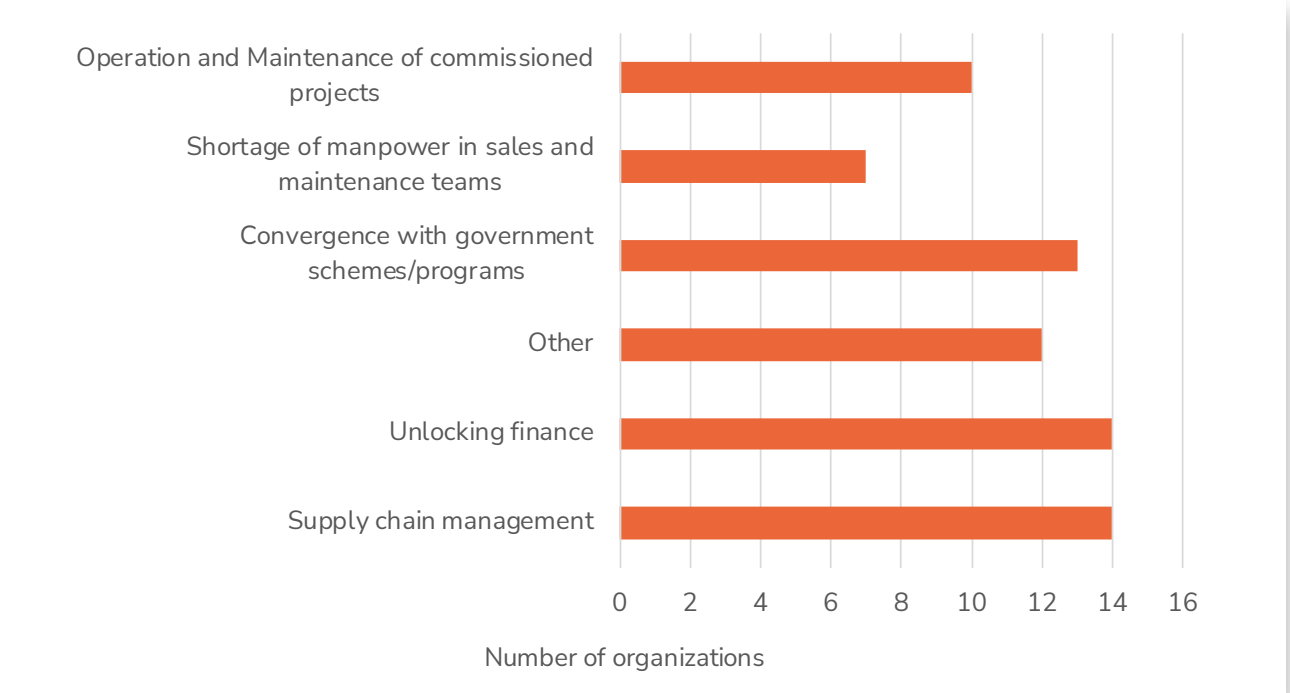


FIGURE 10: Challenges faced by DRE organizations. Sample size: 35

Other challenges highlighted by DRE organizations - Uncertainty and threats of repeated lockdowns, monopoly during lock down by online e-commerce companies, loss of demand/ business, unavailability of good DRE products to market.

1.5.1 Coping mechanisms adopted by DRE organizations

Over the past two years, COVID and recurrent partial region-specific lockdowns have posed multiple challenges for the DRE ecosystem.

Yet, the DRE sector has shown resilience during this crisis, micro enterprises have reportedly faced the ill-effects of the pandemic.

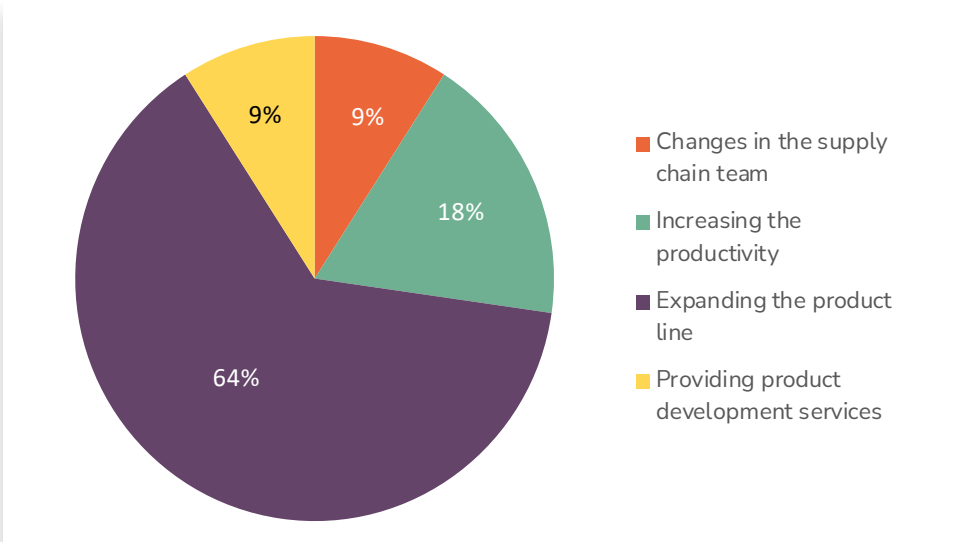


FIGURE 11: Strategies implemented by DRE organizations to adapt to the change in market due to COVID. Sample size: 15

Faced by uncertainties, DRE organizations adopted multiple coping strategies to keep their business afloat. Some DRE organizations reduced their profit margin to keep the business afloat during COVID. Doorastha Analytics, a member of CLEAN, had waived off the mini grid tariff during COVID, as the end-customers' business was completely shut down during the lockdowns. Another CLEAN member organisation, Oorja Development Solutions extended the credit period for loans. Few DRE organizations ventured into the productive end use segment by offering solar dryers, solar cold storage solutions at reasonable costs.

There are other instances where CLEAN members supported the government to create awareness by organizing healthcare camps. Some biomass cookstove manufacturers included LPG stoves in their product line in order to diversify their product offerings, as a coping strategy.

There was increased focus towards healthcare related interventions. Few DRE enterprises reported distribution of pulse oximeters, sanitizers, masks, medicine and created awareness regarding COVID-19 to get through the tough period.

1.6 Opportunities and Barriers for DRE

While a number of social entrepreneurs and practitioners have stepped forward to increase the usage of decentralized solutions to bridge the energy access gap, their inability to

replicate or scale these solutions quickly is a major barrier. This failure to scale or replicate is due to the lack of a supportive ecosystem.

1.6.1 Opportunities

MNRE has issued a revised draft of its policy framework for developing and promoting DRE livelihood applications.

The wave of innovators and entrepreneurs that have come up with a variety of DRE livelihood applications that are not only energy-efficient but also commercially feasible – is one of the driving factors behind the policy framework. Solar and biomass dryers, solar or biomass-powered cold storage/chillers, solar charkhas, and other such applications are some of the popular ones among them.

1.6.2. Barriers

End user financing is still the topmost barrier for the penetration of DRE appliances. The livelihood products are larger ticket size products and the financial strength of the rural population is low. Receiving unsecured financing from Banks, NBFCs, MFIs etc is difficult and most customers don't have access to easy credit. Thus, credit has to be offered by the company.

The rest of the most highlighted issues to diminish the penetration of the DRE appliances are:

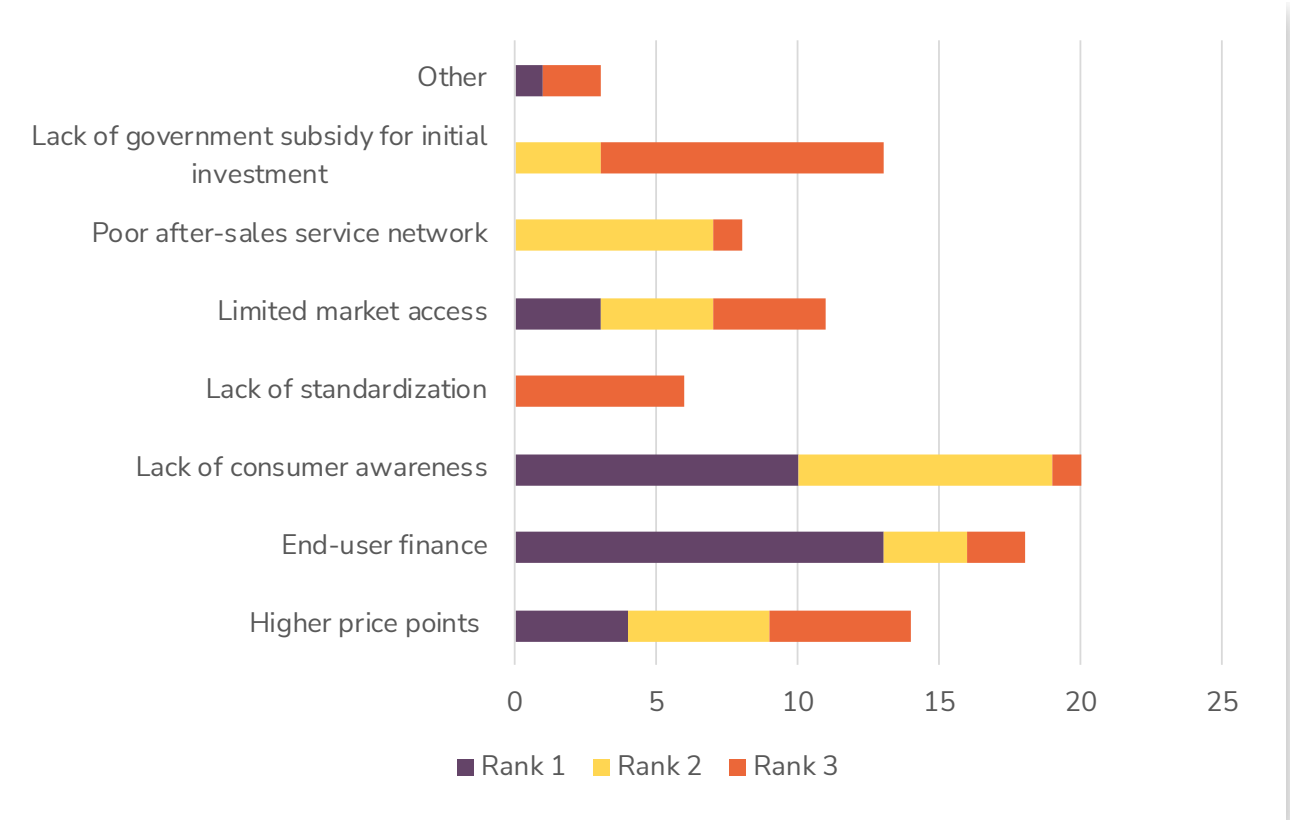


FIGURE 12: Top threats for the penetration of DRE appliances. Sample size: 33

1.7 Market Research in the DRE Sector

The survey results highlighted that 78% of the DRE organizations didn't conduct market research to understand the changes in the market due to COVID. Market research provides confidence to micro enterprises to try new strategies and change business models. Many micro enterprises cannot afford to carry out market research with the support of third-party consultancy.

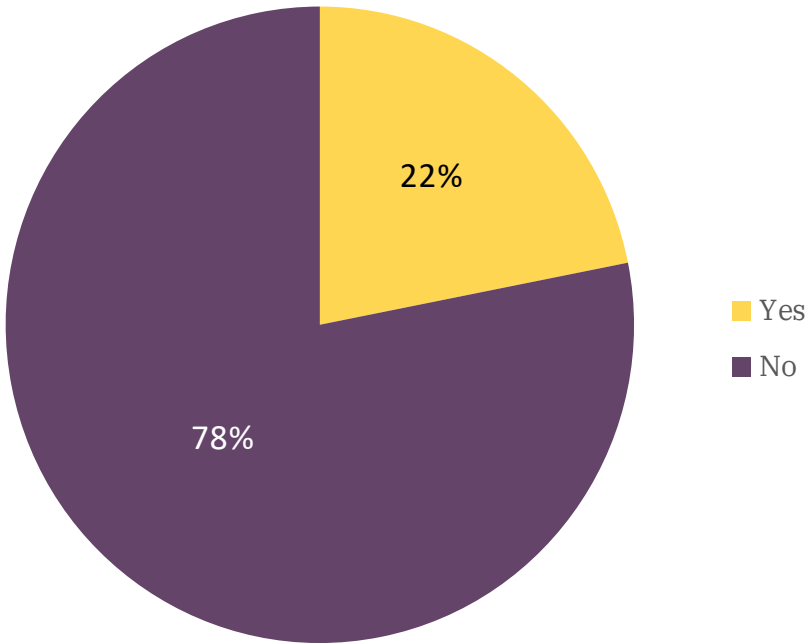


FIGURE 13: Market research conducted by enterprises to adapt to the changes in market scenario due to COVID. Sample size: 32

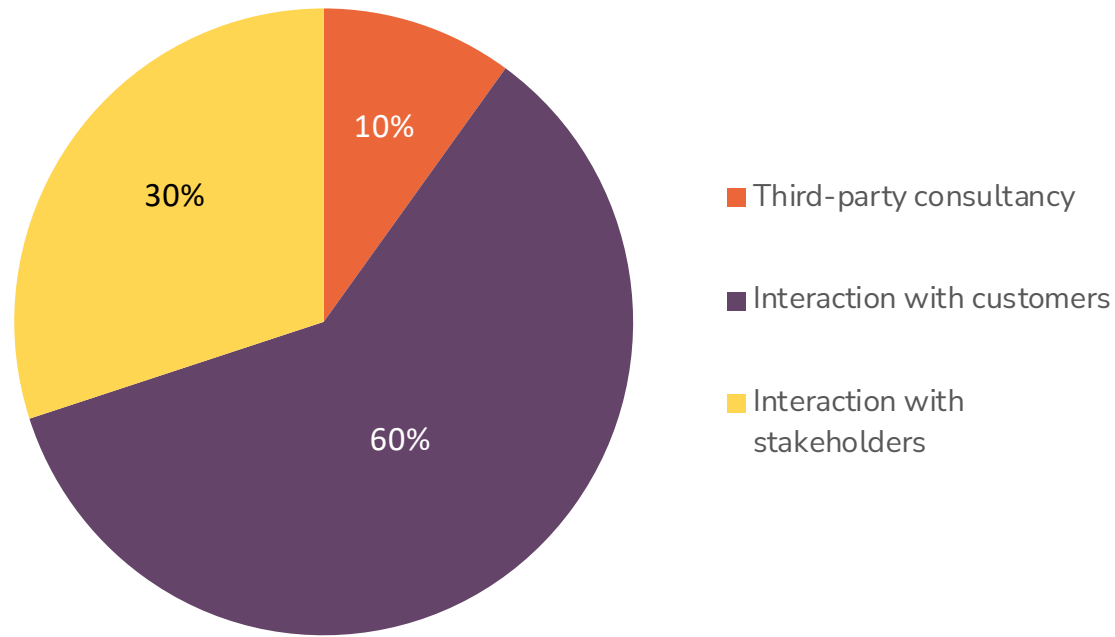


FIGURE 14: Ways through which DRE organizations conduct market research. Sample size: 10

1.8 Quality and Project Management Practices in the DRE sector

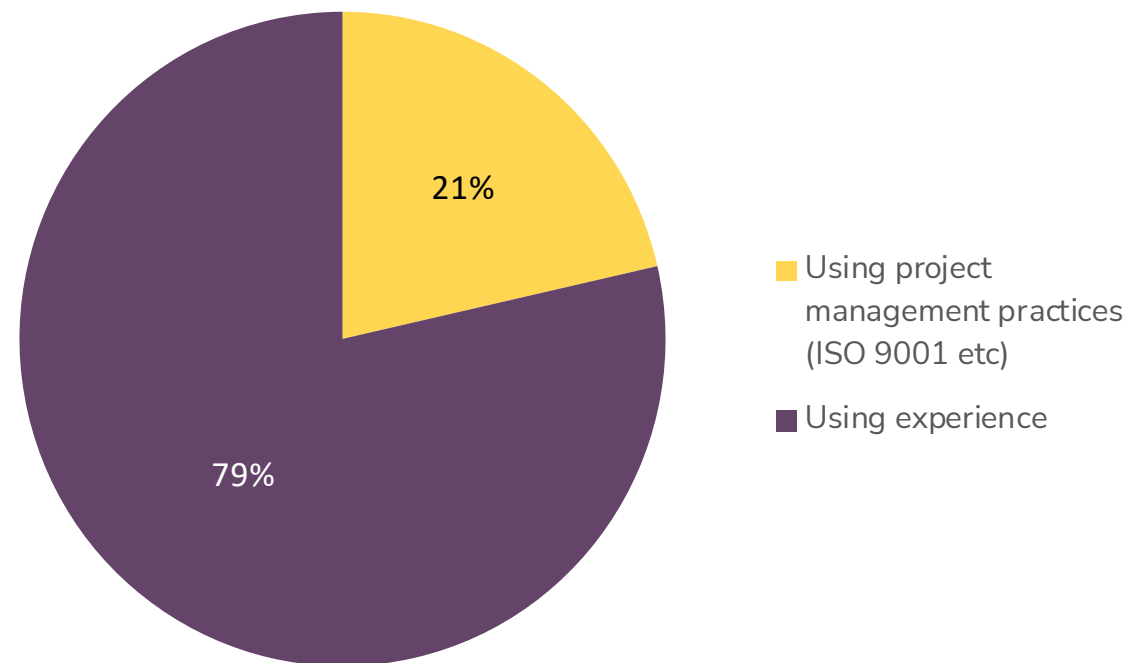


FIGURE 15: How do DRE organizations evaluate the cost and schedule performance. Sample size: 20



Currently 79% of the organizations, who participated in the survey, evaluate their cost and schedule performance based on experience, which is an unstructured approach. As a result, they are unable to map success metrics for their businesses. This also results in challenges in planning and tracking resource allocation.

Following quality management practices allows the enterprises to map the risks in advance and develop mitigation strategies. It was noted that organizations which practice quality management and project management practices can easily communicate to investors, financing entities with their success metrics. Further, it was noted to create trust among investors.

With a proper monitoring mechanism in place, the internal communication within the organization becomes seamless and monitoring the progress of an organization becomes easy. The work efficiency increases. During unfortunate events such as COVID pandemic, risk mitigation, forecasting and changing strategies took priority. .

1.8.1 Challenges

There is a lack of awareness regarding the quality and project management systems. The general notion within the DRE organizations is that the quality management systems are only for manufacturers. However, Quality Management Systems are applicable for service providers as well.

India's DRE sector has become all the more pertinent in present times given its scope as

an enabler of economic growth via a focus on livelihoods and income generation, particularly in rural regions.

The sector has not been immune to the unprecedented impact of the COVID-19 pandemic. DRE businesses have been dealing with challenges arising from the pandemic since the beginning of the pandemic and are still devising strategies to cope with issues.

While the pandemic has caused strains on businesses, it has also resulted in many businesses venturing into new market opportunities via innovative products and services such as solar-powered covid care centers (CCC), solar touch-free automatic hand sanitizers, solarized vaccine carriers, solar-powered e-ambulances, and solar-powered mobile medical units, among others.



2. Financing Landscape of the DRE Sector

2.1 Introduction

This section gives an overview of the state of financing in the DRE sector across multiple financial instruments as shared by DRE enterprises. A review of fresh fundraising and a map of how the DRE sector is fulfilling its fund requirements has also been covered.



The modes and means of infusion of capital have changed especially post Covid-19, with the mushrooming of alternate tools and structures which have enabled the sector to access funds even in difficult times.

Given the evolving nature of fundraising channels, the section also contains a sector outlook from the investor perspective, especially from the view of diverting capital to power rural transformation through clean energy businesses as we 'build back better'.

The pandemic also brought with it a set of new challenges for the DRE sector, however also gave a chance for enterprises to build resilience into their business models.

An assessment of the popularity of government interventions aimed to benefit Micro Small and Medium Enterprises (MSMEs), Startups as well as Covid-19 relief measures aiming to support DRE enterprises survive the pandemic have been covered in this section as well.

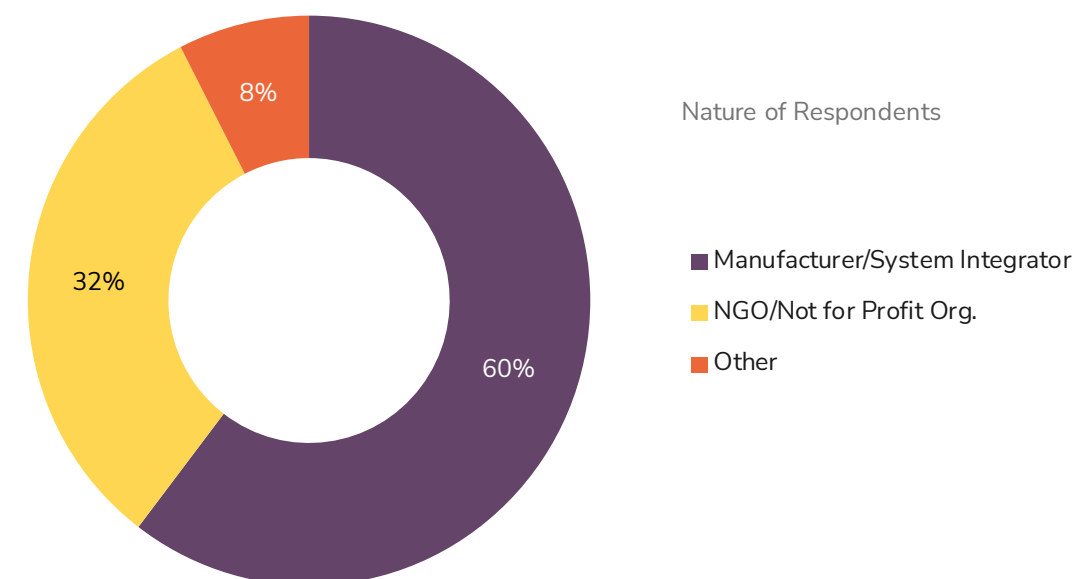


FIGURE 16: Total number of respondents: 57; Others include advisory, consulting and training institutions

2.2 How the DRE Sector is Raising Funds : Map of Ongoing Loans

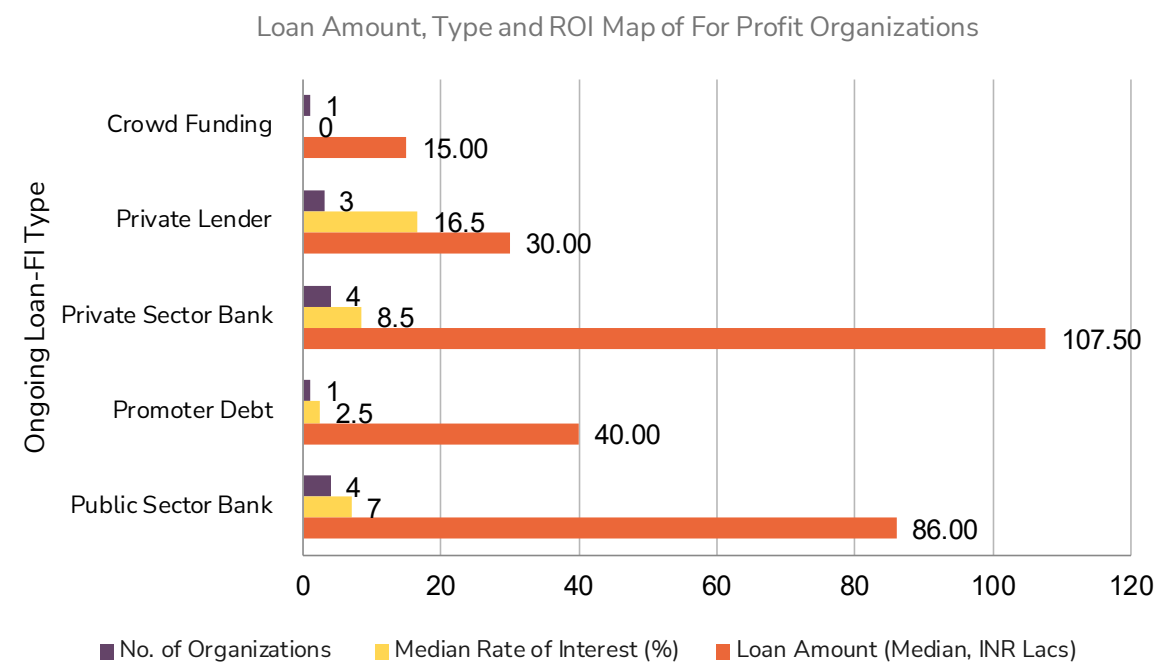


FIGURE 17: Map of ongoing loans of social for-profit enterprises. ROI for Crowdfunding not disclosed by enterprise. Sample Size: 13

It can be observed from the above map that for-profit social enterprises largely depend on bank debt to meet their funding requirements - with both public and private sector banks. Other, but few enterprises have also fulfilled their credit needs through infusion of

promoter debt and crowdfunding. After banks, enterprises also have availed of debt from private lenders. However the rate of interest enjoyed by such enterprises stands higher at 17% p.a. as compared to bank debt which is available in the range of 7%-9% p.a.

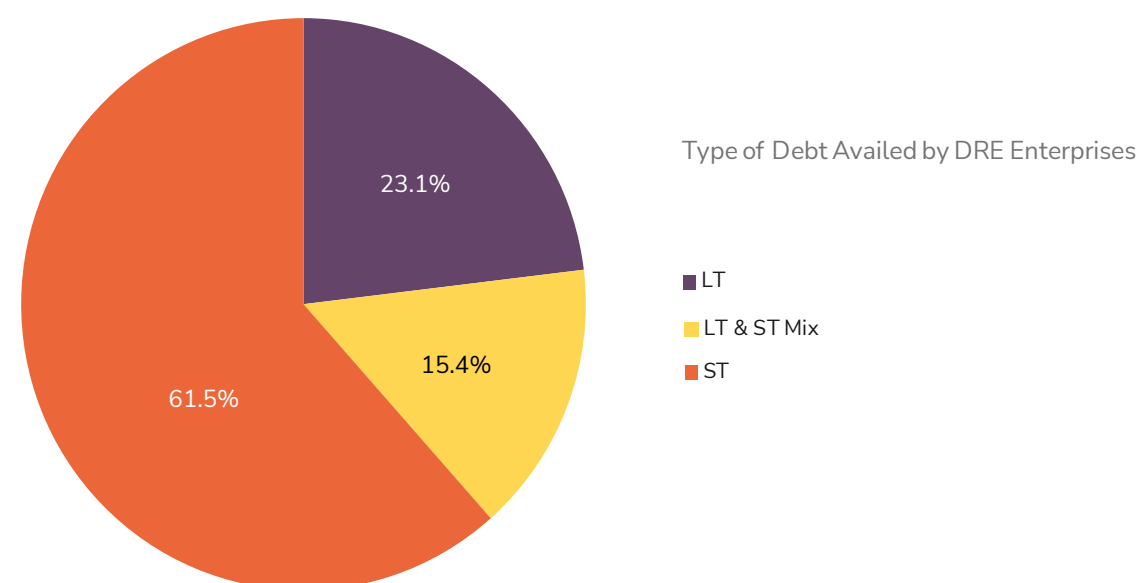


FIGURE 18: Map of Loan Type Amongst For-Profit DRE Enterprises. Sample size: 13

Enterprises have availed of funding to meet their capex and working capital requirements through loans in the form of term debt and working capital loans respectively. 62% of enterprises have ongoing loans which are short term in nature with a median ticket size of INR 40 Lacs. Only 23% have ongoing loans which are long term in nature with a median ticket size of INR 1.15 Crores. A few

enterprises avail of both short term and long term loans. (Short term loans refer to loans availed by organizations to cater to working capital requirements and are of a duration of less than equal to 12 months. Long term loans refer to loans availed by organizations to cater to requirements of capital expenditure and are of a duration more than 12 months).

2.3 State of Fresh Fundraising

Out of a total of 57 respondents, 21 member enterprises successfully raised funds in FY20-21 and FY22 (till October'21), nearly 60% of which belonged to the for-profit / manufacturer and system integrator category of organizations.

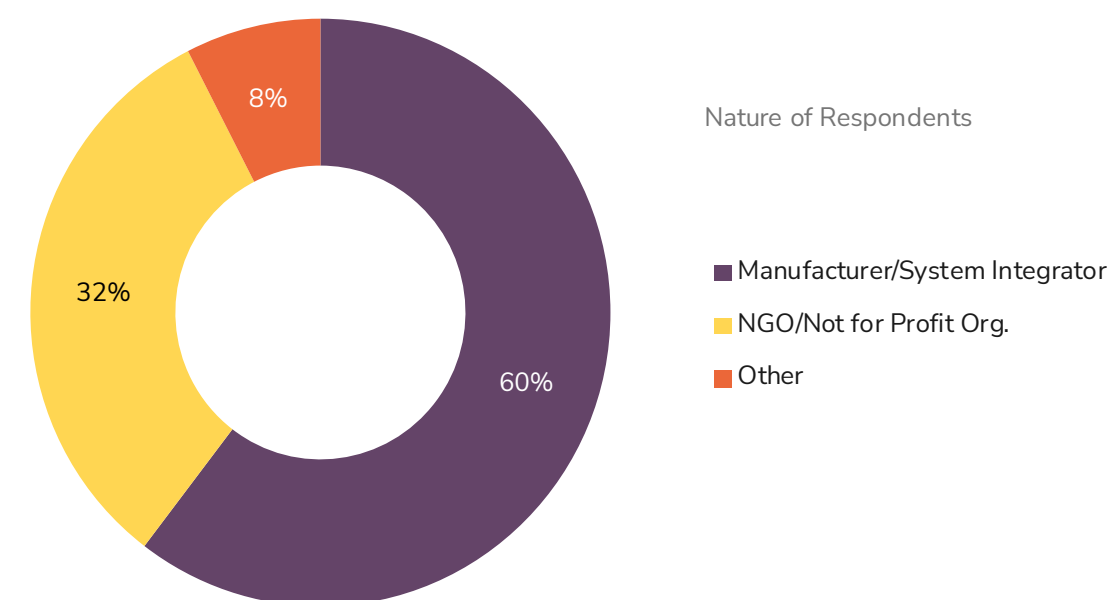


FIGURE 19: Others include advisory, consulting and training institutions. Sample size: 21

Each respondent depending on their stage of business and type of organization have tapped into various sources for meeting their funding requirements, such as debt, grant capital and CSR funds.

It is interesting to note that in spite of the restrictions imposed through the two waves of the pandemic, some of the enterprises were also able to gain access to funding through more mature instruments/modes of financing

such as private equity and compulsory convertible notes and debentures. Advisory and consulting firms and training institutions forming the category of 'Others' in Figure II have been seen to raise grant capital as individual project support.

Out of the enterprises which disclosed the quantum of funds raised, it can be observed that approximately INR 158 Crores of capital

was raised by DRE enterprises with more than 85% of funds raised together through debt finance and private equity mode. This also includes 2 for-profit entities which availed additional funds (amounting to ~ INR 41 Lacs) under RBI's ECLGS (Emergency Credit Line Guarantee Scheme) as part of the RBI Covid resolution framework. None of the total 57 respondents raised fresh funds through Venture Capital.

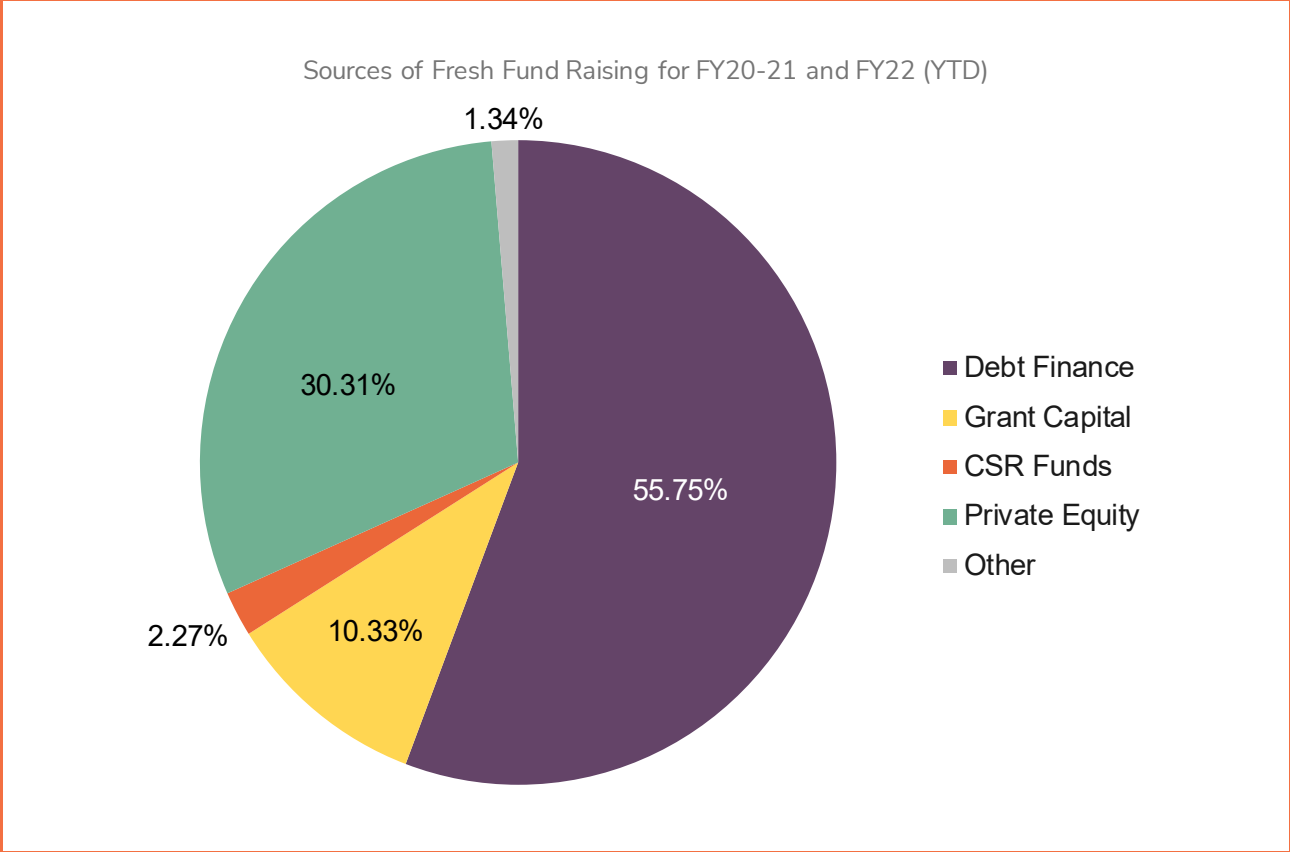


FIGURE 20: Others include promoter debt, convertible notes and compulsory convertible debentures. Sample size: 21

The median of fresh debt raised by for-profit DRE enterprises stood at INR 50 Lacs whereas the median of fresh funds raised through private equity stood higher at INR 2.13 Crores. Not for-profit entities in the DRE sector were able to successfully raise funds through grant capital especially in light of the COVID-19 relief measures rolled out by the government and other domestic and international agencies

and philanthropic organizations. It can be observed that owing to their proximity to the last mile, CLEAN members (for and not for-profit organizations) proved to be effective conduits to provide COVID relief to the 'hardest-to-reach' communities. It can be observed that a total of INR 2000 Lacs was accessed by CLEAN members by way of grant monies (excluding CSR funds).



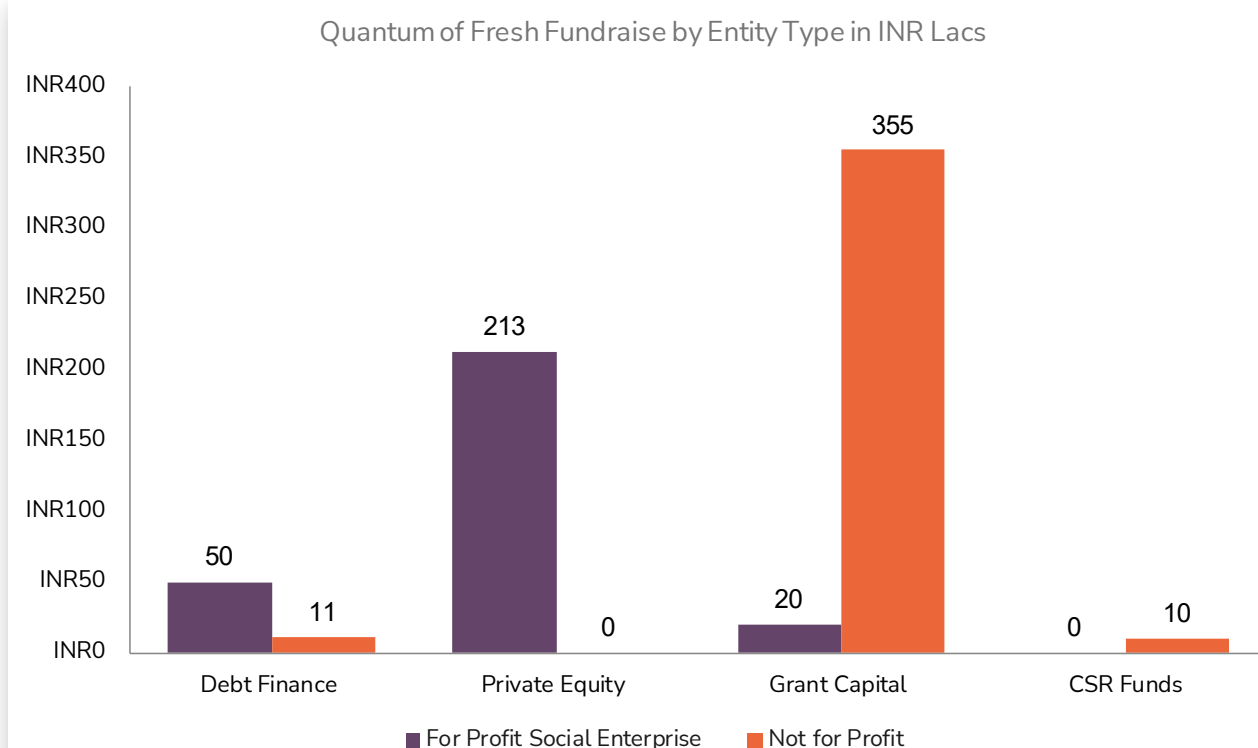


FIGURE 21: Amount in INR signifies median. Not for profit organizations have availed debt in the form of overdraft facilities to cater to daily cash flow mismatches. Sample size: 21

Below are some of the key insights with regards to fresh fundraising efforts in the DRE sector:

- Nearly 15% of the organizations which successfully raised funds in FY21 and FY22 (YTD) had no prior experience of fundraising through commercial sources (debt/ private equity/ venture capital)
- Nearly 60% of the entities which successfully raised funds via debt and or private equity in the past 1.5 years, incurred a loss in either FY21, FY20 or in both years. The total quantum of funds raised by the aforementioned loss-making entities was INR 74.01 Crores through debt and/or PE and an additional INR 3.92 Crores through grants and CSR funds.
- Approximately 75% of the entities which successfully raised funds in the past two years were registered as an MSME under the new Udyog Aadhaar Registration. However, a total of 17% of these organizations were either unclear about the new registration process or had not knowingly registered themselves as MSME. Remainder of the organizations were certain that they do not qualify as MSME. While nearly one-fourth of these organizations were not registered as a Start Up with the Department for Promotion of Industry and Internal Trade (DPIIT), 42% confirmed that they are a registered start up. However, 33% of entities were either not clear about Start Up registration rules/guidelines or had not knowingly registered themselves. Remainder of the organizations were certain that they do not qualify as a Start Up under the DPIIT guidelines.
- Across both registered MSMEs and Start-ups, DRE enterprises raised fresh funding from a gamut of sources such as CSR funds, debt/loans, grants, private equity etc.

- Registered MSMEs raised fresh funds of a median amount of INR 55 Lacs and INR 88 Lacs and registered start-ups raised fresh funds of a median amount of INR 25 Lacs and INR 38 Lacs via debt funding and private equity respectively.
- The median fresh fundraising via debt achieved by unregistered MSMEs in the DRE sector was lower at INR 8 Lacs alluding to the fact that MSME registration may have helped in raising fresh funds via debt. However, the same can not be said for startup registration with DPIIT since the median amount of fresh fundraise via debt by unregistered startups was higher at INR 83 Lacs.
- On the PE fresh fundraising front too, unregistered MSMEs and Startups were observed to raise a higher quantum of funds.

Note: A listing of benefits extended to registered MSMEs can be accessed at https://udyamregistration.gov.in/docs/Benefits_of_UR.pdf and registered Startups can be accessed at <https://www.startupindia.gov.in/content/sih/en/startup-scheme.html>

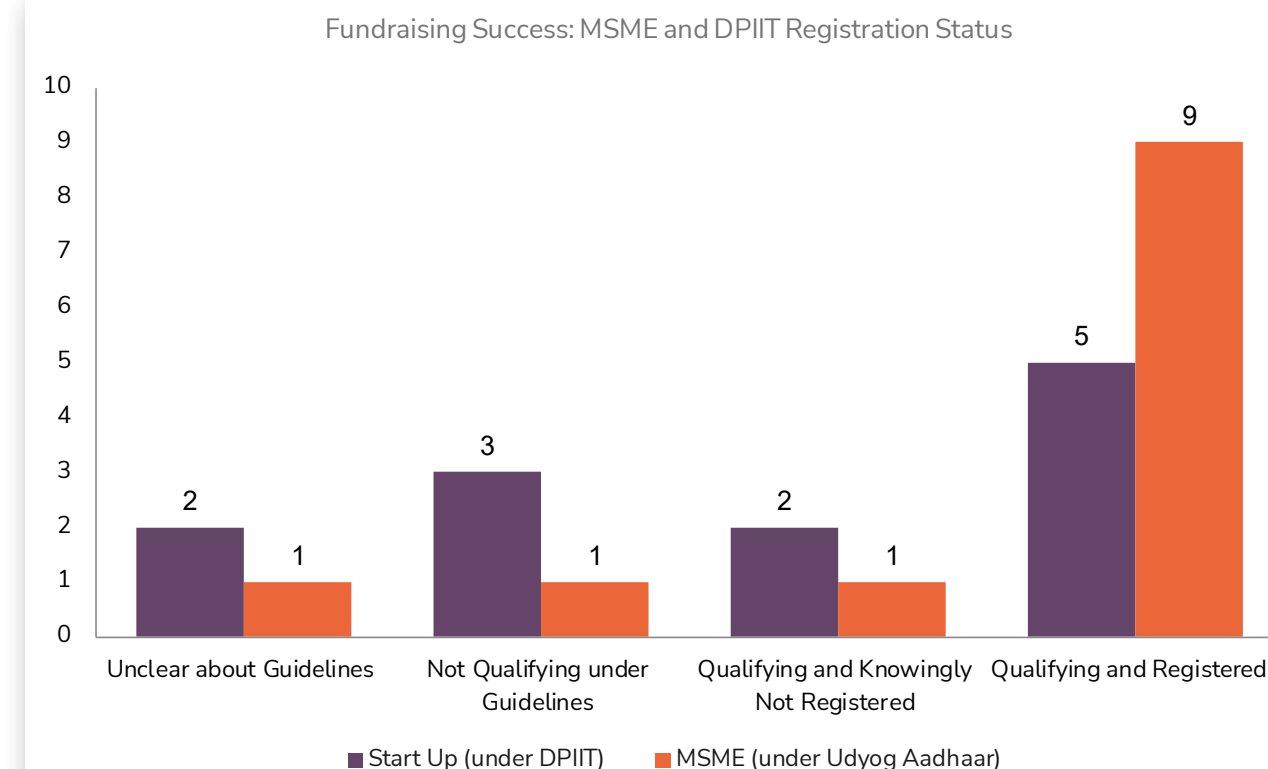


FIGURE 22: Figure on vertical axis represents number of organizations. Sample size: 12

ONERGY



PROBLEM:

The effects of climate change are being witnessed across the globe and sectors. Agriculture, for over 96% Small and Marginal farmers in West Bengal, India, has become a challenge. With limited irrigation facilities, the majority of the small and marginal farmers of Bengal only manage to grow a single crop of paddy during the monsoon/rainy season. Unreliable and unaffordable energy is also one of the key concerns for the farmers in Bengal. Added to their burden is the cost of operating on diesel gen sets and Electric pumps which consume 30% of the farmers' net income, resulting in a decline in their profit.



INTERVENTION:

ONergy has been a pioneer in promoting inclusive business models since 2010. There are two key models promoted to better serve smallholder farmers. One is the Water as a Service (WaaS) model- a water entrepreneur operates the solar pump and sells water to other farmers on an hourly/daily/seasonal basis. Hence a poor farmer frees itself from capex. The second model is Water User Group Model - a Joint Liability Group of smallholder farmers is formed to facilitate financing and optimum water usage among the group. ONergy replaces expensive diesel pumps with solar irrigation. In addition, solar pumps are combined with drip and sprinkler systems ideal for horticulture farmers to improve productivity and reduce water usage. ONergy is also piloting sensor based automated drip irrigation to further reduce water usage by 25% as compared to conventional drip systems. This improves productivity with 'more crop per drop'. All solar pumps come with VFD control drives to improve efficiency and also remote monitoring and control for better service support. ONergy has also created portable/ movable solar pump structures suited for marginal farmers.



IMPACT:

ONergy has created a transformative impact by adopting models such as Water as a Service (WaaS). This has been done by ensuring end user financing through banks to support first loss guarantees and forming Water User Groups. As farmers benefit from an increase in incomes, positive cash flows and better productivity, the switch to solar becomes more compelling. In addition, micro-irrigation methods such as drip and sprinkler support in horticulture and cash crop farming. Till date ONergy has deployed 1750 solar pumps in

West Bengal and 246 farmers have directly benefited from the WaaS model.

ABOUT THE ORGANIZATION

ONergy Solar is an end-to- end solar solution expert. They provide design, engineering, manufacturing, installation, O&M and solar consultancy services for solar rooftop power plants, solar irrigation pumping, solar lighting and microgrids. Their solutions and services are focused towards reducing energy costs for our customers.



2.3.1 Deal Flow

The below table gives an overview of the nature of fresh fundraising successfully done by CLEAN members in FY21 and FY22 (Year Till Date).

TABLE 3: Source: Member responses, corporate filings and public announcements

NAME OF ENTITY	SOURCE OF FUND	TYPE OF FUND	AMOUNT (INR LACS)	TIMELINE	PURPOSE
Oorja Development Solutions Ltd.	Schneider Electric Energy Access Asia (SEEAA)	Equity	746.2	October 2021 - December 2022	To increase farmers' agricultural productivity, to strengthen food systems and to reduce carbon emissions
	Water & Energy for Food Grand Challenge (WE4F)	Grant			
	DOEN Foundation	Grant			
Resham Sutra Pvt. Ltd.	Upaya Social Ventures	Convertible Notes	36.0	2021	Aimed at replacing labor-intensive silk yarn production methods with reeling machines to eliminate hard labor and double a reeler's productivity and income
	Ashden Trust	Convertible Notes	70.0	2021	
	Powering Livelihoods	Grant	20.0	2020	
Devidayal Solar Solutions Pvt. Ltd.	Ashv Finance	-	100.0	-	To enable micro, small businesses to purchase solar refrigerators
PLUSS Advanced Technologies	Carborundum Universal Ltd. (CUMI)	Equity	11500.0	-	The investment will be made to acquire equity shares from the existing shareholders, including promoters, and to subscribe to additional equity capital in PLUSS

NAME OF ENTITY	SOURCE OF FUND	TYPE OF FUND	AMOUNT (INR LACS)	TIMELINE	PURPOSE
NERD Society	MNRE	Grant	60.0	-	Training of unemployed youth
Grassroots Energy Technologies India Pvt. Ltd.	Greater Impact Foundation and Shell India	Equity	Undisclosed	Transaction will be closed by Feb'22	Expansion of Biomethane/ Bio CNG for cooking and mini grid segments
Doorastha Analytics Pvt. Ltd.	Facebook	Grant	Undisclosed	-	Facebook small grant program to absorb livelihood impact due to COVID-19 helped waive off dues from consumers.
Himalayan Rocket Stove	Undisclosed	Private Equity (Seed Funding)	35.0	-	Challenge winner (Startup) to grow the company
	Undisclosed	Grant	90.0	-	Market access program with the collaboration with donor
Envo Renewable Energy Services Pvt. Ltd.	SELCO Foundation	Grant	20.0	October 2021	Providing temperature controlled cart for daily vendors
	SELCO Energy Access Fund	Compulsory Convertible Preference Shares	Amount Undisclosed. 15% equity stake	-	Long term expenditure
E Hands Energy India Pvt. Ltd.	HNI Investor	Equity	77.3	-	-
	Beneficial Returns LLC	Convertible Note	58.8	-	Working Capital
	ICICI Foundation	CSR	47.8	-	-
	Henkel Adhesives	CSR	8.7	-	-

NAME OF ENTITY	SOURCE OF FUND	TYPE OF FUND	AMOUNT (INR LACS)	TIMELINE	PURPOSE
	R.R Associates	CSR	0.1	-	-
	Florence Home	CSR	0.4	-	-
	Rajiv Gandhi Foundation	CSR	8.8	-	-
St. Thomas Charitable Trust	Azim Premji Foundation	Grant	5.6	April 2020 - Feb 2021	Grant for COVID Relief Material for 300 families
	GHCL Foundation Trust	Grant	3.0		Capacity building
	TATA Motor	Grant	1.5		Capacity building
Apeiro Energy Pvt. Ltd.	International Center of Entrepreneurship and Technology (iCreate), Ahmedabad (Technology Incubator)	Technology Exploration Cell Grant	2.0	September 2021 - March 2021	Proof of Concept Development
	Department of Science and Technology, incubation support by iCreate	Nidhi Prayas Grant	6.0	June 2021- January 2023	for prototype development
	Techtonic Clean Energy Challenge Winner,	credit based support and incubation at Social Alpha.	10.0	September 2021- September 2023	
Techno Village	SELCO Foundation (Catalyze Tech)	Grant	18.3	October 2021	Solar based livelihood special focus to marginal women. 1 unit e-rickshaw charging station.
SNL Energy Solutions	SELCO Foundation (Catalyze Tech)	Grant	8.0	October 2021	Model village using solar tech incubator



SECTOR OUTLOOK

Sensitizing Financial Institutions towards lending to DRE Enterprises and End Users

In December 2020, CLEAN released a report on the aforementioned topic jointly with Margdarshan Advisory & Consultancy Services post consulting 49 financial institutions seeking their views on the future of financing in DRE to drive growth of the sector.

The outcomes of the report remain significant as the sector battles with the after-effects of Covid, an imminent third wave and possible economic slowdown. A few highlights of the report have been summarized here, which put across a lender's perspective on lending to the DRE Sector:

- Most financial institutions have dedicated products but they are focussed more towards traditional DRE applications such as solar home lighting systems, lanterns, solar pumps - even though demand for some of these products have decreased over the past few years.
- Level of awareness of new and improved DRE applications and technologies is highest amongst Micro Finance Institutions (MFIs) followed by Non Banking Financial Corporations (NBFCs).
- Financial institutions offer unsecured loans with ticket sizes upto INR 50,000 however those beyond this amount call for provision of a security/collateral.
- Key perceived risks amongst lending institutions are system non-performance, non-scalability in business models, loan default risk and lack of after-sales service.
- The representatives of financial institutions are of the view that the DRE sector needs alternate and innovative funding structures such as credit guarantee support - in addition to the extant interest subvention schemes.
- Creation of awareness about the DRE sector, technologies and their potential is one of the key 'asks' which came from across all sector stakeholders.

THE FUTURE OF CLIMATE INNOVATION FUNDING IN INDIA: TRENDS AND OPPORTUNITIES

SIMMI SAREEN

Director, Unitus Capital

The past year has been a busy one for the climate finance world. For the first time ever, India committed to a net zero goal at a national level. Even with a distant 2070 commitment, the announcement has the potential to catalyse climate action. While the COP26 announcement was by far the largest, it was by no means the only positive news to come our way this year.

Big businesses have equally stepped up their climate action game, with 64 large Indian companies announcing their intention to reduce or eliminate GHG emissions from their operations. We estimated last year that India will need USD 900 billion in climate finance until 2030 to meet its climate goals.

We now believe the number, if all the new commitments are factored in, would not only be considerably larger but also include new segments that have come into focus, most notably alternative fuels like green hydrogen and nuclear power. In all of this progress, big announcements from the government and large corporations take center stage.

However, for climate action to be truly meaningful, it has to be inclusive for the rest of India: our 35 million+ small and medium businesses and its 150 million+ farmers and farming communities need to embrace climate action for it to be impactful. We identify three key trends and opportunities in this move towards more inclusive finance:

- Equity is flowing into broader climate action: Up until 2020, VC and PE transactions were only happening in renewable energy. In a significant change, equity funding expanded beyond solar and wind developers in 2021. The two most notable sectors of interest to investors this year were agritech (thus contributing to sustainable food supply) and electric vehicles.

What's of further interest to us is the recent emergence of either climate tech focused funds or funds that are adding climate tech to their portfolios. We count at least seven conversations in the last six months with newly raised funds that are looking to invest in seed rounds all the way up to series B, and with focus sectors ranging from sustainable cities, green buildings, energy storage, alternative fuels and climate related technology platforms.

- Climate asset finance is finally taking off: Climate startups, unlike other technology plays, often sell tangible assets. One key gap in the climate finance landscape has been the funding for the customers who buy these assets. While the MSMEs and rural micro entrepreneurs are often willing to adopt energy efficient and clean solutions, they lack the means to afford the upfront cost.

2021 saw the emergence of several asset financiers who step in to fund these assets, either leasing them to the end users or providing a loan to the customer for the purchase. In both cases, the customers pay the financier a monthly payment linked to either the saving or the income generated from the asset. Fintech players like Grip Invest and Pyse are also democratizing the source of capital for this asset finance by building crowdfunding solutions.

It's early days for most of these asset finance and leasing players but this is one segment we believe will thrive and contribute to a more inclusive climate action scenario for India.

- Structural gaps continue to exist in scale up finance: Despite the green shoots that are emerging in VC funding and asset financing, we believe that significant gaps still exist and new financing structures need to emerge to solve for climate innovation firms looking to scale up.

Here's one of the many examples of the problem statements that came our way this year that we could not solve: many climate startups sell their products and solutions to governments and large corporations. This particular startup had already raised venture equity and was selling a viable product. Then it received its largest order to date and needed working capital to manufacture and deliver the product.

This is not a gap that equity financiers can solve, and supply chain/working capital financiers deemed it 'too early/too risky' to fund. Specialist climate tech supply chain and working capital funders is one clear gap that we believe needs to be filled for climate tech startups to scale.

If 2021 taught us one thing, it was that a lot of progress can happen in one year. This time last year, net zero was barely emerging as a concept. India has moved the needle significantly on climate action promises and commitments this year. The next year and indeed, the next decade is the time to translate those commitments to action, not just for corporate India but for its small businesses, farmers and homeowners. A more diverse, responsive climate finance community is the only way to achieve that.

References:

- <https://sciencebasedtargets.org/companies-taking-action#table>
- https://drive.google.com/file/d/11HDezt7pD3J2ZLVDqysiq_3jJitCkxol/view
- <https://www.fortuneindia.com/enterprise/pandemic-helps-agritechs-get-bumper-funding/105876#:~:text=Agritech%20startups%20raise%20%24426%20million,from%20the%20year%20Dago%20period.&text=Between%20January%20and%20August%20this,data%20from%20analytics%20firm%20Tracxn.>
- <https://auto.economictimes.indiatimes.com/news/industry/indian-ev-industry-records-inr-25045-crore-investments-in-last-seven-months/84889947>

FUELING CLEAN ENERGY BUSINESSES THROUGH IMPACT INVESTING

BEN BANERJEE

Co-Founder & President, Swiss Impact Investment Association

Coach at Impact Investment School

Advisory Board member of Climate Leadership Coalition

What is Impact Investing? Let's use the most accepted definition of GIIN¹, 'Impact investing refers to investments "made into companies, organizations, and funds with the intention to generate a measurable, beneficial social or environmental impact alongside a financial return". Although new in the financial sector, as per the latest reports, Impact Investing has already crossed an annual amount of USD 1 trn and is expected to be around USD 25 trn by the year 2025. It is important to note that the clean energy sector is one of the most important destinations for impact investors.

We all know that the rise of prosperity and growth of an economy is directly proportional to growth of per capita energy consumption. That is the reason why worldwide we see transformation of rural areas, as it is these areas where huge economic growth is taking place, especially in emerging countries. This increasing demand of energy needs to be fulfilled by clean energy. Few African and Asian countries, who are thinking short term and are trying to fulfil their growing energy needs using fossil fuels like coal are heading straight for massive financial problems, such as stranded assets and severe loss of asset value in the coming decades.

We from Impact Investment Solutions² and Swiss Impact Investment Association³ have been active for quite many years supporting Clean Energy Projects worldwide, especially through funding and investing. Some examples like Tidetec, Q7 Windfarm, Solarus, etc. are publicly known. Summarized below are a few lessons we have learnt in the last few decades:

That these are the golden times for clean energy entrepreneurs. The investors (especially impact investors) are strongly looking and investing in this sector. Adding to that most of the European Clean Energy funds like Global Strategic Capital⁴ from here in Zurich are not only outperforming the market since many years but also the inflow from institutional finance and private investors into such funds have skyrocketed. This trend is also being followed by institutions like EIB⁴ who have committed Euro 1trn in Climate Change Actions (which includes Clean Energy), but also large Banks like UBS and Asset managers including Blackrock etc. have created "Climate Funds" which also are primarily focussing in this sector. Not to forget many Family Offices and Smaller Asset Managers are active in this sector or are getting active, especially nudged by the new upcoming regulations like the 'Green Deal' of the European Union. This does not mean that this is an easy sector. It has few issues attached to it.

- Clean Energy, being a relatively new field, lots of research work still has to be done to produce clean energy which is really clean in every aspect of its full supply chain.

- It should be scalable, durable and cheap.
- Often the new entrepreneurs lack the knowledge of the processes, resources and funding available for this sector and thus fail to leverage it.
- Often Clean Energy is supply based, like Solar, Wind, etc. while consumers and markets prefer demand based. We are noticing that Energy Storage (the possible solution to this issue) and demand based energy like Geo-thermal and Hydrogen production are also slowly becoming hot items for investors.
- The replacement of existing energy infrastructure and its productions will have to be gradual. To start with, it is more about complementing existing energy producers rather than disrupting. Thus the speed of deployment in some countries will be slower than others.
- Energy production has been through large projects requiring massive investments and thus financed by large financial institutions like Governments, World Bank, the Norwegian Sovereign Funds, or Pension Funds, etc. who are looking for a steady income stream for the coming decades. They have policies in place to stomach and process large risk profiles and investments. Unfortunately this makes their ticket sizes large and investment processes cumbersome for the present Clean Energy projects which are often relatively smaller.

So this leaves this sector of Clean Energy mainly in the hands of the Impact Investors and Impactful funds run by family offices or Asset Managers within our ecosystem. Not only are these projects ideal for Impact Investors but also for funds focussing on Blended finance, Public Private Partnership, impact funds, etc.

In conclusion, we live in the golden era for Clean Energy, especially in powering rural areas where the sustainable growth lies. In my opinion, this is not only of existential importance but also makes pure economic sense, if you look at how many people are employed in Clean Energy Sector in major business centres like California compared to those employed by the fossil fuel industry.

References:

- Global Impact Investment Network (<https://thegiin.org/>)
- Impact Investment Solutions (<http://iisolutions.ch/>)
- Swiss Impact Investment Association (siia.ch)
- Global Strategic Capital (<https://globalstrategic.ch/EN/index.html>)
- European Investment Bank (<https://www.eib.org/en/index.htm>)

Note: In 2019, the clean energy industry in California employed 4.1 lac people (source: www.energy.ca.gov) and in the same year, according to a study funded by the oil lobby, around 1.52 lacs Californians work directly in the oil and gas industry.

2.4 Sales and Profitability Trends

The after effects of the Covid-19 pandemic have been harsh on DRE organizations affecting their financial performance and profitability. Nevertheless, it can be observed from the below sections that the financial performance of certain organizations in the for-profit category does look promising.

The below chart maps the revenue categorization of 29 for-profit DRE enterprises, wherein more than half of the organizations fall into less than INR 50 lac category.

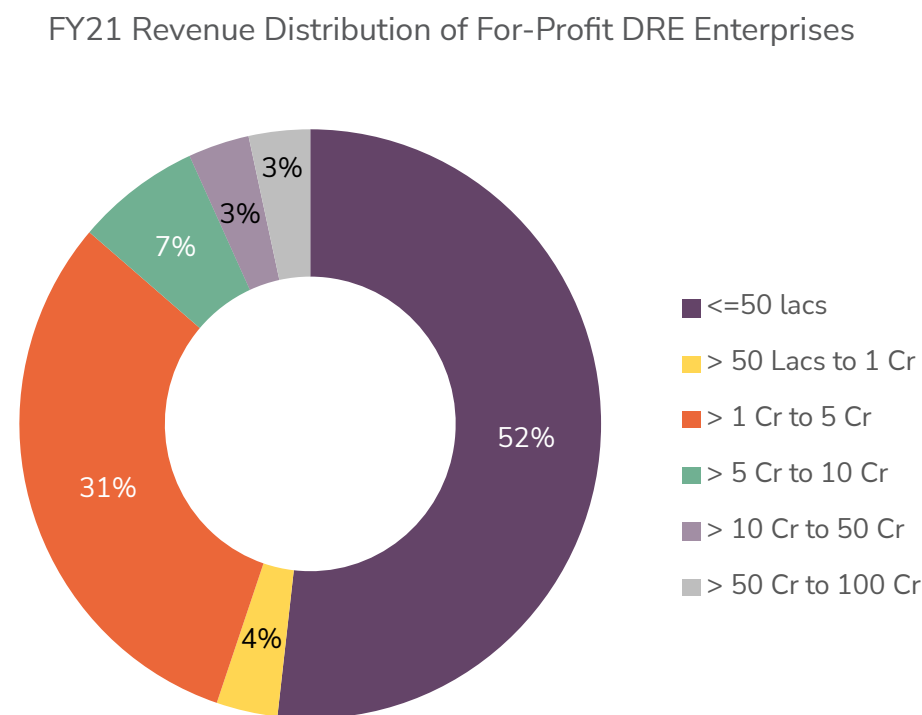


FIGURE 23: Revenue Distribution of For-Profit DRE Enterprises for FY21. Sample size: 29

- When an analysis was done around what these organizations had projected at the beginning of the year for FY21, following observations can be made:
- 67% of these organizations had projected they would fall in the same less than INR 50 lac revenue category.
 - However approximately 26% of the organizations had aspired to graduate to the revenue range of greater than INR 50 lac to INR 1 Crore, but could not do so.
 - 6.7% of the remaining organizations had aspirations to graduate to the INR 1 Crore to INR 5 Crore category but could not do so.
 - Similarly in the greater than INR 1 Crore to less than INR 5 Crore revenue category, 11% of the organizations aspired to graduate to the greater than INR 5 Crore to less than INR 10 Crore category but could not do so.

The below table gives an overview of the profitability trends seen amongst DRE enterprises between FY19-20 and FY20-21. Some of the key observations and trends have been elucidated in the section below.

TABLE 4: Table depicting profitability trends amongst DRE enterprises between FY20 and FY21. Sample size: 57

CATEGORY	NOT PROFITABLE			PROFITABLE		
	FY 19-20	FY 20-21	CHANGE	FY 19-20	FY 20-21	CHANGE
Manufacturer/System Integrator	20	18	-10.0%	16	18	12.5%
NGO/Not for-Profit Org.	10	13	30.0%	6	3	-50.0%
Other	2	2	0.0%	3	3	0.0%
Grand Total	32	33	3.1%	25	24	-4.0%

The below observations have been interpreted on the basis of responses received from 57 member organizations operating in the DRE sector:

It can be inferred from the table above that the total number of loss making organizations increased by 3.1% and those making profits decreased by 4% from FY20 to FY21. Amongst loss making organizations, the NGO/not-for-profit organizations have been impacted to a greater extent clocking an increase of 30% in the number of organizations which were loss making in FY21 as compared to FY20. However, in the not for-profit organizations category, there was a decrease of 10% in the organizations which incurred losses in FY21 as compared to FY20.

Further, the total profit making organizations declined by 4% in FY21 as compared to FY20, primarily because of a decrease in the profitability of NGOs/not for-profit organizations which decreased by 50%. The total number of for-profit DRE organizations which made a profit in FY21 increased by 12.5% as compared to FY20.

16 for-profit social enterprises stated that they were profitable in FY20. Despite the adverse effects of the Covid-19 pandemic, more than 80% of these organizations were

able to maintain profitability in FY21 as well. Approximately 20% of these organizations turned a loss in FY21 primarily on account of reduced demand from the customer end, supply chain disruptions and working capital issues, detailed analysis of which has been provided in the following sections.

20 for-profit social enterprises stated that they were not profitable in FY20. While 75% of these organizations continued to be unprofitable in FY21 as well, the remaining 25% turned a profit in FY21 on account of rural/community-level connections built by these organizations which helped them fulfil specific orders and maintain business continuity. Out of the aforementioned 25% of the entitled which turned a profit in FY21, we observe that majority of these organizations (60%) have not availed of any external (fresh) funding in either FY21 or FY22 (YTD) and 80% have no external ongoing loan from either banks, NBFCs or private lenders.

Of the aforementioned (75%) organizations which continued to make losses in FY21, 40% were successful in raising fresh funds during FY21 and FY22 (YTD) through a gamut of sources such as grant capital, debt finance and private equity.

E-HANDS ENERGY

PROBLEM:

In the remote and rural areas of India, lack of reliable electricity or access to electricity and internet connectivity is one of the major reasons for lack of access to financial services offered by banks. Banking itself is a challenge in rural areas. Add mobile banking to it, that often becomes a territory difficult to navigate. According to research, 'there is a fundamental mistrust in using phones or digital modes to transact, particularly in rural areas.'

INTERVENTION:

To address the gaps in communication and accessibility, E-hands designed a solar branch, with SPV capacity ranging from 0.6kW to 5kW supported by a suitable battery bank. The installations run completely on clean energy, operating on 'off-grid' mode and thus dissolving the need to depend on diesel generator and the poorly available grid connectivity. Installations consist of micro wind - SPV hybrid systems and small wind turbines of 1.3-2.3 metres rotor dia with 0.6-1.1 kW generation capacity, located at a wind regime of 4.5 m/s annual average wind speed, in Maharashtra, Tamil Nadu, and Karnataka.

IMPACT:

Till date E-hands has been able to provide affordable and clean energy to 800 branches in 23 states with 24 million financial transactions of over 1.4 million people. E-Hands Energy, which began with a modest trial of powering four rural branches of a NBFC with wind/SPV hybrid in 2012, has now grown to run over 800 branches in 2021 on clean energy across 650+ towns and villages and has another 100+ branches in the pipeline to be rolled out by the end of the current fiscal year.



ABOUT THE ORGANIZATION:

Since inception in 2009, E-Hands Energy's prime mission is to harness India's abundant solar and wind energy resources, to provide affordable clean green energy access to millions of people. To this end, it partners with RE manufacturers, leading NGOs, like-minded corporate entities, financial and educational institutions. Thus far, we have traversed rooftops and hilltops with a range of

solar, micro-wind turbines, hybrid solar-wind renewable energy and rural solar lighting solutions; benefiting over 45,000 people spanning 500+ installations covering border areas, railway crossings, NGOs, rural homes, schools and IT & Micro Finance companies.

As a member of ADB's "Energy for All" program it has launched several initiatives which have resulted in reduction of 2500+ tons in carbon emissions into the atmosphere.



2.5 Mapping the Challenges Faced by DRE Enterprises

The road to 'building back better' has been tough for all MSMEs and the same is true for DRE Enterprises as well. As one delves deeper into the challenges faced by DRE enterprises, especially in light of the Covid-19 pandemic, some of the key issues which come to light have been depicted in the graphic below. Some of the other challenges highlighted by

members were inability to provide on-site support, availability of raw materials, price fluctuations (mainly increase) for metal and metal components, costs involved with helping employees and their families to be safe and maintain health whilst bearing the burden of paying salaries with minimal sales for over 6 months across two lockdowns.

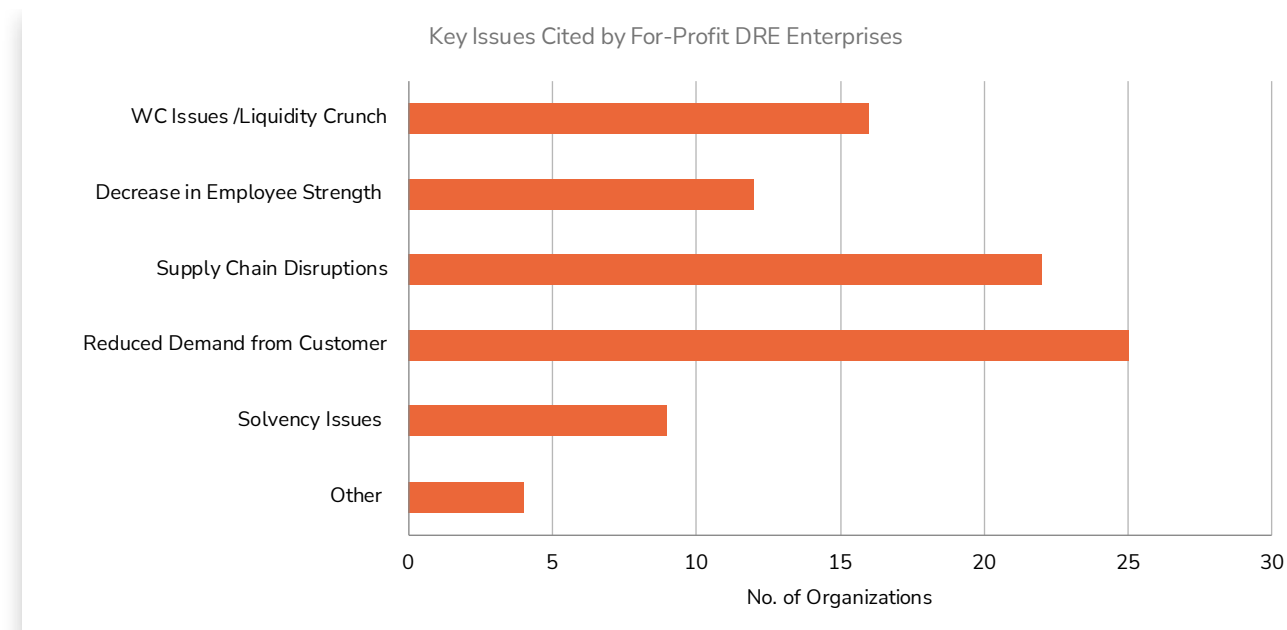


FIGURE 24: Map of key issues cited by For-Profit DRE Enterprises. Sample size: 36

An effort was also made to identify challenges which are specific to a particular enterprise type. While reduced demand from the customer end was stated by all categories of DRE enterprises, this issue was more pronounced amongst microgrid developers, DRE manufacturers and organizations

supporting livelihoods through DRE. The same type of organizations also cited supply chain disruptions as one of their key challenges.

Microgrid developers and DRE manufacturers stated working capital and liquidity issues as their most popular concerns.

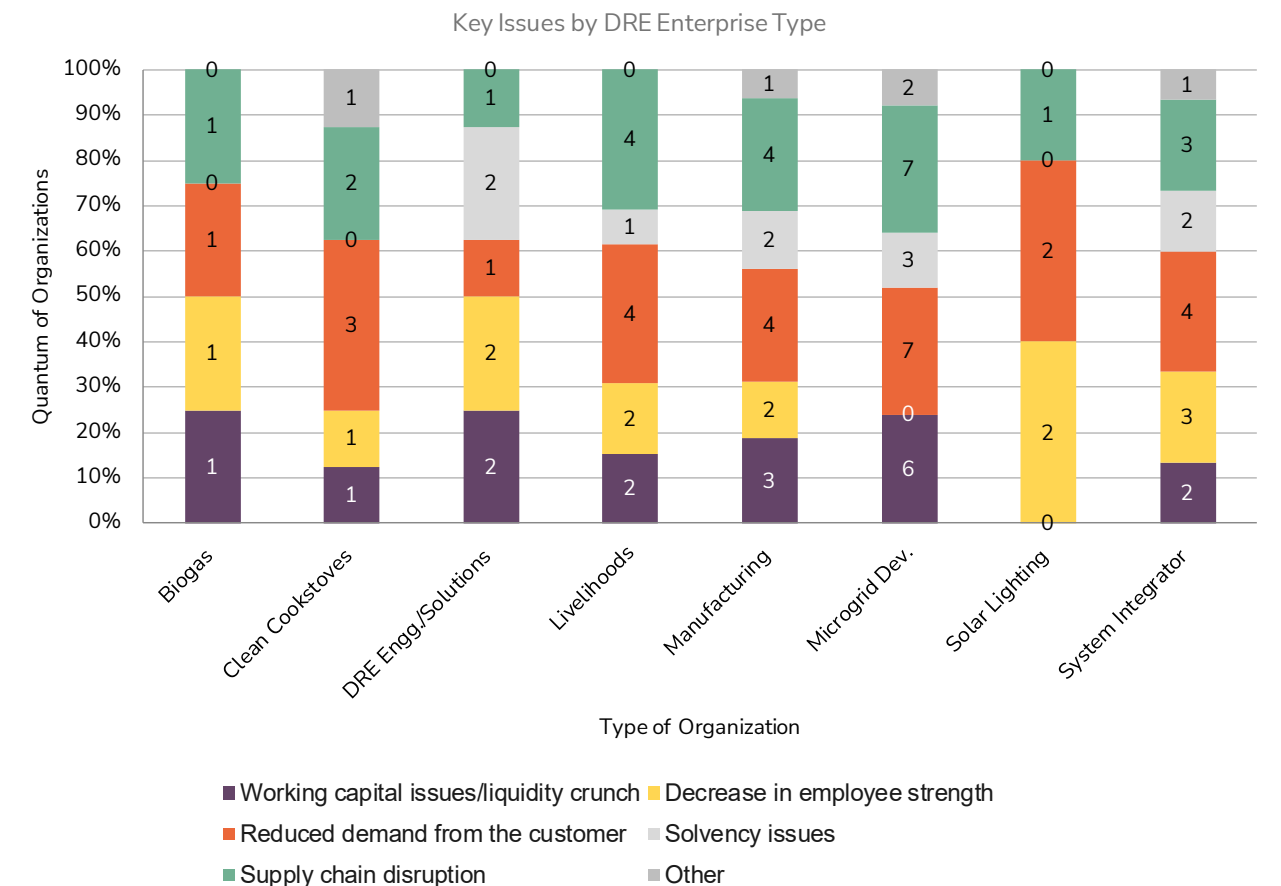


FIGURE 25: Mapping Key Issues with For-Profit Enterprise Type, Sample size: 36
Note: Data labels refer to number of enterprises facing given issue

2.6 MSME and Start Up Registrations Amongst DRE Enterprises

MSMEs in India fulfil a crucial role by providing large employment opportunities at a relatively lower capital cost and industrialization of rural and backward areas thereby reducing regional imbalances^Λ. The government extends several benefits to registered MSMEs such as the opportunity to avail collateral free bank loans, subsidy on patent registration, subsidized working capital loan rates etc. The government has also put in place similar schemes to support recognized startups such as tax exemptions, patent support, facilitating scale up through government backed procurement opportunities, incubation opportunities to facilitate growth etc.

Responses from 35 for-profit DRE enterprises revealed that 80% and 43% of the

organizations qualified and were registered as MSME and Start Ups respectively. Nearly 35% of these organizations were registered as MSME and Startup. 11.4% and 20% of organizations were unclear about the MSME and Start Up registration guidelines respectively and hence were not registered.

On the other hand, few organizations 5.7% and 8.6% were aware they qualified under MSME and Start Up category respectively but were not yet registered. It is worthy to note that in July 2020, RBI had recently revised the MSME classification criteria which mandates all MSMEs to register on the new Udyam Registration Portal which has replaced the earlier practice of filing for Udyog Aadhaar Memorandum (UAM).

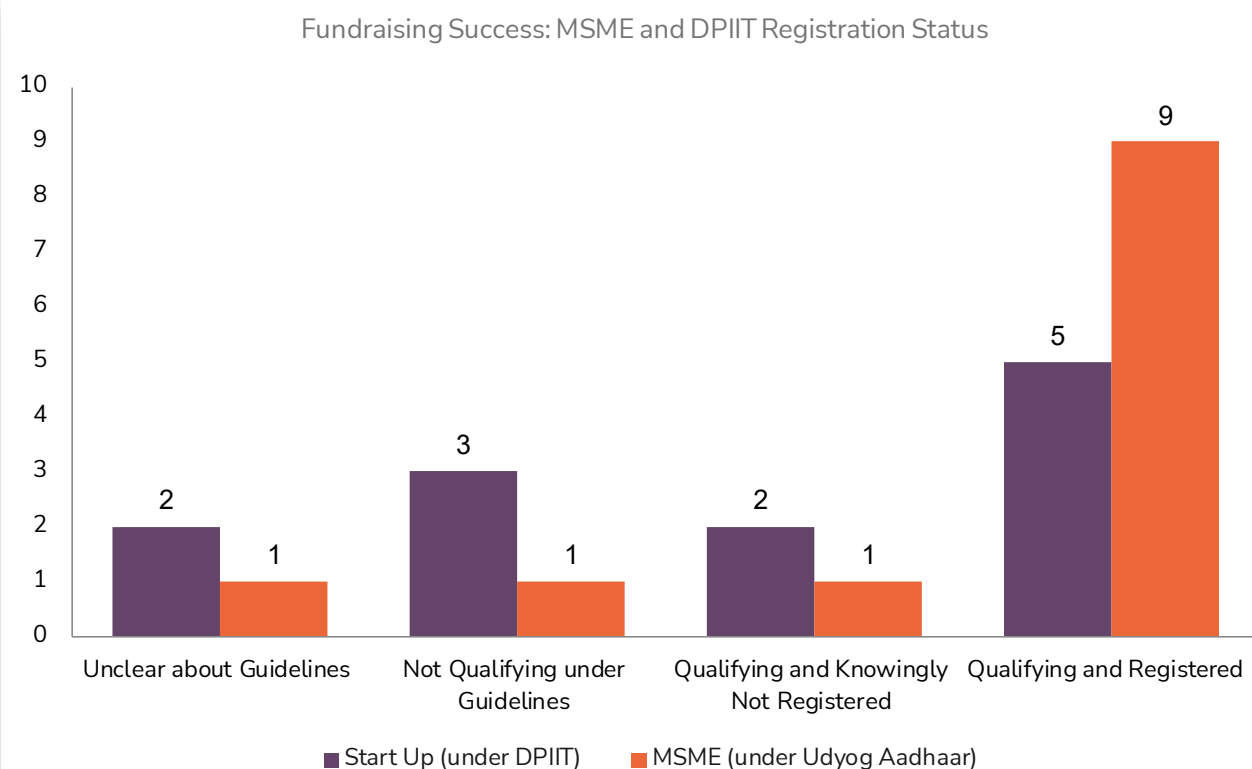


FIGURE 26: Map of MSME & Start Up Registration amongst for-profit DRE Enterprises, Sample size: 12
(Note: Figure on vertical axis represents number of organizations)

Of the DRE enterprises which have registered themselves as MSMEs, 64% are classified as Manufacturing and the remaining as Service enterprises. Amongst both manufacturing and service categories, the majority of DRE enterprises are classified as micro enterprises.

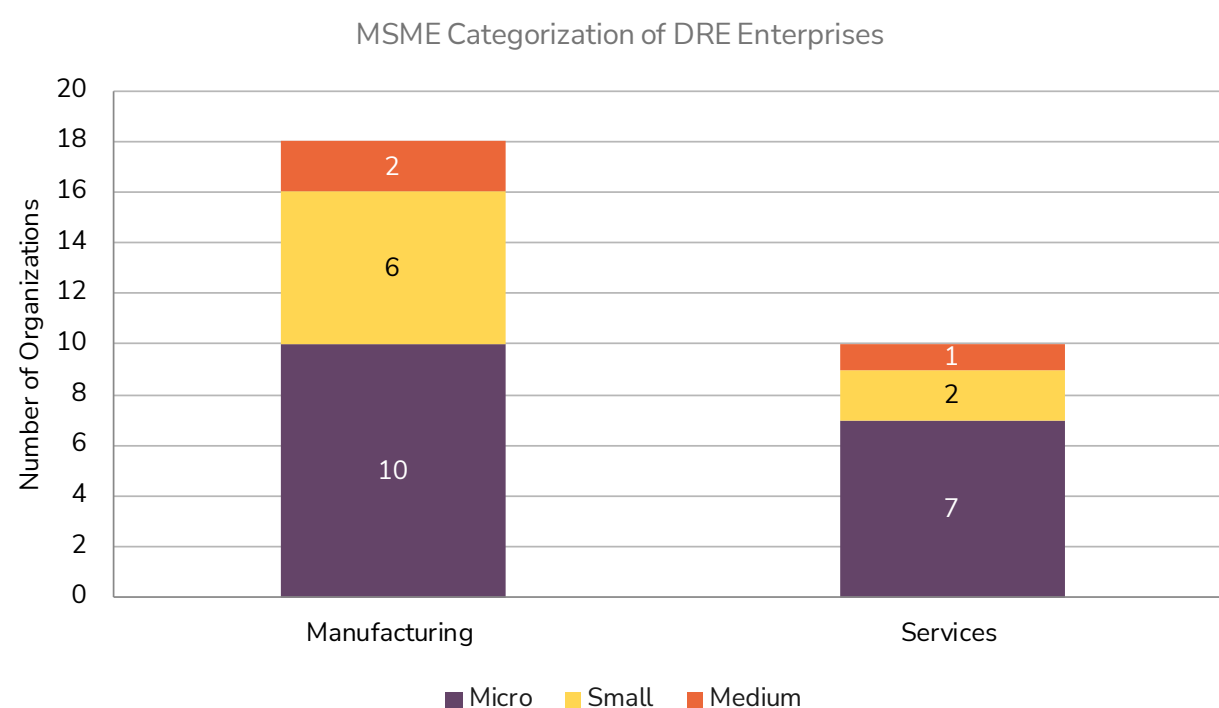


FIGURE 27: MSME Categorization of For-Profit DRE Enterprises. Sample size: 28



IMAGE 4: What Classifies as MSME : Understanding Revised Classification WEF 1-Jul-2020

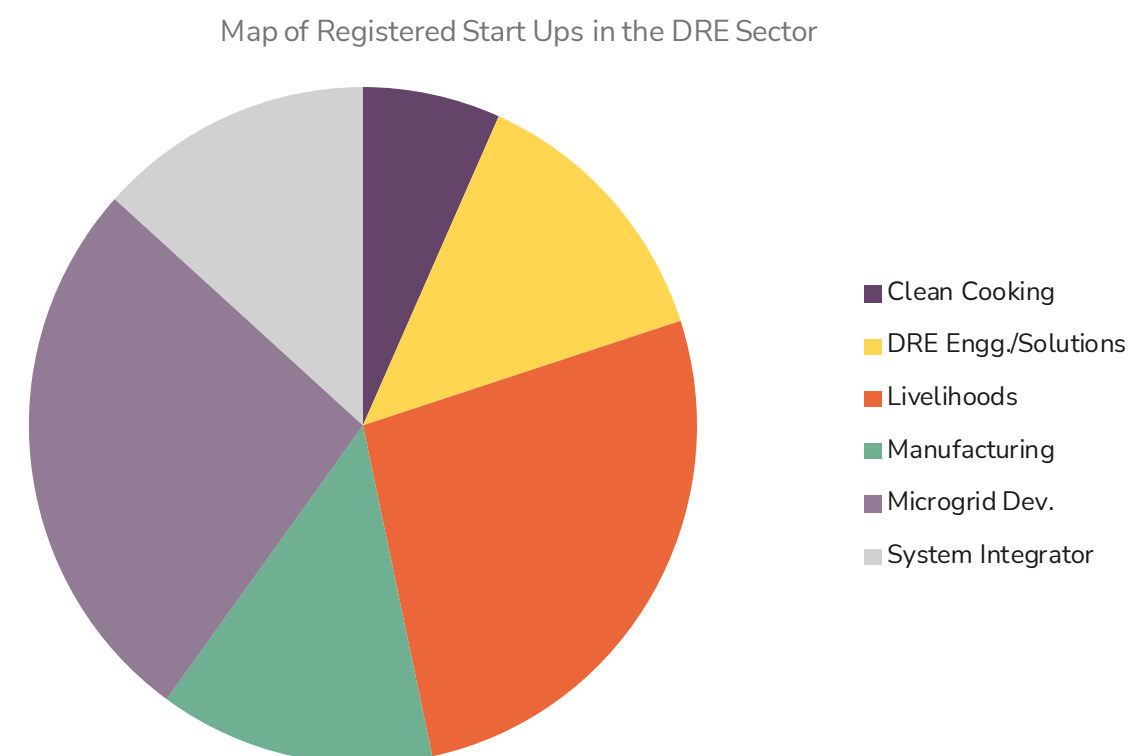


FIGURE 28: Map of Registered Startups Amongst For-Profit DRE Enterprise Respondents. Sample size: 15

Start Up registration with DPIIT was most popular amongst microgrid developers and DRE organizations supporting livelihoods - which together represent more than 50% of registered startups amongst respondents. Nearly 13.3% of the aforementioned

organizations amongst the registered startups have been successful in raising funds in FY21 and / or FY22 (YTD) to the tune of INR 1.1 Crores in total. These organizations also have prior history of availing debt finance from banks/private lenders.

2.7 RBI's Resolution Frameworks for Covid-19 Relief

During the two waves of the pandemic, the Reserve Bank of India (RBI) announced Resolution Framework 1.0 and 2.0 (in August 2020 and May 2021 respectively) to provide relief to retail and corporate borrowers and banks. These measures were specifically designed and implemented to provide monetary and financial support to Covid-hit industries, especially the most vulnerable borrower category - MSMEs.

In addition to this, the resolution framework policies were aimed to provide liquidity to the borrowers at lower costs. This was done by way of providing an option to avail moratorium on loan interest and principal repayments. Special provisions were made wherein a lender could review and increase the quantum of working

capital limits, decrease margins and increase drawing power without classifying the loan as 'restructured'. A prerequisite laid down by RBI for borrowers to avail restructuring benefits was that they should be registered as MSME in the Udyam Registration portal, thus underscoring the need for MSME registration amongst MSMEs and DRE enterprises alike.

Out of the total number of for-profit DRE Enterprises which have an ongoing loan with either a public or private sector bank, only 25% availed of the benefit of moratorium on loan interest and principal repayments.

An even lower proportion of enterprises (8%) availed of additional loan under the Emergency Line Credit Guarantee Scheme (ELCGS).

2.8 CSR in DRE

The nature of funding requirements of the Decentralized Renewable Energy (DRE) sector vary depending on the nature of respective enterprise impact, business models, vintage, and quantum of the requirement. As per a recent assessment carried out by CLEAN, in light of the adversities faced during the pandemic, grants, CSR and corporate philanthropic funds are one of the primary financial requirements of these social organisations.

An analysis of the top 100 BSE listed firms revealed that CSR investments in clean energy initiatives amounted to a mere 6% of overall CSR spend by Indian corporate entities in FY15-16#. Out of these 100 companies, only 39 corporations had programmes in clean energy#. As on date, the total CSR contribution flowing into the sector has only marginally increased.

Through CLEAN's interactions with corporates providing CSR support for the DRE sector, it is evident that the CSR initiatives of most corporations are aligned with the SDGs such as healthcare, education, poverty alleviation, agriculture, livelihoods & decent work, climate action, skill development etc.

There is a clear need to showcase how DRE technologies have the potential and are creating impact across multiple SDGs and not only SDG#7 (Affordable & Clean Energy) and SDG#13 (Climate Action).

Several DRE-tech enabled social organisations, amongst the CLEAN member base itself, have demonstrated their ability to create linkages with other SDGs, thus positively and sustainably impacting society as a whole.

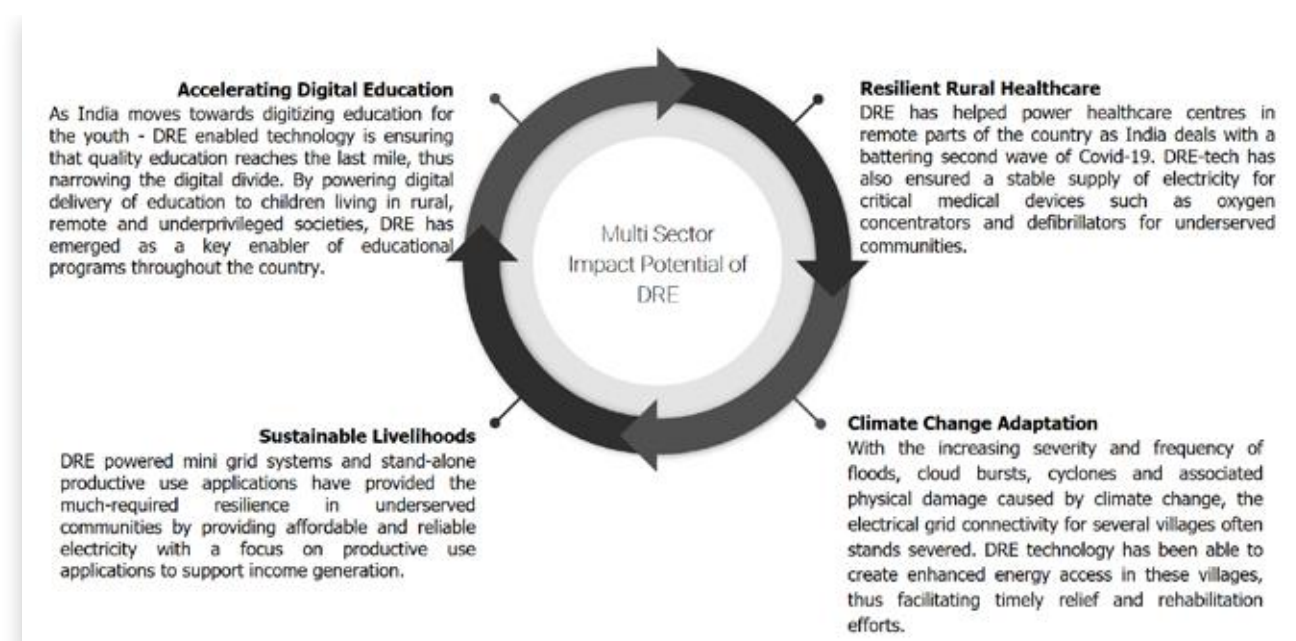


FIGURE 29: Multi-Sector impact potential of DRE Technologies

When respondents were asked about the sectors directly impacted by their work in the DRE sector:

- 72% of the respondents are directly impacting agriculture and allied activities, as demonstrated via interventions by Coolcrop Technologies, Hydrogreens Agri Solutions, Inficold India, Katidhan and Khethworks covered as case studies in the report.
- 65% of respondents are contributing towards the development of healthcare as showcased via interventions by LitsnLights and Techno Village covered as case studies in the report.

- 57% of respondents are contributing positively towards creation of basic infrastructure as demonstrated through interventions by E-Hands Energy, Husk Power Systems and Navitas Green Solutions covered as case studies in the report and
- Nearly 43% are contributing are driving access to education.

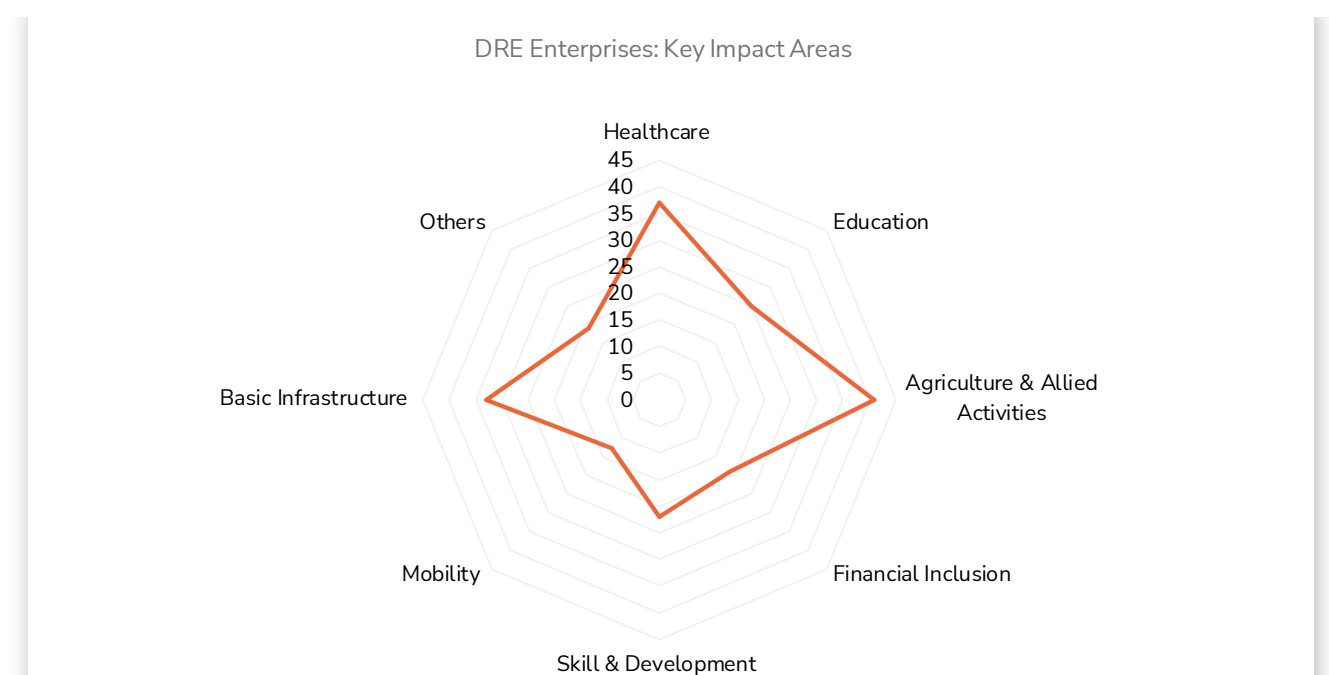


FIGURE 30: Mapping the impact created by DRE Enterprises, Sample size: 51

CSR when used as a blended finance instrument has the advantage of de-risking the flow of commercial capital into the DRE sector by fueling pilot projects and funding demonstrations. CSR-funded initiatives have the potential to showcase to the banking and financial institutions fraternity the advantages of lending to the DRE sector and reiterating that DRE projects are bankable, capable of generating returns and scalable in nature

However, it has been observed in CLEAN's conversations with Indian corporates that the quantum of CSR funds flowing into the clean energy sector has only marginally increased since the majority of corporates have diverted their funds for healthcare related and Covid-19 relief projects within and outside their organizations. As rightly pointed out by Samhita's report on CSR Trends and Opportunities in India: the clean energy sector (similar to water conservation, agro-forestry etc). requires a threshold level of domain and technical level expertise due to which accessing and funding opportunities in these sectors is difficult since CSR fund management teams do not possess these attributes as yet. The report also states that given that these technologies/causes are still nascent in the CSR system makes them too risky and not worthy of long term patient capital which is their primary requirement.



HUSK POWER SYSTEMS

PROBLEM:

Traditionally, decentralized renewable energy (DRE) in India has been focused on household solutions using pico solar, solar home systems (SHS) or clean cookstoves, which are essentially consumer goods.

Minigrids, however, are energy infrastructure that require considerable upfront capital to build, with operations lasting over 20 years. Maximizing capacity utilization over the life-time of that infrastructure is a key success factor. Solely relying on household demand to make the minigrids business model scale is not commercially viable. In order to increase demand, Husk Power Systems (“Husk”) instituted a new market strategy to address this challenge and prove that minigrids can not only reliably serve a diverse set of customers

with heavier loads, but also outperform both DISCOMs and diesel generation.

INTERVENTION:

In order to scale demand and increase its minigrids’ Capacity Utilization Factor (CUF), Husk focused on businesses that had the potential for significant daytime use, such as welding, agro-processing and food production, small-scale manufacturing, cold chain, irrigation, and other applications. At the same time, Husk instituted an end-user pay-to-own credit scheme that allows these types of customers to acquire more energy efficient machines, thereby reducing the cost of operations while also increasing productivity.

IMPACT:

Since implementing its strategy, Husk’s ‘heavy load’ customers have steadily increased.



The company now has about 6,000 micro-small- and medium-sized enterprise (MSME) customers, the highest average revenue per user (ARPU) and the highest CUF of any minigrid developer in the industry.

More precise impact data is still being collected, but clear benefits are already being passed on to customers. For example, Santosh Yadav, the owner of Baba Rusk Biscuit Factory in Uttar Pradesh, was a heavy diesel user before converting to Husk Power, and now saves 25-30 percent on power each month, as well as reduced maintenance costs.

Husk Power was also the first minigrid developer to monetize emissions reductions by displacing diesel generation, offsetting 15,000 tonnes per year.

ABOUT THE ORGANIZATION:

Husk, founded in 2008 with India as its initial focus, has grown to become the global leader in solar hybrid minigrids and rural clean energy services. (The company’s original biomass gasification solution using waste rice husks continues to be used at larger sites in combination with solar). Today, the company has more than 130 minigrids in operation across India, Nigeria and Tanzania. India operations are focused mainly on Bihar and UP, and largely serve under-the-grid communities.

Husk has raised about \$40 million till date from investors including FMO, Swedfund, Engie Rassembleurs d’Energies and Shell, and has also received support from The Rockefeller Foundation and its Smart Power India program.

2.9 Mapping End User Financing Requirements in DRE

Access to finance, at the right time and terms, is key to help the DRE sector and its stakeholders to achieve scale, grow and make profits, whilst creating valuable social impact. The catalytic role of end user finance is well

established in the sector not only because of the wide scope of benefits which come with clean energy adoption, but also since most users without modern energy access also lack the financial resources.

2.9.1 Risky Perception of End User Finance for DRE

However, end user finance has been perceived as 'high risk' by most supply side stakeholders along the financial value chain due to which access to the 'right kind of credit' by end users stands impeded. As per a recent study carried out by CLEAN amongst its members, less than 30% of clean energy enterprises had tie-ups with institutions to facilitate end user finance

for their end customers. High upfront costs of technology adoption, few track records of successful adoption, after-sales service issues are some of the inhibitions amongst lenders. Moreover, no formal credit history, poor economic profile and susceptibility to shocks (loss of livelihoods) and remote settlements make the beneficiary relatively 'unbankable'.

2.9.2 Mapping End User Financing Requirements amongst DRE Enterprises

As observed via a recent survey amongst 14 CLEAN members actively seeking to build end user financing linkages, a major part of the demand came from enterprises which are implementers and system integrators, manufacturers and organizations engaged with productive use applications. Nearly 60% of the end-user financing is sought for

more expensive products that either lie in the price category of INR 40,000 to INR 65,000 or are priced at greater than INR 1,10,000. Across all product and price categories, as per the assessment of the DRE enterprise, end users are willing to pay for 23% to 30% of the product cost as upfront payment (downpayment).

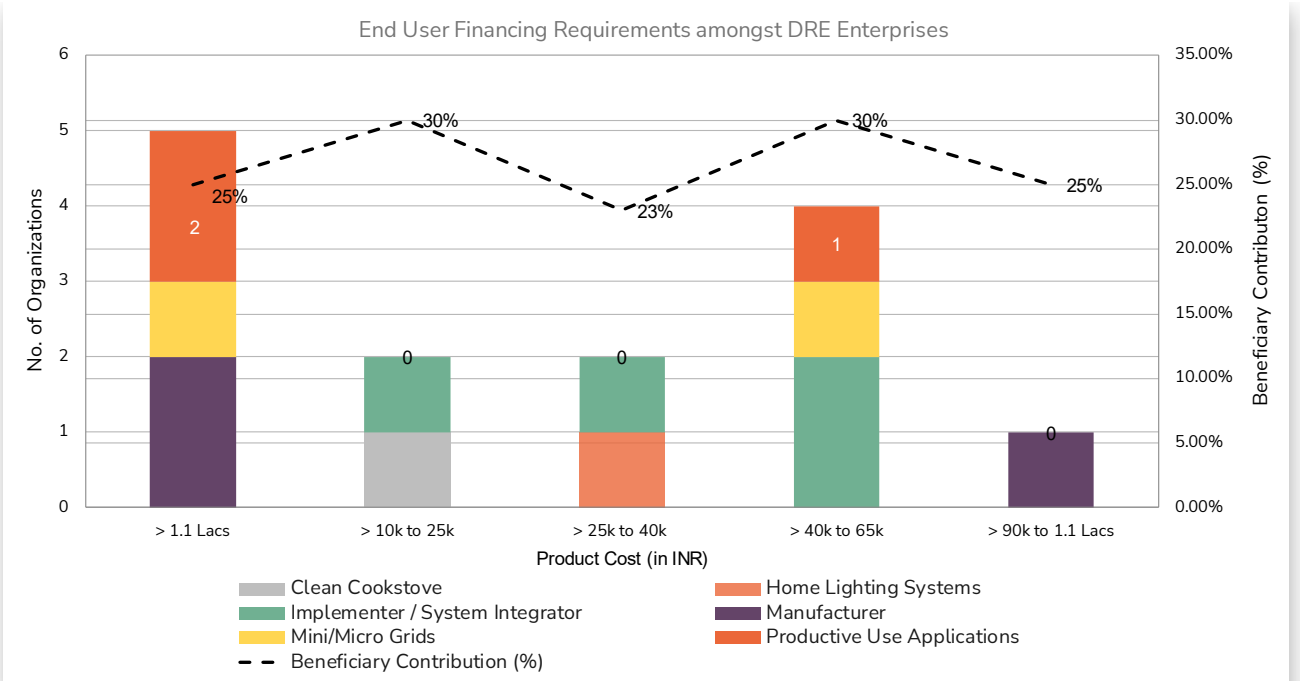


FIGURE 31: End User Financing Requirements amongst DRE Enterprises by Product Cost, Product Type and Expected Beneficiary Contribution; Sample Size: 14

TABLE 5: Pan-India end user financing opportunities amongst DRE Enterprises by State. Note: This table is not a depiction of the market size and total market opportunity, but a representation of current member requirements for creating end user financing linkages as per a survey conducted by CLEAN in October 2021 amongst members.

PRODUCT DETAIL	NO. OF BENEFICIARIES IDENTIFIED	LOCATION
Off-grid Livelihood Solutions	More than 35	Assam, Meghalaya, Nagaland
Rice Hullers, grain pulverizers, carpentry tools,chest freezers	More than 35	Nagaland, Jharkhand, Assam
Solar off-grid power systems	More than 35	Maharashtra
Solar Cooling Appliances	More than 35	Tamil Nadu, Karnataka, Andhra Pradesh
Solar powered vertical farming system	More than 35	Karnataka, Andhra Pradesh, Rajasthan
Solar bulk milk chiller	More than 35	Karnataka, UP & MP
Clean Cookstove	More than 35	Uttarakhand, Ladakh, Meghalaya
Home lighting system	20 to 35	Odisha
Solar powered entertainment systems	20 to 35	Rajasthan and UP
Solar Panels	20 to 35	Odisha
Home lighting system	20 to 35	Manipur
Solar rice mill and oils extractor	10 to 20	Assam
Solar off-grid power systems	5 to 10	Karnataka, Tamil Nadu
Off-grid Livelihood Solutions	5 to 10	Uttar Pradesh

As also outlined in the report on Sensitizing Financial Institutions towards Lending to DRE Enterprises and End Users developed by CLEAN, though at a macro level the DRE sector looks promising to lenders, consistent efforts still need to be made to create awareness at multiple levels amongst all stakeholders along

the financial value chain. In addition to this, designing relevant loan products for specific asset classes, leveraging extant government schemes and creating an ecosystem to enable good after-sales service - will all go a long way towards enabling financial institutions to extend loans to end users.

2.10 Summary of Conclusions and Way Ahead

Despite the pandemic, the sector has done reasonably well in terms of financial performance and fund raising activities. We observe that after the first wave and ensuing lockdowns, enterprises were better prepared to tackle uncertain business situations (not only limited to COVID-19 and other pandemic related aftereffects), since the pandemic forced them to establish better financial control thereby instilling resilience in their business models. Debt finance was the most popular form of fund raising adopted by DRE enterprises fulfilled by private and public sector banks for FY21 and FY22 (Till October'21).

This was followed by private equity, grant capital and CSR funds. Out of the total responses received, it can be observed that approximately INR 158 Crores of capital was raised by DRE enterprises with more than 85% of funds raised together through debt finance and private equity mode.

The quantum of fund raise via private equity was significantly higher than that availed via debt finance amongst for-profit enterprises. It could be observed that though a formal lockdown was not imposed by the government, enterprises faced issues of reduced demand from the customer end and supply chain disruptions - two key reasons why financial performance continues to be sub-optimal. The total number of loss making organizations increased by 3.1% and those making profits decreased by 4% from FY20 to FY21.

However, DRE enterprises continue to raise capital despite financial stress and economic slowdown. It can thus be inferred that enterprises which were successful in raising

capital were able to demonstrate resilience and project financial strength to the lenders/ investors. 20 for-profit social enterprises stated that they were not profitable in FY20.

25% of these turned a profit in FY21 on account of rural/community-level connections built by these organizations which helped them fulfill specific orders and maintain business continuity. Of the aforementioned (75%) organizations which continued to make losses in FY21, 40% were successful in raising fresh funds during FY21 and FY22 (YTD) through a gamut of sources such as grant capital, debt finance and private equity.

As demand picks up and businesses realign their strategies for the new financial year, end user finance was one of the key requirements which businesses cited, in order to aid growth and scale up. However, creating end user financing linkages presents its own set of challenges in a sector wherein end user beneficiaries are largely unbanked and not exposed to formal lending mechanisms.

Across all product and price categories, as per the assessment of the member DRE enterprise, end users are willing to pay for 23% to 30% of the product cost as upfront payment (downpayment) which points towards the confidence at the end of the beneficiaries in DRE products.

While not representative of the total market size, 14 CLEAN members have put forth a requirement to create end user financing linkages through loans of approx. INR 1.1 Crores for 350+ beneficiaries.

2.11 References

#Energising Development – CSR in Clean Energy: What are India's top companies up to' Samhita's clean energy report created in association with SSEF and IFC.

<https://msme.gov.in/about-us/about-us-ministry>



3. Technology and Innovation

Energization, decentralisation, and digitization are key innovation trends that are shifting paradigms, allowing more renewables to enter the system, shifting roles and duties, and allowing new entrants into the industry.

The chapter emphasises on the innovations, the various sub-sector briefs and the DRE sector's needs to create a local manufacturing ecosystem.



3.1 Innovations in the DRE Sector

Over the past year, DRE organizations have come up with several innovative solutions which are presently in pilot or implementation stages. This section aims to highlight some

of the key innovations from the DRE sector. The graph below shows the major drivers of innovation in the sector and it is heartening to note the centrality of the user in this regard.



FIGURE 32: Primary reason for introducing the innovation. Sample size-25

Research and Development(R&D) is the key element of many organizations. When it is well planned and used it enables a business to generate increased wealth from time to time. CLEAN members have been at the forefront in innovations in the DRE space. According to the responses, the basic reason to bring in

the innovation is to address the challenges in the existing product or the service in terms of performance and efficiency.

The other focus area and thought process for R&D was centred around improving , customer experience, affordability and reliability.



3.1.1 Power Trailer system in rural areas by h2e Power

Power trailer system for rural areas

H2e Power has designed a power trailer system, built with a solar fuel cell battery hybrid technology which is equipped with a GSM switch, IoT capabilities and real-time weather reporting. The Solid Oxide Fuel Cells (SOFCs) uses hydrogen that can be extracted from a variety of available local renewable sources to produce power and usable heat.

The system can power farmer's irrigation pump, agri-machinery and also meet household power needs for devices and appliances. The trailer can be hooked behind a small vehicle like a motorcycle or a tractor to be towed around. The maintenance team has remote access to the systems operations for 24x7 monitoring and diagnosis.

Advantages- Reduction of risks from unpredictable weather and increased productivity for farmers. Most suitable for off grid locations.



IMAGE 5

3.1.2. Combined stack cookstove by Ecosense Appliances

'STREE' is a hybrid clean cookstove developed by Ecosense Appliances. The design of the cookstove has been developed taking into consideration that women like to sit on the floor and cook food. The Multiple burners equips them to cook food faster and spend less time in the kitchen. The concept is to combine all the current cookstove technology in one

solution giving end-users more freedom to cook food as per their convenience.

The design is also customizable, the 3 combinations could easily have variations such as having only natural draft + forced draft, LPG cylinder + forced draft stove or LPG cylinder + natural draft.



IMAGE 6

3.1.3. Bioethanol gel based cookstove

Simi Stove is one of the least expensive stoves on the market today that uses Ethanol Gel, one of the safest and most effective clean cook fuels available. It can boil 1.5 liters of water in 17 minutes using only 25g of Ethanol Gel. The cost of the stove for government and NGOs INR 926. The stove is not susceptible to blackouts.



IMAGE 7

3.1.4. End to end energy monitoring mechanism for DRE mini / micro grids - Doorastha Analytics



IMAGE 8.1

Monitoring of a solar asset involves sensors to check various parameters of the solar plant/grid, logging the data and uploading the data to the cloud, where a visualization engine can show different aspects of the performance of the grid.

Doorastha Analytics Pvt. Ltd. is a start-up company that has developed a monitoring system that can be used in any micro-grid to enable remote monitoring. This can be combined with Doorastha Smart Meters and Pay-as-you-Go implementation to provide a mechanism to any micro-grid operator to maximize revenue from their operations.

Doorastha's iLUMY based smart monitoring system does this through a device called the "Grid Controller" which captures and logs data from the sensors.

3.1.5. Solar loom bobbin drives - SCS innovations

Powerlooms require bobbins every 2 minute. Traditional way of making a bobbin with hands takes 15-20 min. A solar loom bobbin drive has been developed by SCS Innovations for mechanising the process of winding of bobbins. A DC sewing machine motor and blacksmith blower regulator have been retrofitted to make this machine. Bigger AC powered machines to make bobbins generate 10 bobbins cost



IMAGE 8.2

Various data views provide information on various components of the grid, such as generation, distribution, and battery state of charge. It also shows the Grid Controller's warnings and faults, which can signal difficulties, many of which can be handled proactively to avoid downtime and hence maximise income and customer happiness. This has been demonstrated in the field, where the monitoring system has aided in assuring high-efficiency micro-grids, developing long-term sustainability for the assets deployed in the micro-grid, and ensuring high-quality supply to customers. Additionally, the Operations portal of Doorastha is used to map all the plant and grid parameters, along with all consumer information. This provides for an easy view of the plant operations. An iLUMY mobile app, which includes a wallet, provides the operator with a mechanism to recharge meters and track the collections.

INR 36000 excluding Solar PV components. This innovation by SCS Innovation cost around INR 15000 including Solar PV and battery. The machine has been piloted in an SHG with 10 members. Previously to process 1 kg of bobbins manually, it used to take 3 days for the SHG members, now it takes only 45 minutes by using the machine.



IMAGE 9: An installed solar powered loom bobbin drive in Nalbari, Assam

3.2 DRE Technology and Sub-Sector Briefs:

This section of the report highlights pertinent challenges and key updates on DRE technologies.

3.2.1 BIS standards

In order to enable DRE enterprises to participate in government programs and avail benefits, BIS standards are required for new inventions. Patented new innovations face challenges in receiving accreditation by BIS. Existing BIS standards cannot be used for the new technologies and hence new technologies will need new standards in place. It takes a considerable amount of time for BIS to develop new specifications for new innovations. To combat this issue, clear process to move from innovation, to pilot/demo, standardisation etc. should be facilitated by the government.

Government schemes can also be modified for new innovators to qualify after a short prima facie performance study by the experts.

Deenbandhu model is a successful biodigester model that is still being deployed in many rural areas. BIS standards need to be created for Deenbandhu type biogas plants above the capacity of 6 cubic meters. This is one of the examples of how standards need to be developed or modified as new product or further development in the existing variants takes place.

3.2.2 BIS Consultation on Low Voltage DC (LVDC):

LVDC is a new concept/emerging technology which explores the use of Direct Current (DC) for both generation and distribution of electricity. LVDC has gained the attention of scientists and technologists around the globe because of its immense potential to address global concerns such as access to electrical energy, depleting fossil fuels, energy conservation and clean environment.

In August 2021, BIS organized a webinar and stakeholder consultation in an attempt to identify the gaps in the LVDC standardization. Few of the highlighted points were:

- Guidelines for selecting suitable voltage and earthing systems in different operational environments.
- Fault detection and identification techniques
- Conformity testing of equipment and devices
- Matrix of voltage, current and distance applicable in DC installations
- Economical Recommendations for wire cross sections in copper and aluminum
- Selectivity of connectors for LVDC (criterion

of selection and use-cases)

- Classification & topology for practical DC microgrids in on-grid and off-grid environment
- Safety and installation of photovoltaics for productive use applications (DC devices)
- DC power consumption metering
- Segregation between AC and DC circuits
- Protection against electric shock and updating of installation rules

In order to reduce the overall cost of energy service, DRE players running micro/mini-grids have long used energy efficient end-use devices.

Low Voltage DC (LVDC) appliances perform well, and efficient end-use consumption is at the heart of any distribution side management (DSM) programme. With the benefit of enhanced electronic controls and resulting energy efficiency, LVDC appliances such as LED bulbs and lights, BLDC fans, and BLDC motors are widely used in many livelihood applications which are currently being powered and dependent on conventional AC grid power.

3.2.3 Clean cooking

The Government of India has announced the Ujjawala Yojna 2.0 in August, 2021. The PM Ujjawala Yojana 2021 program aims to end daily challenges of rural areas by providing free gas connection to women of below poverty line households.

With the increase in the LPG costs, the refills have become expensive for the rural population to afford. In forest and high rainfall locations, the usage of LPG limits to the monsoon season only. Different clean cooking interventions work well according to the different agro-climatic zones. Energy efficient biomass cookstoves have the scope to complement the efforts on clean cooking fuel access.

Improved cookstoves have reduced health and environment impacts. Due to lack of policy level support for improved biomass cookstoves, funding agencies have reduced interests in financing Improved cookstove projects. Forest and allied departments should prefer to deploy biomass cookstoves and support biomass cookstove construction and O&M training.

Field measurements of PM2.5, efficiency and other parameters should be practiced more to get more accurate measurements of the emissions and efficiency. In addition to protocols for lab testing of biomass cookstoves, the BIS standards for biomass cookstoves should incorporate protocols for field

-measurements of biomass cookstoves. BIS standard is a binary indicator and doesn't have tiers. This makes it difficult for the customer to compare between the different biomass cookstoves.

Solar based electric cooking is also expected to gain pace in the coming years. Solar based electric cooking by using induction cookstoves is the cleanest form of cooking that can be practiced. Few of the challenges faced by the segment in rural areas are the high prevalence of aluminum vessels and vessels without flat bottoms that can't be used in induction cooktop

3.2.4 Productive end use

A small improvement in energy efficiency can reduce the capital cost of DRE appliances significantly. DRE organizations are focused on reducing the system costs by making energy efficiency improvements. Manufacturing enterprises working in the DRE sector are focused on enhancing the overall efficiency of the applications and need support from educational and research institutes to improve the energy efficiency of different components

3.2.5 Small wind

Small wind turbines ranging from 400W to 25kW are ideal for areas with a good wind resource throughout the year such as hilly areas, coastal areas and high monsoon areas. Small wind turbines costs have not reduced much over the years. It requires a stronger push from the government in the form of subsidies. The wind resource is site specific in nature and hence an extensive wind resource assessment is essential for the selection of potential sites. Small wind practitioners rely on historical wind speed data and expert judgement, which at times can over predict wind speeds at a site. They cannot afford wind resource assessment campaigns due to high costs. The National Institute of Wind Energy (NIWE) has installed 890 wind monitoring stations and issued wind potential maps at 50m, 80m, 100m and 120m.

and hesitancy to shift from biomass based cooking.

The Government of India has added bio-slurry under its FCO list. Bio-slurry can play an important role in substituting chemical fertilizers. Currently bio-slurry is being sold at a nominal rate of INR 6-7/kg.

To achieve higher selling rates, bio-slurry needs to be aggressively promoted. Biogas practitioners also face difficulties in implementing mechanisms for dewatering slurries in small scale projects.

such as the mechanical power transmission systems. Bureau of Energy Efficiency (BEE) can look into initiating schemes to improve energy efficiency in micro and small enterprises in addition to its designated consumers. Though the energy savings would be low by improving the energy efficiency in micro and small enterprises, the cumulative energy savings from all the micro and small enterprises would have a significant impact.

It would be beneficial for the small wind turbine practitioners if NIWE measures the wind resource at 5m and issues wind potential maps.

The assessment process for small wind turbines with NIWE is a very lengthy, which involves installation of wind turbines on site for a year. Small wind turbine suppliers mentioned that 1 year is a long period for assessment. To circumvent this process, suppliers choose to self-certify the small wind turbines. Small wind turbine manufacturers are affected by the increase in material costs, petrochemical costs etc. To boost local manufacturing, small wind turbine component manufacturing can also be included under the Production Linked Incentive scheme.



3.2.6 Pico hydro

Pico hydropower is usually clean, sustainable and environmentally friendly as most of the pico hydro plants are canal based or run of river type which uses running water to drive the turbine.

The weir or barrage is small and no water is stored; it is free from societal and geographical issues such as relocation of local inhabitants or deforestation.

According to CLEAN members, the sector is moving slow as compared to the solar and bioenergy sub-sectors. The pico hydro power plants are feasible when it is well utilised for running productive applications and the power generated during the night can be supplied to the grid. The opportunity for the sector players is to demonstrate a sustainable model project with businesses electrified by it provided the support is extended to the sector.

CASE STUDY 5

CLEAN ENERGY TECHNOLOGY



PROBLEM:

Palghar district in the state of Maharashtra is one of the most underdeveloped regions in the country. Almost 90% of the population in the region is dependent on firewood for cooking as they cannot afford LPG. Women in Palghar often spent their whole day collecting wood. The district witnesses heavy rainfall and it becomes extremely difficult in the rainy season for women to collect wood. They have to collect and store wood before the rainy season starts. Inside the house, women and children are exposed to harmful gases that come from using firewood. Many families in the region are dependent on agriculture, but with fertilizer costs increasing exponentially and with excessive use of chemical fertilizers depleting the soil quality, there was an urgent need to help these farmers adopt sustainable farming practices.

INTERVENTION:

Tata Motors through their CSR initiative approached Cleanergy Tech Solutions for deployment of their unique biogas plant-Kisangas in the Palghar district. Kisangas is an affordable, portable, ready to install biogas

plant. The installation requires only 5-6 hours and it occupies a limited space compared to the traditional biogas plants. Their main objective was to provide access to clean fuel to households and also help farmers adopt sustainable agriculture. Cleanergy Tech Solutions with BAIF Development Research Foundation (who was already working in the area) introduced the technology in the area. Every farmer needs cow dung compost to maintain the nutrient quality. Farmers earlier struggled to get a good quality compost. Kisangas plant apart from clean fuel also generates slurry which acts as a quality organic fertilizer for farmers. The switch to an economic organic fertilizer from expensive chemical fertilizers brought huge respite to farmers. Additionally, to smoothen the process, Farmers were also given training on the application of slurry.

IMPACT:

After installation of the first 3 units and its success, BAIF started getting a strong demand from large numbers of farmers. Farmers liked Kisangas technology as compared to traditional biogas plants as it was very easy for them to operate. One Kisangas plant helps to replace about 1.3MT of wood per year. One plant saves at least INR 25,000 per year of fertilizer cost. Women in Palghar now utilize their time in their farms for more productive purposes.

ABOUT THE ORGANIZATION:

Cleanergy Tech Solutions was founded in 2016. Their aim is to provide sustainable organic waste management solutions. Their indigenous modular biogas, Swachhgas, is one of the most versatile, efficient systems and gives excellent economic returns to urban as well as rural establishments. Our mission is to empower people to utilize waste as a commodity.

CASE STUDY 6

COOLCROP



business and technical aspects of storage, marketing and post-harvest practices.

PROBLEM:

Members of Limkheda Farmer Federation have been selling their produce within a day on the same day of the harvest. Their harvest comprises various vegetables (like leafy greens, bitter gourd, bottle gourd, cucumber, green chillies, etc.), fruits (like watermelon, mangoes, etc.) and flowers. Lack of a preservation or storage mechanism meant they could not aggregate their produce or maximize their value by tiding over the market gluts, especially during low demand and high supply days/periods of the year.

INTERVENTION:

Centre for Integrated Livelihood Initiatives (CINI) who was already supporting the development programme for the Limkheda Women Farmer Federation through their local partners identified the problem and the need for a decentralized cooling solution to preserve the harvest.

In May 2021, CoolCrop commissioned a 6 MT dual-chambered cold storage system completely powered by solar PV. The unit is managed by entrepreneurs who are trained and monitored by CINI and CoolCrop on

IMPACT:

About 30-40 farmers of the federation have started using the storage system on a collective basis. They have stored potatoes, watermelons, green leafy vegetables and marigold flowers over the past 6 months of the system's commissioning. The average post-harvest wastage has reduced from more than 25% to less than 5%. In the case of flowers, during the festive season, the farmers were able to generate a profit of more than 200% with a few days of preservation in the storage facility.

ABOUT THE ORGANIZATION:

CoolCrop develops decentralized solar cold storages at the point of harvest or aggregation so as to provide access to primary processing, preservation and long-term storage to small farmers, farmer groups or farmer companies.

CoolCrop works with Farmer Producer Companies (FPCs), resource institutions, NGOs and multilateral and other development organizations to identify the post-harvest needs of farmers involved in horticulture.

CASE STUDY 7

GRAM OORJA



PROBLEM:

Harhi village is located in rural Jharkhand with approximately 50 households. While LPG connectivity was available in the state, the villagers primarily depended on firewood and traditional chulhas for their cooking requirements. The long distance that the villagers had to travel to procure the cylinder was inconvenient for the villagers as they had to spend additionally on the conveyance. However, the firewood resources are now dwindling in the local region due to the overconsumption.

INTERVENTION:

During the initial assessment, Gram Oorja's team found that the village has cattle present in good numbers. This meant that they could be used as an effective resource for cattle manure. This manure could be utilized to provide access to clean cooking energy for the village. To do so, the team at Gram Oorja developed a biogas cooking grid with a distribution line spanning approximately 2 kms. The flexible biogas plant has a capacity of 50-60 m³ and a feed capacity of 1.25 - 1.5 tons/day. The feed is collectively contributed by the village community. A pump has been installed



which runs the feed for the plant into the tank where it is mixed with water prior to entering the digester.

The gas thus produced is scrubbed in order to remove hydrogen sulphide, after which it is supplied to the households.

IMPACT:

In the last 14 to 18 months, the village has saved 335 cylinders of LPG by switching over to Biogas.

ABOUT THE ORGANIZATION:

Gram Oorja aims to act as a catalyst for commercializing on-the-ground viable renewable energy solutions for rural communities and enterprises. They have developed a community-based approach where projects are developed around the needs of the local community. The organisation develops projects with support from CSR funds, hands them over to the village community upon completion, and provides operations and maintenance services thereafter. The project has been supported by the Selco foundation and implemented by Gram Oorja's team.

CASE STUDY 8

TECHNO VILLAGE



team's concept of having a state-of-the-art boat clinic came to fruition and a significant milestone was achieved.

The boat clinic needed a reliable source of power to function, and thereby Techno Village was onboarded to solarize the entire boat. Techno Village installed the boat with a five-kilowatt capacity solar plant.

The boat would be a mobile facility which would be on the move to reach the targeted beneficiaries. This ensures uninterrupted power, essential to run equipment like oxygen concentrators, nebulizers, autoclaves and semi auto analyzers.

PROBLEM:

Healthcare is a basic requirement for communities but a very important one. For years, the villages scattered around the Brahmaputra and its islands have been deprived of access to proper and reliable healthcare facilities.

Around 1.17 lakh people reside along the Brahmaputra and strikingly about 70 per cent of this population comprises of Msihing tribes, an indigenous community that has been struggling every day for basics like healthcare and education.

People from these islands earlier had to travel more than 40 kilometers to access healthcare facilities which would often cost them a lot.

INTERVENTION:

Padamshree Dr. Sudarshan and his team at Karuna Trust have for long had this strong desire of reaching the unreached communities with reliable healthcare options. Thus, the

IMPACT:

The solar installation has ensured that the mobile boat unit became a reliable primary healthcare unit that is used to set up healthcare camps and distribute medicines free of cost. It also supports a Minor Operation Theatre that caters to emergencies. There is a dedicated labour room to attend to the pregnant women. This healthcare unit is expected to impact at least 6000-7000 households.

The inconvenience of travelling long distances often dissuaded the community from accessing healthcare. This is a big reason why some of these river islands have a high infant and maternal mortality rate in the state. With the solar powered boat coming to their doorstep, the inhabitants have found a huge relief.

ABOUT THE ORGANIZATION:

Techno Village Energy Pvt. Ltd. works with tribal and other backward communities in the ultra-poor pockets of the country.

RESHAM SUTRA

PROBLEM:

The Unnati solar powered Tasar yarn reeling machine from Resham Sutra has revolutionized the lives of women in the tribal villages of Saraikela Kharsawan in Jharkhand state. Prior to this, the only earning option for the tribal women was collecting tobacco leaves from the forest area and working occasionally on the farms (usually during ploughing and harvesting season).

India is the leading consumer of silk in the world, and the second largest producer as well. Two kinds of Tasar silk are produced in the country - Tropical Tasar and Oak Tasar, with Tropical Tasar being produced exclusively in India. This gives India a unique benefit, as there is a growing global demand for this material. However, it is still unable to meet the demand fully, since the production processes used traditionally are incapable of producing large quantities and high quality outputs.

This opens high potential to enhance the local livelihood options by using improved production equipment such as the solar

powered Tasar yarn and fabric equipment. This is highly beneficial, particularly for the forest based and remotely located producers. Analysis of previous trends show that every kilo of Tasar silk produced has resulted in, on an average, 6 person-days of employment. To leverage this enormous potential, Resham Sutra worked with the local government to set up the Unnati silk centres in Jharkhand.

INTERVENTION:

The geography of Tasar silk rearing coincides with the tropical forest areas in the states of

Jharkhand, Bihar, Chattisgarh, Odisha, Madhya Pradesh, West Bengal, Andhra Pradesh and Maharashtra. This overlaps with some of the lowest per capita income geographies and most naxal affected parts of the country, including Jharkhand. The Self Help Group (SHG) based rural production model has been tried in the state's rural areas and has worked very well.

After Resham Sutra introduced women to its solar silk reeling machines; Unnati, Buniyaad and Dyna Charkha, the women have not looked back. What started small has now culminated into a bigger movement of change for the tribal women. More than 900 women from 32 Self Help Groups (SHG) have already been trained by Resham Sutra across its 20 training centres.

IMPACT:

The results are life changing. There is a multi fold increase in the productivity level and subsequently the income of these women. Earlier they would barely manage to earn a few hundred rupees for the art but after being trained to operate the efficient silk reeling machines, their annual earnings now are touching INR 5000. These women now also have a role in the family's decision making conversations. The development has also fuelled their dream of providing better education to their children, who are now enrolled in schools. Resham Sutra is now working with these women to integrate them into the silk farming process as well.

ABOUT THE ORGANIZATION:

RESHAM SUTRA innovates renewable energy based Rural Livelihood enabling machines. It helps rural Silk yarn producers and fabric weavers to install higher productivity machines. This increases their income and reduces physical and mental stress.



3.3 Remote Monitoring Systems

In micro and mini-grids, energy management is regarded as a core part to improve the renewable energy consumption and energy efficiency. To this accord, remote monitoring

systems support both the service provider and the consumer to keep a track of the performance of the connected components and appliances.

3.3.1 Benefits of implementing remote monitoring systems

Remote monitoring systems help in technical optimization, timely maintenance, reduction in OPEX costs and better load management. Remote monitoring systems help service providers to alert their customers quickly of any imminent issues. Most of the issues in DRE systems can be solved remotely through over the air update. By using remote monitoring systems, longer breakdowns can be avoided. The repair and maintenance costs can be reduced through remote diagnostics and troubleshooting.

Remote monitoring systems provide feedback to service providers on the generation and consumption patterns. Based on the feedback received, service providers can design better solutions. By analysing the consumption and generation patterns, service providers can identify if a system is oversized. In case the

system is oversized, the consumers can opt to sell excess electricity stored in batteries. Tracking energy demands helps in fixing the size of installation needed for the customer and continuous monitoring helps in reducing O&M cycles.

Remote monitoring systems also come with PayGo meters. This allows end-users to pay for their energy systems piecemeal, greatly increasing product reach.

Remote monitoring systems can be very helpful for carbon offset reporting. By devising a mechanism to calculate carbon emissions, the emission reduction achieved in projects can be calculated. Carbon offset monitoring and reporting, provides an additional revenue stream to service providers and can reduce the burden of high capital costs on the consumers.

3.3.2 Challenges faced while implementing remote monitoring systems

- The remote monitoring systems require at least a 2G internet connection to send data to the cloud server.
- Lack of awareness regarding the energy monitoring systems in the DRE sector.

The survey shows that 26 % of the DRE organizations have cited that they require support from different stakeholders to deploy

remote monitoring systems (RMS). 26% of the respondents have responded that they haven't felt the need yet. About 22 % of the organizations cited that installation of RMS leads to increased payback period.

The survey also pointed towards the need for awareness creation about the benefits of implementing remote monitoring systems.

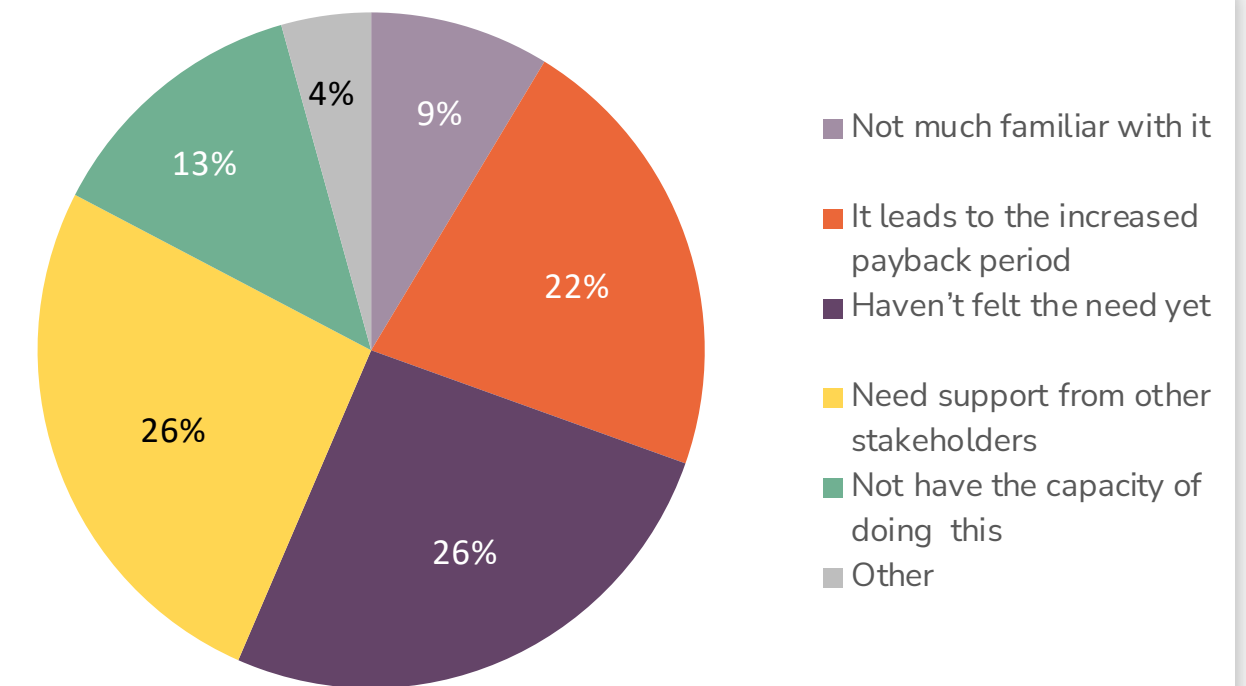


FIGURE 33: Reasons for not implementing energy monitoring systems in DRE mini grids and appliances. Sample size: 12

Inclusive Energy India manufactures smart biogas meters and remote monitoring systems for solar home systems. Biogas smart meters measure pressure and flow rate (cubic meters) regularly. By analyzing these two parameters, the biogas service provider can assess the health of the biodigesters, real time and remotely.

For example, in an ideal digester, as flow rate increases, the pressure inside the digester reduces. The smart meters can also identify if gas leaks are happening.

HYDROGREENS

PROBLEM:

In Bajju district of Bikaner, Rajasthan, it was very hard for farmers to get access to green fodder, let alone high protein green fodder. Scarcity of water and high temperatures make it extremely difficult to fulfil the dietary requirements for cattle and thereby make dairy livelihood a challenge. In most parts of the town, small and marginal farmers relied on cattle rearing and dairy farming as one of their principal sources of income. Due to the consistently rising temperatures, the fodder produced wasn't healthy and rich for the cattle and hence people in Bajju started incurring more input costs for their cattle feed. Green and nutritious fodder

seemed like a far-fetched dream. Adding to the town's troubles were the frequent power cuts and lack of a reliable source of power.

INTERVENTION:

It was in 2019, that people of Bajju were introduced to a unique system of growing fodder. Urmul trust, which is actively working in the area to improve people's lives connected the community with Hydrogreens, who work dedicatedly on building micro-climate-controlled systems that improve productivity and sustainability of the farmers.

This unique concept uses a low cost Fogponics technology that can be installed in a 12sq ft area of a house. The technology uses water in a vapour form to minimise the water requirement to produce the green fodder.



IMPACT:

Hydrogreens installed seven vertical farming systems in the village. Initially mistakes were made in the method of sprouting but that were easily addressed by additional tutoring and picture guides provided by Hydrogreens.

They also sent out three members from its team who further trained more members on the other uses of the system, including how they could link their products to the market and generate new revenue sources for themselves.

"Because of Hydroponics, we are able to provide green forage to our livestock throughout the seasons, even in summers. We no longer have to worry about water scarcity for production of green fodder. Now our cows are getting stronger and producing more milk, of improved quality". Says Pramila, a beneficiary.

Later on, Pramila went on experimenting with growing wheat grass and further selling it to local juice shops and earning which fetched her Rs 100 per tray, per day. (There are 28 trays in each system).

She also tried drying the wheatgrass, converting it into wheatgrass powder and selling it to the local vendors. Today Hydrogreens has impacted more than 300 lives in the town.

ABOUT THE ORGANIZATION:

Hydrogreens' mission is to provide high protein hydroponic fodder options that are natural, palatable, digestible & good for livestock.

It designs micro-climate controlled systems that improve dairy farmers productivity, sustainably.

INFICOLD

PROBLEM:

The Mahabaleshwar temple in Gokarna, Karnataka has undertaken the responsibility of 'Amrutanna Prasad Bhojan'. This initiative serves free lunches and dinners to more than 2000 devotees on a daily basis.

The temple lacked a cold storage unit for preserving vegetables, Milk and Coconuts. Lack of cold storage meant that food was getting wasted in enormous quantities.

A solution was urgently needed to prevent the heavy losses faced by the temple.

INTERVENTION:

Inficold India Pvt Ltd. commissioned an off-grid Solar Cold Storage 6MT storage capacity for storage of fruits and vegetables that enables the temple to prepare and preserve food for devotees visiting the temple.

This system supports both pre-cooling and storage of perishables to preserve their freshness and increase shelf life.

IMPACT:

After the installation, the wastage of vegetables and coconuts has gone down significantly. Before the installation, 800kgs of vegetables and 500 pieces of coconuts perished due to the hot and humid climate.

The reduction in food wastage has reduced the GreenHouse Gas (GHG) emissions by 700



MTCO 2 per year. Now that diesel generators have been replaced with Inficold's solar cold storage, the temple no longer incurs high diesel expenses. It also ensures that emission of GHG is minimized in the environment.

Additionally, the temple management is now buying vegetables and fruits in bulk which in turn saves the investment on commodities when purchased in smaller volumes and separately. The temple is also able to save on its transportation costs as well. GHG emissions of 19 MT CO₂ have been saved by eliminating Diesel generator usage.

ABOUT THE ORGANIZATION:

Inficold Off-grid Solar Cold Storage enables farm level cooling for perishable commodities. The solar energy is stored in the Thermal Storage System for cooling during non-solar hours. TSS stores cooling energy in the form of ice, which is one of the most reliable, cost effective and non-hazardous forms of energy storage.

Cooling is transferred from TSS to cold storage through refrigerant (known as DX cooling). Refrigerant cooling loops are more energy efficient and have high cooling rates than traditional water/glycol-based systems. The system can be powered by a grid during extended cloudy conditions.

KHETHWORKS

PROBLEM:

Only 48% of the total net sown area in India has access to irrigation resources. Yet 54% of the population earns its livelihood through agriculture and 86% of farmers are small and marginal farmers. Over-dependence on inconsistent monsoon rains and a lack of irrigation facilities affect the productivity and income of smallholder farmers the most, particularly in eastern India, where productive electricity is less prevalent. There are over 38 million farmers who tend an acre or less of land in east India, where recharging water sources are available, but lifting the water is expensive. Diesel prices are increasing and kerosene availability is decreasing. With irrigation energy costs estimated to be 20-40% of production costs, smallholder farmers are

choosing to abandon farming outside of the monsoon and migrate for labor.

INTERVENTION:

Khethworks developed solar pumps specifically for and with marginal farmers, primarily in eastern India. It is a solar pump that is small enough to carry with a flow rate big enough to satisfy marginal farmer's preferences at a bankable price point that does not depend on subsidy. With over 60% in peak wire-to-water efficiency as tested by the Central Power Research Institute, the performance leads the market. As per the Ministry of New and Renewable Energy specifications for micro-pumping, the Khethworks pump provides over twice as much flow as similarly-sized pumps at a price at least 40% below the suggested benchmark cost. Women and men farmers carry the Khethworks solar pump system from their homes to their fields, choosing where

and when they want to irrigate, and connect the plug-and-play system. With the push of a button, they can cultivate year-round to increase productivity and incomes. Khethworks is working to create an end-user finance retail market for small solar pumps to scale through distributors and dealers.

Khethworks partners with organizations working on the livelihoods to reach smallholder farmers, primarily in the tribal belts of Jharkhand and Odisha. Khethworks has systems deployed in Assam, Madhya Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, Rajasthan, Chhattisgarh, and West Bengal.

IMPACT:

Khethworks has sold hundreds of their solar pump products across 10 Indian states and also exported them to three countries over the last two years. If farmers cannot pay the

full cash amount up front, Khetworks allows them to make down payments for INR 20,000 and pay the remainder of the pump system cost over the next two cropping seasons. Khethworks is also working with farmers in under-electrified geographies, who aspire to be year-round commercial farmers with a focus on vegetable cultivation.

Working with partners like Collectives for Integrated Livelihood Initiatives (CINI), a Tata Trusts initiative, Khethworks identified clusters of aspiring commercial farmers in Odisha.

In one of these clusters, three women farmers decided to purchase the Khethworks pump jointly in March 2021 with grant support from CINI. Last year, only Kanchan cultivated chilli during the summer season, earning INR 8,000 using a watering can for manual irrigation. This summer, with the Khethworks pump system, all three of them practiced cultivation. Kanchan was able to earn INR 38,000, Subhadra earned INR 15,000, and Sarita earned INR 6,000.

This represents a 7X increase in their cumulative income in a single season, during which the pump system paid for itself.

With the Khethworks solar pump, there is an estimated annual reduction of 425 kg CO₂ per farmer (assuming replacement of a 1.5 Hp Kerosene pump used 240 hrs per year with 0.7 L/hr fuel consumption).

ABOUT THE ORGANIZATION:

Khethworks Private Limited is a social enterprise with a mission to enable year-round irrigation, cultivation, and income generation for smallholder farmers. Conceptualized at the Massachusetts Institute of Technology (USA), the patented Khethworks system features a hyper-efficient, portable, open-well submersible pump.



CASE STUDY 13

LITS N LIGHTS

PROBLEM:

The unprecedented COVID-19 pandemic came as a harsh shock to the entire country. The healthcare system witnessed a massive struggle. While hospitals, especially the ones in remote areas, struggled due to the dearth of beds and oxygen, the difficulties were doubled because of severe power cuts and unavailability of energy storage.

The districts of East Khasi Hills and East Jaintia Hills in Meghalaya witnessed the same adversity. Making primary health care centers and hospitals in these districts fully operational seemed like an impossible task.

INTERVENTION:

It was during the onset of Covid-19's second wave that Lits N Lights, a Guwahati based enterprise focusing on distribution of DRE products, was approached by SELCO to solarize eight health care centers in the districts of East Khasi Hills and East Jaintia Hills.

Each of these sub-centers within the district catered to an entire village, with a population of around 300 people. With no source of power, nor any backup, these centers prior to Covid-19 pandemic were usually non-functional beyond 2pm IST. However, the

need for power in these centers surged during Covid-19, when vaccination storage at a prescribed temperature became a necessity.

IMPACT:

Each centre was set up in a week's time from the day of commencing work. This included setting up a solar system of 1kW and training the staff on battery and panel maintenance. The solar system installed includes a solar module, solar inverter, solar battery and a baby warmer. Till date Lits N Lights have installed twelve such solar systems across different centres. These centres now remain open till late evening and the vaccines are safely stored for a longer period, which has come as a huge respite to the 1600+ people connected with these eight centres in East Khasi and East Jaintia hills.

ABOUT THE ORGANIZATION:

Lits N Lights, based out of Guwahati, has more than 10 years of experience in solar market.

It works with some of the leading brands and provides complete solar solutions under one roof. The enterprise also undertakes the supply and installation of off-grid/ on-grid solar power plants.

CASE STUDY 14

NAVITAS SOLAR



PROBLEM:

Water across many parts of India is often contaminated with fluorine, iodine, arsenic and other impurities. This contaminated water is neither fit for consumption nor can be used for other purposes. According to a report by NITI Ayog, experts believe that 40% of people in India may not have a connection to a clean water source by 2030. Owing to climate change, continuous depletion in groundwater levels is also one of the emerging problems in today's time. Non-availability of bore-well or corporation's water makes it difficult for women to complete the chores and disrupts their daily lives.

INTERVENTION:

To address the growing concern around non-availability of safe drinking water, Navitas Green Solutions developed the Solar Powered Community Water Purification System. In the system, water is lifted from open sources such as an open well, river, pond, canal etc., and is

then stored in an over-head tank. The system is powered by Solar Panels consisting of 2 or 3 solar modules (approximately 335 Wp) and can easily lift water from a depth of 30 metres. The water is purified using RO and UV technology which removes arsenic and other impurities from the water. At places where it is installed, 30 % of the water is used for drinking purposes and 70% water is utilised for sanitation purposes. The Drinking water outlet operates by a touch sensor, which ensures less wastage. Two streetlights, along with the system are provided for the easy accessibility of the system under low light or darkness. This system is sustainable in nature as it is automated and powered by solar energy.

IMPACT:

In the remote areas where safe drinking water is difficult to access, the community water purification system has brought huge respite for people. The module is currently deployed in North East, Sundarbans, border areas, and disaster prone zones. This system is also very useful to fulfill the drinking water requirements in army camps, as it reduces the burden of supplying tankers of fresh water, resulting in lesser transportation cost and reduced emissions. This system has also been successful in fulfilling requirements of water for drinking and other usage in schools and small villages.

ABOUT THE ORGANIZATION:

Navitas Solar strives to provide one of the best solutions for sustainable solar electric power with one of the most advanced production lines in India. Navitas Solar specialises in manufacturing of high efficiency mono & poly crystalline solar modules. With a total installed capacity of 200MW p.a. solar module production, expanding to 500MW in the same facility, Navitas Solar stands among the largest solar module manufacturers in India.

3.4 Local Manufacturing of DRE Components

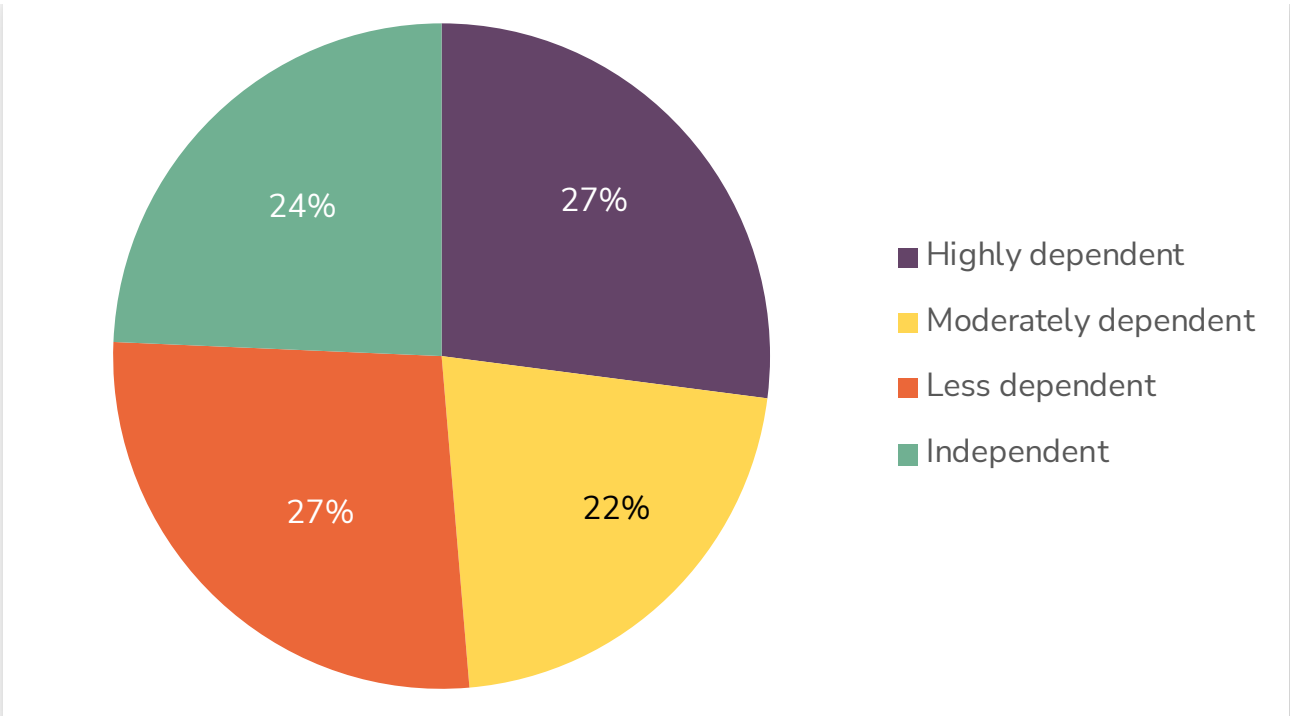


FIGURE 34: How dependent are DRE organization’s business on imports? Sample size: 12

Nearly 27% of the DRE organizations are highly dependent on component or appliance import. These include Solar home systems and lighting manufacturers and Solar PV

module manufacturers. Solar PV module manufacturers are dependent on Silicon wafer imports from China.

3.4.1 Issues Related to Procuring Locally Manufactured Components

As the import duties go up, DRE manufacturers have been forced to explore procurement of locally manufactured products, however there are several issues which need to be resolved before the DRE sector can start procuring components locally. The domestic suppliers don’t give preference to low quantity orders. The cost of procuring a low quantity of local components is high. The costing of the appliances is inconsistent when procuring a low quantity of appliances. The quality of Solar PV panel packaging has reduced over time to reduce the overall cost of Solar PV panels. Few Solar PV panels get damaged while shipping. The service providers lose time waiting for the replacement. DRE service providers are also required to insure the transported components - further adding to the overall product costs.

Few minigrid players opined that locally manufactured smart meters are expensive compared to the imported smart meters. Mini grid players have challenges in identifying suppliers who can complete the control room setup and integrate inverters with the rest of the systems. Soft starters which reduce the starting current are also expensive. Distribution system in mini grids is capital intensive accounting to significant part of the overall cost of the mini grid system. There is a crunch in semiconductor related components in India. Sourcing ICs (Integrated Circuits) from local suppliers has been a challenge. Due to economies of scale, the locally available DRE components are quite expensive. Moreover, due to COVID, the component costs have further increased.

While the BLDC motors which are made for e-rickshaws are readily available, identifying suppliers for BLDC motors with specific power requirements is difficult. A support system with

favourable government policies, support from premier educational institutes to address this issue is needed.

TABLE 6

COMPONENT	CHALLENGE
Integrated Circuit	Crunch for semiconductor related components. Sourcing ICs has been difficult.
BLDC motors	Sourcing BLDC motors of specific power requirements is difficult
Solar PV panels	Packaging quality has deteriorated
Biogas burners	Design aspect of biogas burners needs to be improved

The few of the key components that needs more push on the local manufacturing front based on responses from CLEAN members are: lithium ion and gel batteries, PayGo controllers, Operational Amplifiers, real time clocks, biogas burners, BLDC motors for various applications etc.

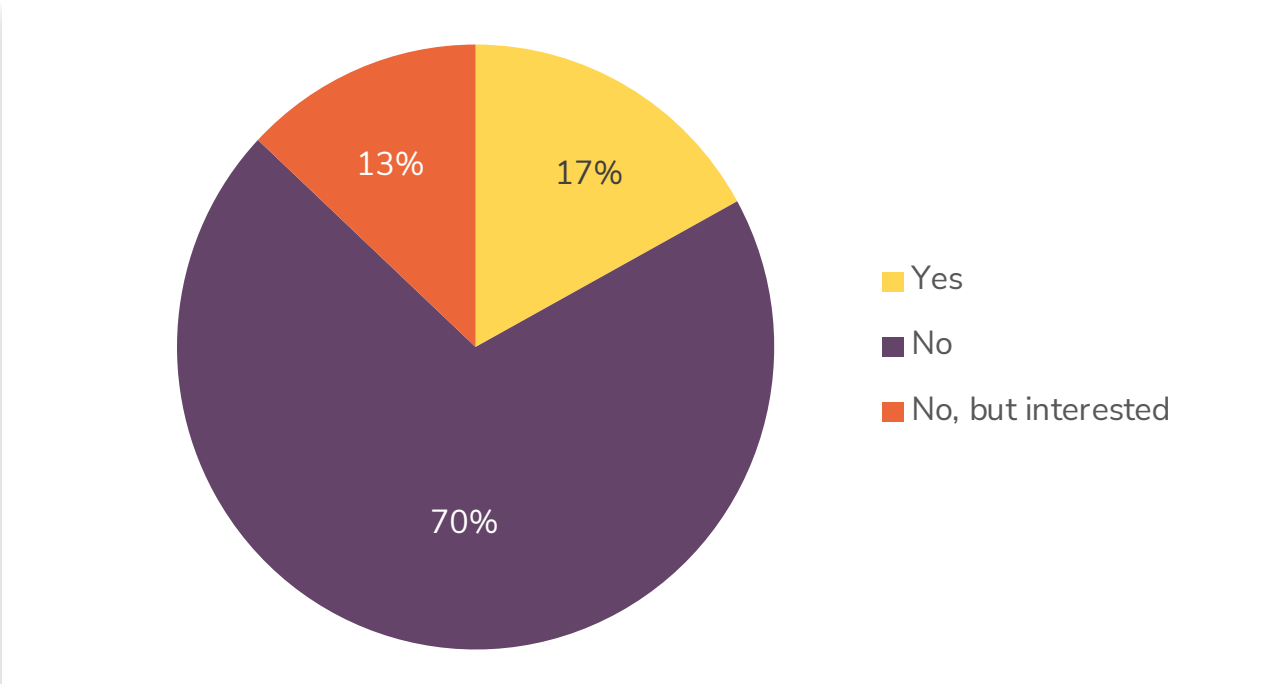


FIGURE 35: Are DRE enterprises exporting their products?: Sample size: 22

Few DRE companies have been successful in tapping international markets and business potential for their DRE technologies.

30% of the respondents who have a product which can be exported showed interests in

exploring market outside India but have been unable to navigate the need, market, channels, and implementing partners necessary to help them build a presence in other countries, contributing to accelerating development in energy access.

NBIRT

PROBLEM:

The village of Korbongpara is a remote tribal village in Tripura. It was for a long time facing the problem of non-availability of safe drinking water due to the erratic nature and cost of electricity in the region.

The village was in need of a sustainable solution. ONGC supported NBIRT to provide safe drinking water to the village of 'Korbongpara' through the Solar route.

INTERVENTION:

For this, NBIRT wanted to develop an operable submersible pumping system through solar PV power, develop an Iron removal filtration

system to address high iron content present in groundwater, develop an ultra filtration based solar water Purification system to provide safe drinking water and at last, install, demonstrate and commission the system at 'Korbongpara' Village.

NBIRT had previously developed a community model of the water purification system and had provided it to more than 30 schools and Institutions at Tripura, Assam and West Bengal.

In the project implementation phase, NBIRT:

- Installed 2kWp Solar PV power plant for groundwater pumping:
- Installed 2HP Solar Submersible pump:
- Installed 1.2kWp Solar PV power plant and Booster pumping system:
- Installed central water purification and storage unit:
- Installed water distribution system:
- Installed second water purification system:
- Provided Micro Solar Domes (MSD) of 'Korbongpara' Village.



IMPACT:

The Demand of Drinking water in the village is about 519 litres per day. The installed system has been tested to purify about 1500 litres of water per day at optimal performance. Thus, not only the water demand of the village can be met by the intervention but a reserve for 2 days is also ensured.

There is a more than 50% decrease in health related problems arising due to consumption of impure water. Villagers have been trained on the operation and maintenance of the device. The system is now run by a SHG (Self-Help Group) in the village to ensure sustainability of the intervention.

As compared to burning firewood to boil water and using a grid for water purification, the Solar Water Purification system has led to reduction of 109 Tonnes of CO₂ annually. The Solar Pumping system has led to the reduction of 32.85 Tonnes of CO₂ annually.

ABOUT THE ORGANIZATION:

NBIRT is a core support group of SEED Division, Department of Science and Technology, Govt. of India. NBIRT is known for interventions like the Micro Solar Dome, India's first floating solar power plant, Solar Water Purifier, Solar Sanitation systems, 'Solar Jacket', 'Janata ATM' and many other interventions, some of which are now under national programs in India.

NBIRT with headquarters at Tripura is active majorly in the Eastern and North Eastern parts of India. NBIRT has a research Centre at Kolkata and a Training Centre at Assam.

In addition to research programs, NBIRT also conducts frequent Training and capacity building programs related to Solar technologies. NBIRT is also associated with InSIC in promotion of Solar Energy in Middle-low-income countries.

REVV ENVIRONMENTAL SOLUTIONS

PROBLEM:

Water, Food and Energy scarcity have increasingly emerged as vital issues for India. India's quest for energy security and sustainable development to a great extent rests on the ability to tap energy from renewable sources. With the growing population and increasing power prices, managing waste and wastewater utilities are becoming a challenge in India.

According to an Economic Times article 70% of our sewage and 40% of industrial effluent remains untreated and discharged into fresh water bodies worsening the water scarcity challenge. Further, over 377 million urban

people live in 7,935 towns and cities and generate 62 million tonnes of municipal solid waste per annum. Only 43 million tonnes (MT) of the waste are collected, 11.9 MT is treated and 31 MT is dumped in landfill sites, as quoted by Down to Earth magazine. Landfilling is the main method of waste disposal (70% of food waste) in India and has caused significant greenhouse gas emissions.

This waste combined, as a resource, has the potential to generate enough energy to supplement our country's energy needs and solve the water scarcity issue to a large extent.

INTERVENTION:

REVV Environmental Solutions has developed a robust microbial consortium and its nutritional combinations, a patented innovation, which enables improved operation and high performance of wastewater treatment plants.

This solution addresses the twin edged problem of managing waste water and organic fraction of solid waste, altogether, in a single set up as against treating them separately in existing classical arrangement.

With its effective mechanism, REVV's microbial consortium improves the efficiency of a biogas plant.

The consortium has been well tested on various types of Biogas plants such as Conventional, CSTR, Plug Flow as well as various feed types of feeds; Organic Waste with High Lignocellulose Content, Food (Potato) Processing Industry waste, Vegetable waste, Kitchen waste, Poultry Litter, Horse Dung, Maize plant waste, Napier Grass, Segregated OFMSW etc. in small (rural), Medium (semi urban) and Mega Sets up (large metropolitan cities). Additionally, this product can be applied in management of wet waste as well.

IMPACT:

The microbial consortium provides 25% cost reduction in wastewater treatment, about twice more biogas recovery and six times less CO₂ emissions, along with availability of reusable water and employment generation.

With conventional Biogas using cow dung, the biogas generation is usually in range of 50-70m³ per tonne of vegetable waste while

with usage of REVV consortia, yields have been reported in the range of 120-150m³ per tonne.

The solution from REVV can help make smart cities better in waste management capabilities by creating and promoting a circular economy concept. The output after the treatment would also ensure treated water, fit for secondary use, apart from other social, financial and environmental benefits. Till date, the solution from REVV has been implemented in 350 wastewater treatment facilities (of 500 Kiloliters per day), which would make about 3000 million metric of CO₂ mitigation possible in just 5 years.

This also contributes effectively to India's efforts to achieve the Sustainable Development goals under Good Health and Well Being (SDG 3), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7) and Sustainable Cities and Communities (SDG 11).

ABOUT THE ORGANIZATION:

REVV Environmental Solutions has answers to everything that takes place in every step of waste management and has proven competency in transforming waste into reusable resources. Waste treatment and bio-methane production through Anaerobic Digestion (AD) process is their core area of expertise.



CASE STUDY 17

SIMI STOVES



PROBLEM:

Every day, three billion people cooking with solid fuels produce dramatic levels of Household Air Pollution (HAP). This not only contributes to 4 million deaths a year, but also releases tonnes of pollutants into the atmosphere, such as black carbon, methane, carbon monoxide and carbon dioxide. The Clean Cooking Energy Roadmap which has been developed in collaboration with NITI Aayog and GIZ envisions to eliminate the use of all cooking arrangements that cause HAP in India by 2025. But the numbers in India itself are alarming. According to a World Health Organization report, 789,600,000 people in India are still dependent on wood, charcoal and kerosene for cooking, and every year 481,700 people die because of the emissions released.

INTERVENTION:

During the research for a table top cooking product, the team at Simi Stove came across the shocking number of deaths caused by HAP and decided to address the situation with a solution. The idea was to build an economically viable stove to keep the cost down, hence they focused on designing a

stove that will use clean burning fuels more efficiently than developing a more efficient improved combustion stove. The outcome was development of Simi Stove, which was specifically designed to use ethanol. Simmi Stove gives a high thermal efficiency rating of 67% (BUET). The stove at the moment is one of the least expensive stoves in the market that uses ethanol gel, one of the safest and perhaps the most effective clean cooking fuel available. It can boil 1.5 litres of water in 17 minutes using only 25g of Ethanol Gel.

IMPACT:

The adoption of Simi Stove has helped the underserved communities access cleaner air, who previously, due to pricing issues were unable to afford improved cookstoves. Simi Stove is an extremely viable solution. The ethanol fuel per month, for a family of five would be approx. INR 300, this is 800 cheaper than the LPG cylinder. The amount of air pollution and HAP eliminated has the potential to save thousands of lives. Additionally, the stove is not susceptible to blackouts or brownouts. The stove can also be used as a secondary cooking source by families who rely primarily on electricity. The stove will save women from the drudgery of collecting firewood and enable them to spend time on other productive tasks. The stove doesn't require any maintenance for the initial two years but beyond that only the burner needs to be replaced, which would roughly cost only around INR 100.

ABOUT THE ORGANIZATION:

Simi Stove manufactures improvised stoves which run on Bio-ethanol gel and which produces almost negligible CO and any harmful component compared to traditional improved cookstoves.

CASE STUDY 18

KATIDHAN



PROBLEM:

Wild animals attacking agricultural lands and livestock/cattle stock destroying crops, vegetation and fruits is a common occurrence in the agricultural regions, thereby resulting in economic losses for land owners/stakeholders, leading to an increasing human wildlife conflict issue. The present methods of tackling this issue are not automated and not consistent to be effective in the longer run. It depends on the presence of humans on the ground to drive away wild animals who intrude into the agricultural land areas.

INTERVENTION:

Katidhan has built Parabraksh, a solar powered autonomous light which is designed with a focus that enables it to work well against farm intruding animals. With an efficiency of

between 92-98%, it becomes an effective tool to keep animals such as elephants, tigers, leopards and wild boars off the farmland. The product is ideally placed at the boundary of the agricultural land at a pole of the customer's choice, keeping in mind the height of the animal that needs to be kept away from the crops and land. The product gets charged during the day and can easily go on for 15-20 days without sunlight. It is designed in such a way that at night it forms different patterns. The wild animal intercepts the light from the product as a larger predator from the forest and hence leaves the area undisturbed. For low sunlight-receiving areas, the product comes with a micro-USB option with which the product can easily be charged with a normal phone charger.

IMPACT:

Farmers who used the product witnessed a 140% increase in their income. It reduced the wildlife movement around the farm area and ensured that the farmers had surplus crops. On an average, the farmer sees return on these products within two months of its usage. As of today, Katidhan has directly/indirectly resolved issues of more than 750 farmers across the country and established partnerships with various developmental organizations and state forest departments to mitigate human-animal conflicts.

ABOUT THE ORGANIZATION:

Katidhan has a vision to build high impact technological products that disrupt sectors while creating new ones ensuring that they bring about positive climate change solutions. Currently, their area of focus involves research and building relevant tech solutions that could reduce economic losses faced in the agriculture sector due to wildlife attacks and also to reduce the human wildlife conflict potentially.

4. Policy Landscape of the DRE Sector

This section of the report captures key updates on Government programs and schemes which have been announced in the last one year. An analysis of benchmark costs from FY 2017-18 to FY 2021-22 has been presented to highlight trends. The perception and participation of CLEAN member organizations towards government schemes/programs has been covered.

4.1. Updates on Government Programs and Schemes

4.1.1. PM KUSUM:

PM-KUSUM scheme is one of largest initiatives of the world to provide clean energy to more than 35 lakh farmers by solarizing their agriculture pump.

- **Component A:** The revised target under component A 10,000 MW of Decentralized Ground Mounted Grid - Connected Renewable Power Plants of individual plant size up to 2 MW. The scope has now been expanded to cover pasturelands and marshy lands. Projects under 500 kW can also be deployed now subject to approval from the respective state.

Projects with commissioning dates between 1st April to 15th June 2021, are eligible for claiming an extension of 75 days (beyond the 12-month completion timeline). There will be no penalties to the renewable power generator for power production below rated capacity utilization factor.

- **Component B:** MNRE will retain 33% of eligible service charges for information, communication, and education (IEC) activities.

50% of the service charge will be released to respective state agencies by MNRE after the placement of LOA for activities.

Groups of users (water user associations, farmer producer organizations, primary agriculture credit societies, or cluster-based irrigation system) may now procure pumps with capacity higher than 7.5 HP with central financial assistance (CFA) considering up to 5 HP per member as the maximum allowable benchmark.

Joint ventures of manufacturers of solar pumps/modules/pump controllers with system integrators will be eligible to install and bid.

USPC pumps are eligible for subsidy under the scheme. Standalone solar pumps are used only for 100-150 days in a year and solar energy generated during the balance period is not utilized.

In order to make effective use of solar energy it was proposed to introduce USPC, which will not only run the water pump but can also run other electric equipment such as cold storage, battery charging, flour mill, etc.

Simplification of PM-KUSUM

- States can invite their own bidder for empanelment of the vendors for different regions in the State for the installation of standalone solar pumps under Component-B. The ceiling price for the bids in the state tender would be the price discovered in the latest centralized tender.
- The implementation period has been extended up to 24 months from the date of sanction under Components A, B, and C. Extension beyond 24 months shall be considered as per provisions of scheme guidelines.
- For feeder level solarization, incentivizing the farmers who consume less electricity than the benchmark consumption by paying them per unit consumption less than the benchmark. Utilization of this incentive will be optional for the farmers. DISCOMs will inform farmers about the benchmark consumption and amount of incentives per unit which they can avail in case of lower consumption.

4.1.2. Draft Policy Framework for Developing and Promoting DRE Livelihood Applications

The Ministry of New and Renewable Energy (MNRE) has issued a revised draft of the Draft Policy Framework for Developing and Promoting Decentralized Renewable Energy (DRE) Livelihood Application in March 2021. The previous version was released in October 2020.

In the new draft, the ministry has proposed convergence of the policy with schemes of different Ministries/Departments which are being implemented by various central/state agencies. The State Nodal Agencies (SNAs) coordinate with these implementing agencies to provide technical support for DRE livelihood applications. SNAs may form a State Implementation Cell for DRE based livelihood applications bringing the State Departments engaged in the implementation of such applications on the common platform.

4.1.3. Atmanirbhar Bharat Rozgar Yojana

The central government announced Atmanirbhar Bharat Rozgar Yojana on 12.11.2020 containing several measures to revive the economy and provide relief to any stressed sector. The scheme proposes to incentives employees, registered with EPFO for giving employment to new employees and re- employing persons from low wage brackets who lost their jobs during covid pandemic. New employees under the Employees' Provident Fund Organization (EPFO)-registered organizations will enjoy benefits, including subsidy support by way of EPF contributions. The scheme is expected to cover 65% of employees and 95% of establishments in the formal sector. Additionally, Rs10,000 crore under the Prime Minister Garib Kalyan Yojana is expected to boost rural employment in the informal sector and encourage the growth of the rural economy.

4.2. Benchmark Cost

The Ministry of New and Renewable Energy releases benchmark costs for off-grid and decentralized solar PV systems every financial year. The present section outlines the trends in the costs set for specific DRE products from FY 2017-18 to FY 2021-22 and analyzes the challenges which have been identified over the years.

4.2.1. Solar study lamps

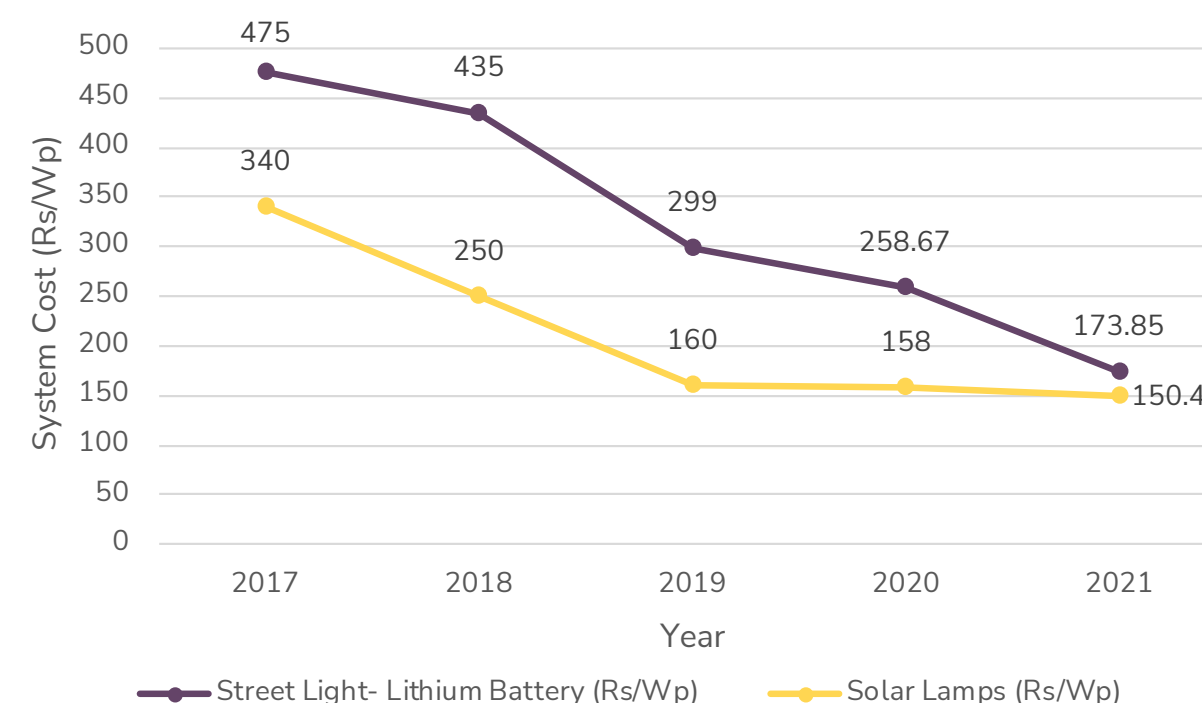


FIGURE 36: Solar street lights and lamps (General States)

- Solar street lights and solar lamps showcase a decreasing trend from FY 2017-18 - FY 2021-22 in the general states category.
- The cost of solar street lights per watt has decreased by 46% from 2017 to 2021. Whereas the cost of solar lamps per watt have decreased by 56% during the same time period in 2017,

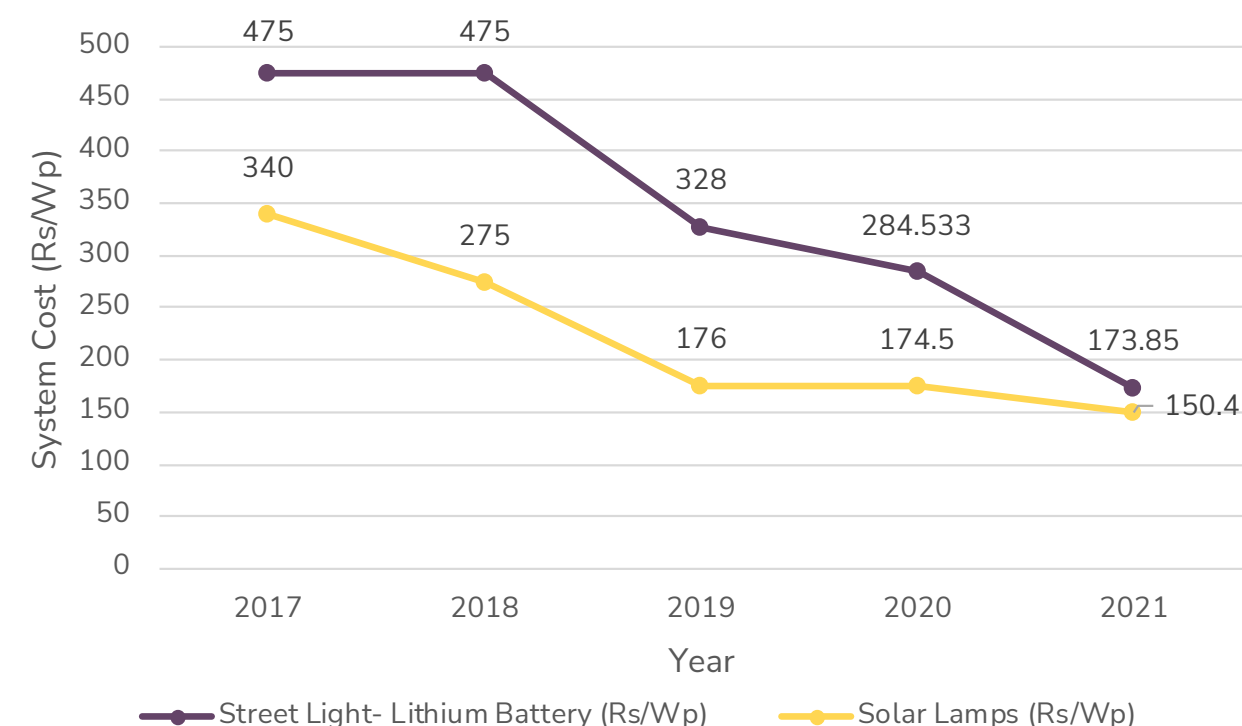


FIGURE 37: Solar street lights and lamps (North Eastern States/Islands/Hill States)

- Solar street lights and solar lamps showcase a decreasing trend from FY 2017-18 - FY 2021-22 in the NE states, islands and hill states category as well.
- The cost of solar street lights has decreased by 63% and 56% for solar lamps during the time period analyzed.

4.2.3 Standalone Solar Power Plants/Packs

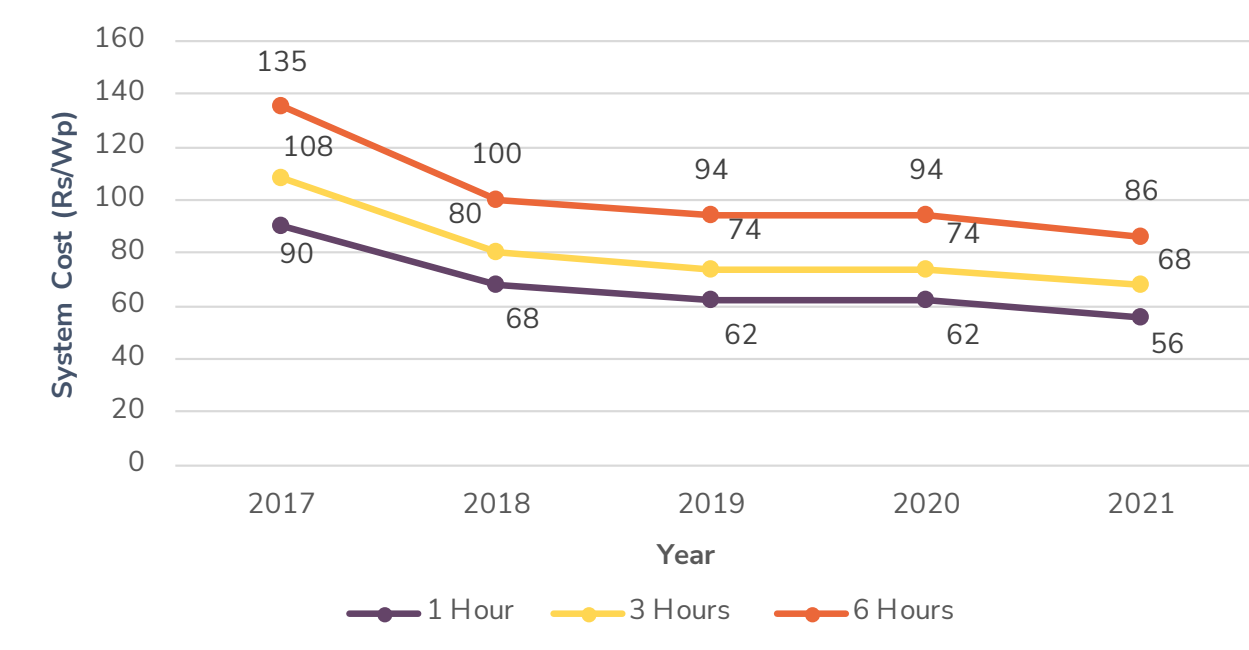


FIGURE 38: Standalone Solar Power (Upto 10 kW) (General State)

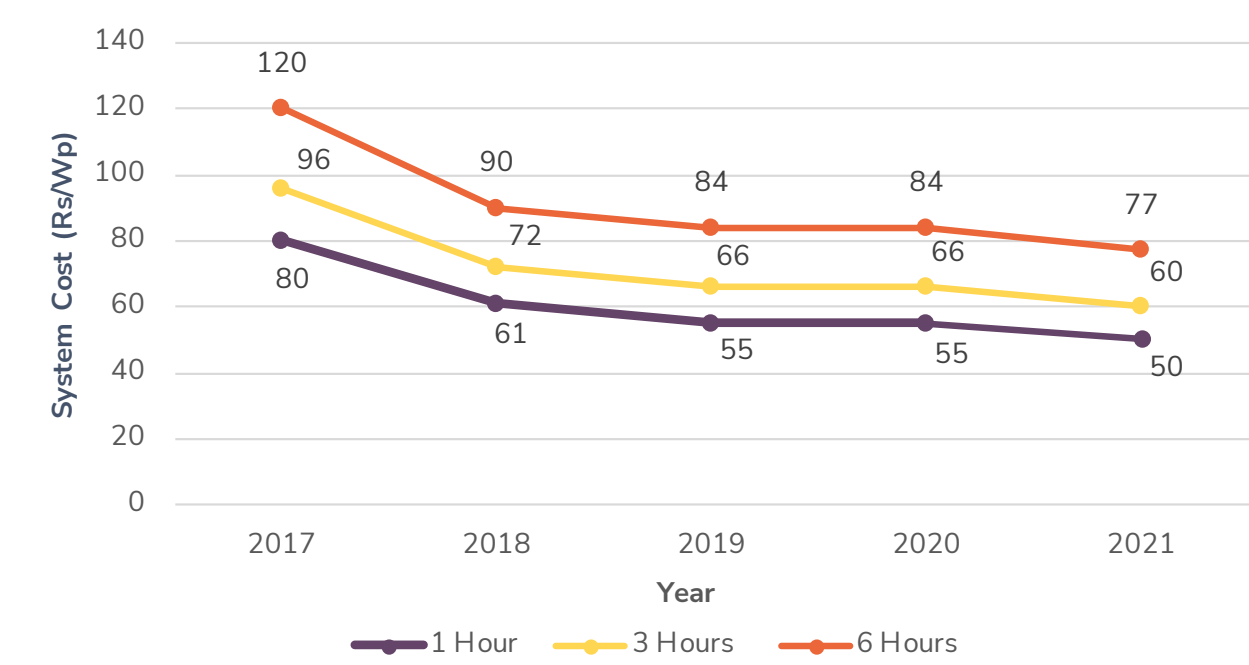


FIGURE 39: Standalone Solar Power (>10 kW-25 kW) (General State)

- Benchmark costs for standalone solar power plants/packs have seen a steady decline between FY 2017-18 to FY 2021-22 for the general states category.
- For capacities of up to 10 kW and 10 kW - 25 kW, an average decline of 37% across different backup hours was observed.

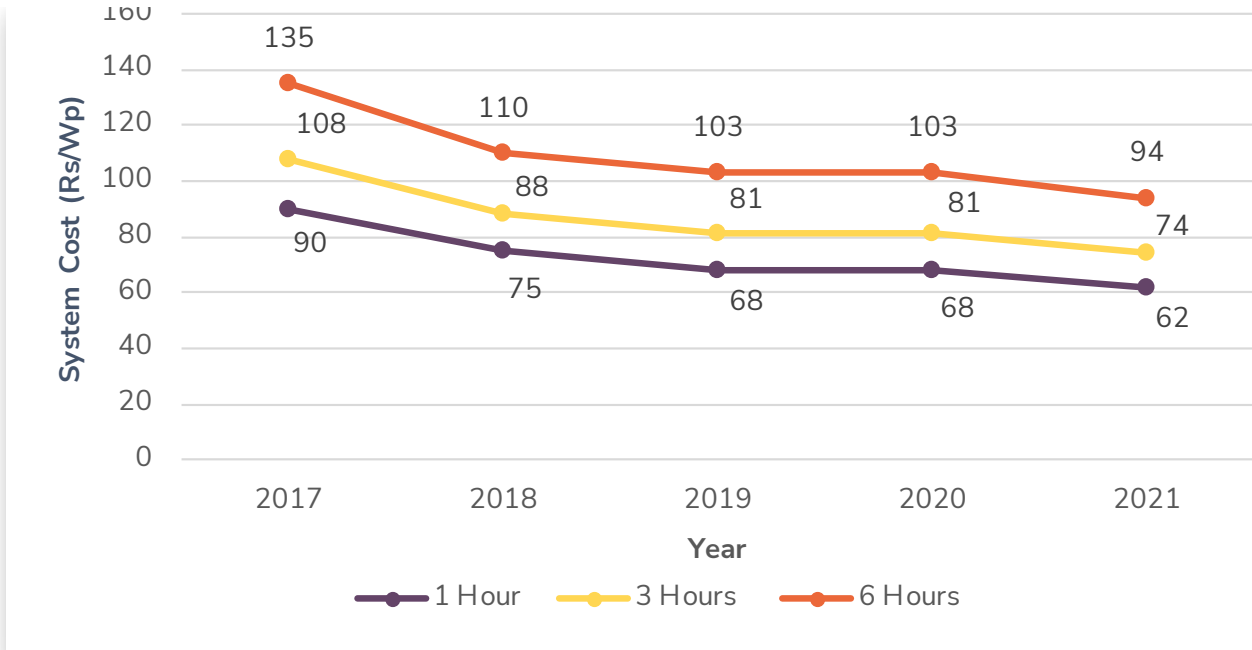


FIGURE 40: Standalone Solar Power (Upto 10 kW) (North Eastern States/Islands/Hill States)

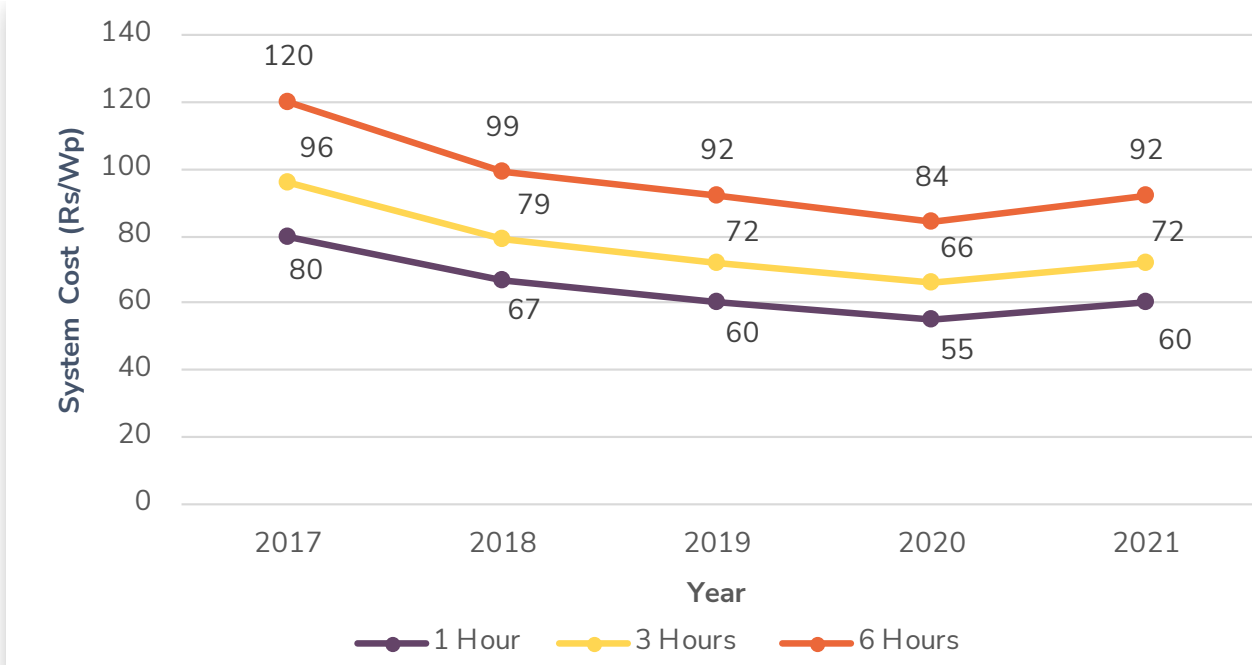


FIGURE 41: Standalone Solar Power (>10 kW-25 kW) (North Eastern States/Islands/Hill States)

- In north eastern states, islands, and hill states category, an average decline of 31% was noticed for standalone solar power plants/packs with capacity up to 10 kW.
- For capacity between 10 kW - 25 kW, an average decline of 31% was noticed between FY 2017-16 to FY 2020-21. From FY 2020-21 to FY 2021-22, an average increase of 9% was observed.

4.2.4 Solar Water Pumps

- There has been no uniformity in the pump capacity and size of solar water pumps (SWPs) between FY 2017-18 and FY 2021-22. This makes it difficult to identify trends in benchmark costs for the same.
- In the benchmark costs for FY 2021-22, costs have been set for SWPs with and without the universal solar pump controller. The costs include remote monitoring and are exclusive of GST charges.

Recommendations:

- It is suggested that the additional costs like O&M, transportation, erection & commissioning be considered while setting the benchmark costs.
- The cost of raw materials is predicted to increase due to the rise in GST rates which is likely to impact manufacturing and balancing of the system. It is suggested that the increase in GST rates be considered while determining future benchmark costs.
- It is recommended that the costing for a street light should be upwards of INR 2000/watt and INR 800/watt for solar lanterns/study lamps for the general State category.
- We recommend the Ministry of New and Renewable Energy to call for technical bids before financial bids in government projects to ensure good quality of products are being used in projects. This may also prevent manufacturers from quoting lower prices by compromising the quality standards.

4.3. CLEAN Members Participation in Government Programs

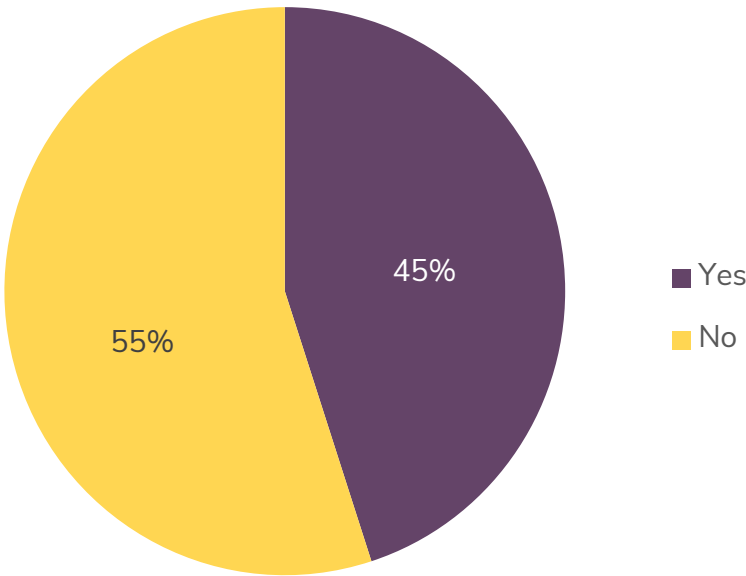


FIGURE 42: Participation of CLEAN Members in Government Programs in 2020-21. Sample Size: 77

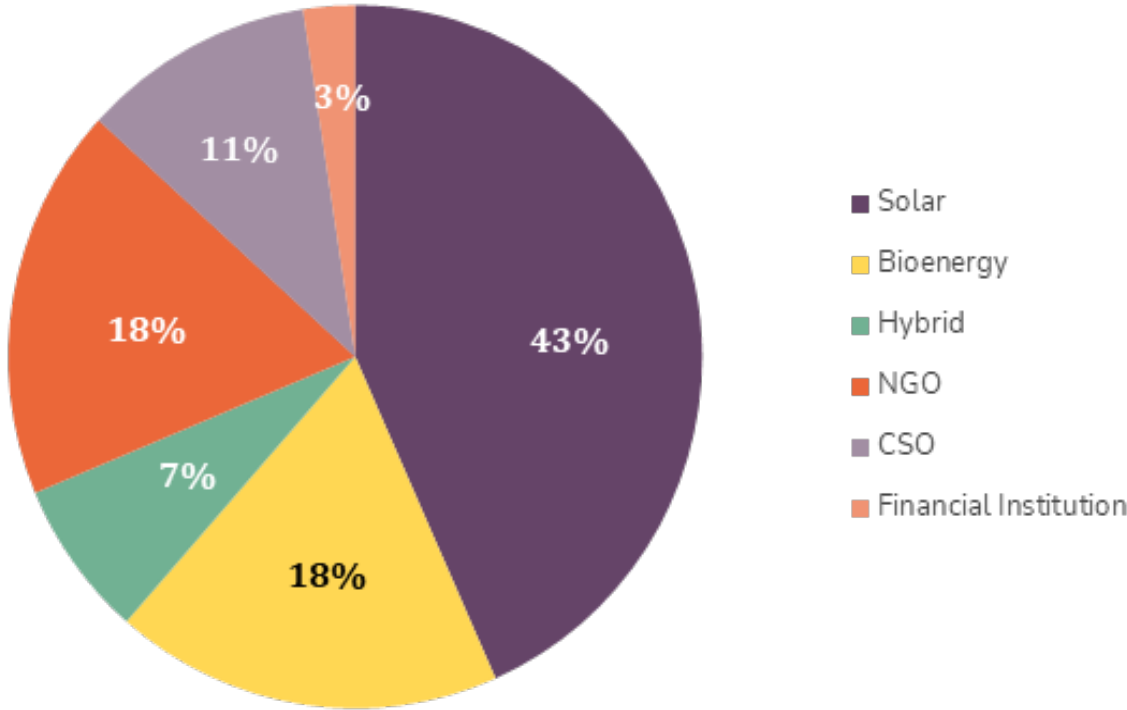


FIGURE 43: Breakdown of Participation of CLEAN Members in Government Programs in the Past Year. Sample Size 77

(Note: NGOs, CSOs, and Financial Institutions function in multiple sub sectors within DRE)

4.3.1. CLEAN Member Perception of DRE Policies and Programs

CLEAN members who participated in the survey reported their participation in several government programs and shared their feedback on the key challenges they faced.

Some members deploying solar water pumps under the PM KUSUM scheme under Component B and C reported lack of awareness among implementing agencies in the States of Jharkhand, Odisha, and West Bengal.

Under the New National Biogas and Organic Manure Program and the National Dairy Programme it was reported that the duration of time for implementation of pilots is often too lengthy and scale up does not necessarily happen after the pilot has been conducted. On the incentive of scale up, the cost of product is often cut down during the pilot stage.

However, during the scale up phase, the route of open tenders is taken and no incentives are provided to organizations who undertook the pilots.

Beyond the pilot stage, it was also reported that the implementation timelines were often constrained which made adhering to them difficult for enterprises. Moreover, coordination support with ground level government agencies was also difficult. Members working with State Forest Departments (deployment of solar powered animal deterrents and repellents) reported similar challenges.

Members working with DAY-NRLM are finding it difficult to coordinate with multiple agencies working together (for e.g., project implementers, training providers, market linkage providers, etc.). It was reported that

the release of funds took a long amount of time which caused financial constraints. Similar challenges were reported under DAY-NULM.

A lack of availability of standard guidelines for the process of IEC certificate was reported. This lack of clarity makes getting DRE products certified difficult. There is a need for easy availability of documents outlining the process end to end for different types of applications/appliances.

While the GEM portal has made the online bidding process comparatively smoother, making it simpler for enterprises to build their proposals via the portal. However, the bureaucratic hurdles in clearing the proposals/bills on the ground level still exist. Moreover, there is no grievance authority set up that could quickly resolve issues. Raising issues at the GEM portal leads to a legal review of the process which is lengthy and time consuming.

Members felt that often the intent behind policies were good but lack of ground level support and knowledge amongst implementing officers leads to watering down of the intended impact. Moreover, it was reported that the subsidy disbursement is still pending for various MSME and there is little clarity on the matter.

Lack of clarity in the subsidy support which is available. Knowledge gaps between Centre and State also make claiming subsidies challenging

It was reported that the SGST linked subsidy in Gujarat has not commenced yet although it has been announced in various manufacturing policies. Members shared that it was difficult to avail the Emergency Credit Line Guarantee Scheme, however, NBFCs were not willing to disburse funds. Similarly, under the 'PSB Loan in 59 Minutes' scheme, PSB banks were not willing to disburse the funds despite the enterprises securing approval in-principle.

Recommendations for Future Policies and Programs

The following recommendations have been gathered from inputs received from CLEAN member organizations:

End Users:

- Reduction in GST rates and custom duties is required in order to encourage uptake from low-income groups and bring down the costs of DRE solutions.
- Financing support with minimal documentation for end consumers who are not linked to formal banking systems is required in order to make the solutions affordable for them.
- Direct subsidies, interest free/low interest small ticket loans, and income tax relief would also enable large scale uptake.
- Availability of subsidies, especially for larger applications, is required to make them affordable to end consumers.
- Enabling mechanisms and incentives for OPEX model renewable energy plants (BOOT model) and 'Pay-as-you-Go' models at the end user level, will bring accountability on usage, and also provide flexibility to the consumers.
- Incentives can be given for the use of energy efficient DRE solutions.
- Awareness workshops, exhibitions, and demo units need to be conducted to familiarize end users with the solutions.
- Developing a local ecosystem for manufacturing, installation, and servicing for end consumers. This will enable a reduction in transportation costs and thereby bring down overall cost of the solutions.

Enterprises:

- Easier tax structures, lower import duties, and reduction in GST rates can also encourage larger deployment of clean energy solutions.

- Reduction in subsidy release time to two months will ease financial burden on enterprises.
- Tax benefits for R&D in the renewable energy and sustainability domain and incentives for green energy will promote innovation. Increased opportunities for conducting pilot projects can also help with the same.
- Incentives, financial support, and removal of turnover limit barriers for startups are required to encourage participation in schemes/programs.
- Simplification of procedures and removal of bureaucratic hurdles will increase ease of participation in government schemes/programs.
- Clearer policies are required on Article 6 transition under Paris Agreement. Additionally, capacity building workshops are required on the carbon market and its benefits.
- Support mechanisms are required for identification/mapping of beneficiaries especially for smaller enterprises who do not have the capacity to conduct market and need assessment.

4.4. Certification of DRE Products and Applications

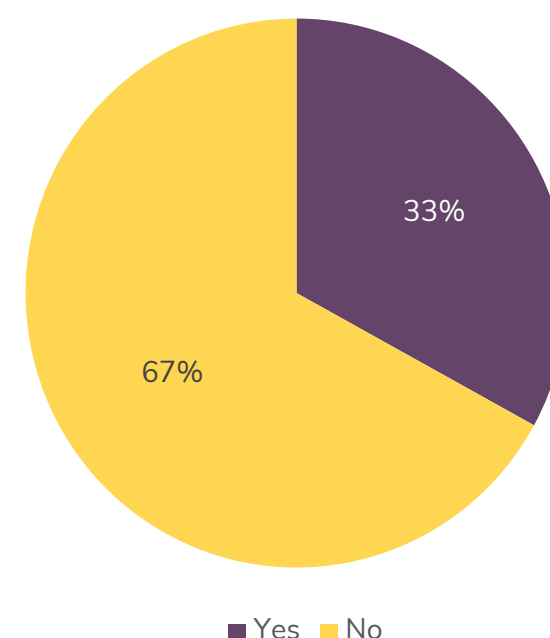


FIGURE 44: Enterprises who have sought/not sought certification. Sample size: 45

Majority of the respondents (69%) sought certification for their products to build confidence amongst their customers. 31% of respondents sought certification in order to participate in government programs and avail subsidies.

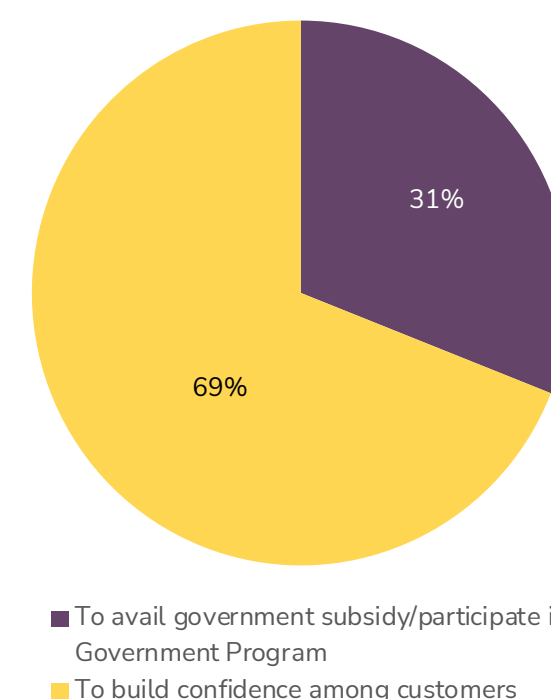


FIGURE 45: Reasons for Certification. Sample size: 13

Other reasons for seeking certification include compliance with export requirements and assessment of carbon footprint.

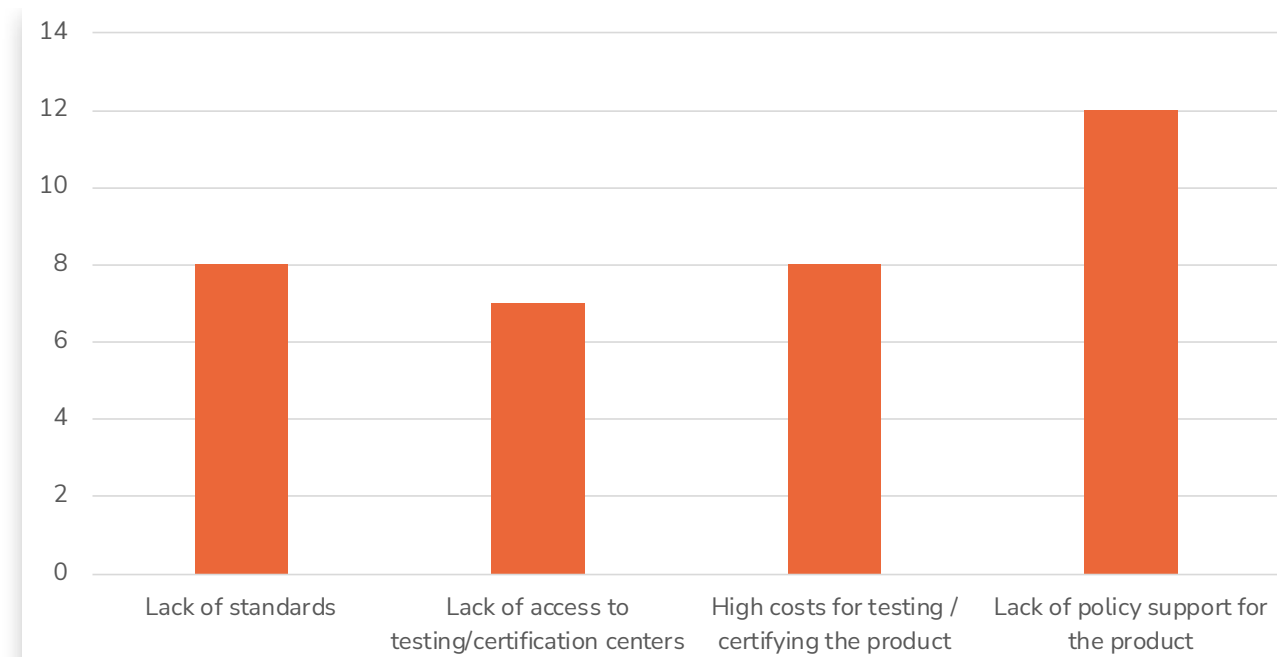


FIGURE 46: Reasons for not seeking certification. *Sample size: 20*

Majority of the respondents (34.3 %) have stated lack of policy support for their products as the reason for not seeking certification (figure x).

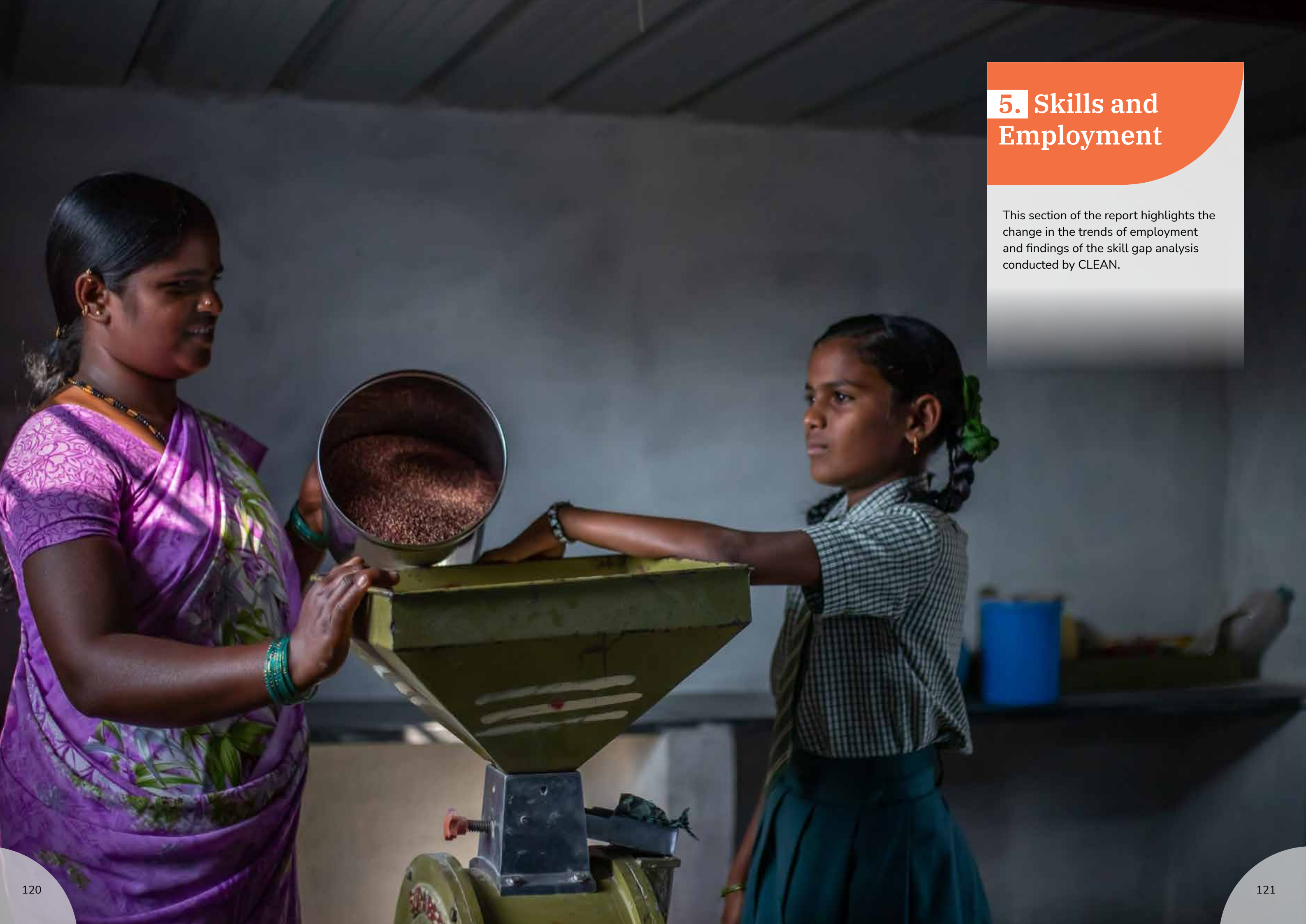
22.86 % of the respondents stated that lack of standards for their products and high costs of testing have been a deterring factor. While 20% of the respondents stated they lack access to testing/certification centers for not seeking certification for their products.

Other reasons for not seeking certification include lack of clarity from certifying agencies

on procedures and requirements. Many members also buy certified components and follow international standards for their products. Some respondents also stated that they do not require certification for their products.

A lack of availability of standard guidelines for the process of IEC certificate was reported. This lack of clarity makes getting DRE products certified difficult. There is a need for easy availability of documents outlining the process end to end for different types of applications/ appliances.





5. Skills and Employment

This section of the report highlights the change in the trends of employment and findings of the skill gap analysis conducted by CLEAN.

5.1 Employment in DRE Sector

The pandemic has had a significant impact on the DRE sector, since travel restrictions have disrupted the supply chain and brought the local employment creation through DRE to a halt, CLEAN members reported.

During CLEAN’s conversations with members, we discovered that covid had an influence on all categories of members, including last mile delivery, NGOs, system integrators, and manufacturers.

Based on the survey, there were mixed responses from the members on the trend of employment during the covid period in FY 20-21. While 36% of the respondents reported to have increased their team strength, 42% of the members reported no change in the team strength. The 22% of the organizations participated in the survey had to lay off their employees in order to survive the covid period. This dominantly included organizations which are involved in last mile delivery of DRE products.

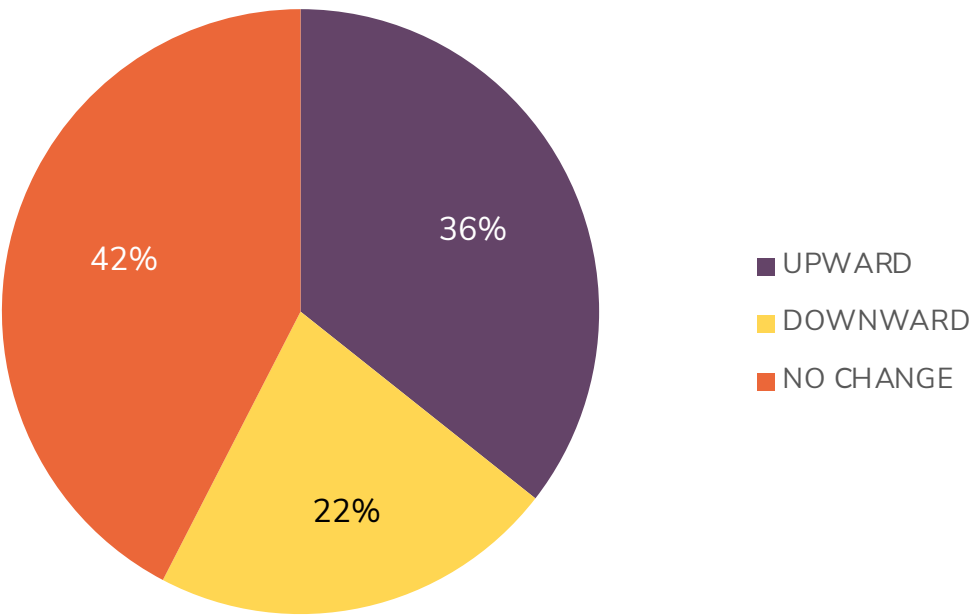


FIGURE 47: Trend of employment in DRE organizations: Sample size: 59

The increase and at least retainment of the staff in the organizations are attributed to the pre-established financial strength and stability as well as the approach of the organizations during the covid time in FY 20-21.

In FY 20-21, 42 DRE organisations offered 392 new career opportunities, out of which 80% of staff hired were male and the remaining 20% were female. While in the FY 20-21 the organizations have relieved 83 staffs in which 71% were male and 29% were female.

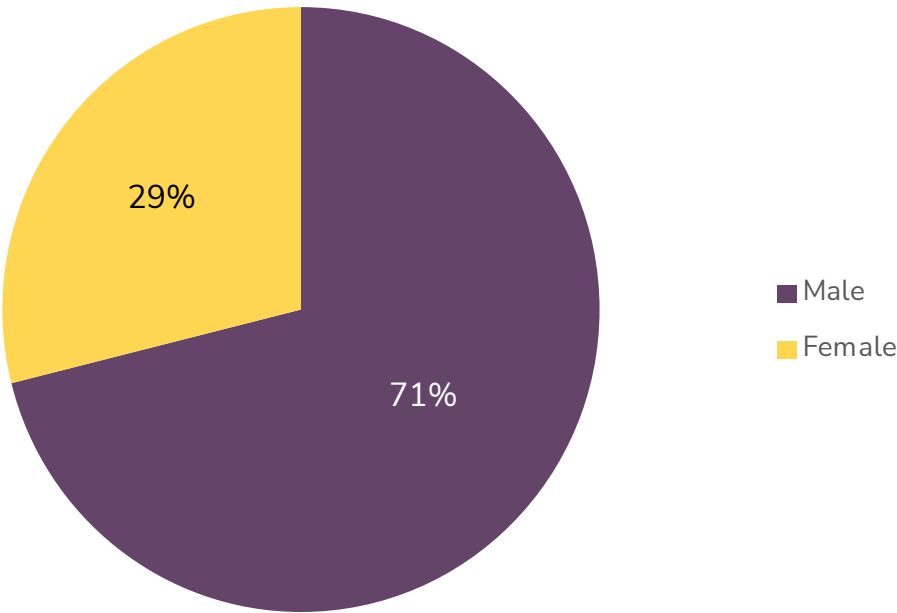


FIGURE 48: Staff relieved in the FY 20-21. Sample size: 42

5.2 Training and Skill Development

5.2.1 Impact of COVID on skills and training related activities

Due to COVID, many training sessions were organized online. As per the responses from CLEAN members operating in skills and training, due to the shift to online training classes, these members were able to reach out to more participants across the country.

Virtual study materials such as animation videos, motion graphics and field installation videos were used for online training. However, hands-on training and practical sessions got postponed.

5.2.2 Number of participants trained in the last year

Three Training institutes in the CLEAN member base have collectively trained 2760 participants on technologies such as solar PV, biogas, solar water pumps. Training institutes have also trained 275 overseas participants from 15 different countries. The average

employability after training stood at 87% of the total participants trained. 31 DRE enterprises and NGOs together have trained 2514 local technicians on operation and maintenance of DRE products and services and solar light manufacturing.

5.3 Skill Gap Assessment

In a separate skill gap assessment conducted by CLEAN supported by bp India, CLEAN identified the subjects and skill sets where knowledge gaps exist as per the members. Out of the total of 41 responses, the majority of the responses were for the sub-sectors such

as solar PV & mini grids, improved cookstoves and biogas. The assessment questionnaire had requested for information from the sub-sectors of solar pumps, battery storage, livelihood applications etc...

TABLE 7

TECHNOLOGY (41)	AREAS OF SKILL GAP (NO. OF RESPONSES OUT OF 41 RESPONSES)								
	DESIGN	MANUFACTURE	SUPPLY	PROCUREMENT	INSTALLATION	AFTER SALES SERVICE	FINANCE AND ACCOUNTING	OPERATION AND MAINTENANCE	OTHER AREAS CITED
Solar PV and Minigrids (16)	10	1	2	7	8	9	9	12	Safety Audits as a part of O&M, Here, the issues with design and O&M of microgrids has led to the high responses in these two areas. Solar PV by itself has gaps in the procurement, installation, after-sales service and F&A.
Improved Cookstoves (14)	6	2	4	4	5	11	7	8	
Biogas (10)	5	1	2	2	5	6	6	6	
Livelihood Applications (7)	1			2	4	5	1	5	
Solar Pumps (4)	3	1	1	2	2	3	1	2	
Wind Solar Hybrids (2)	1	1	1	1	1	2	2	2	
Micro hydro (2)	1			2	1	2	1	1	
Storage (3)	2			1	2	3	1	1	The understanding of combined operations & control of battery, solar and wind power plant is very limited

As seen from the survey analysis, lack of available trained manpower in O&M and after-sales service segments were put forth by most of the survey participants on the technical side.

CLEAN's secondary research showed that the large number of training manuals available for various sub-sectors of DRE such as solar PV, mini-grids, biogas etc. have limited contents and do not include all the topics related to that particular sub-sector.

For biogas sub-sector, the manuals do not or partially cover installation and commissioning, operation and maintenance of household level biogas plants. Household biogas technology is often neglected and no standardized training material is available which covers all aspects of installation, operation and commissioning of different types of small-scale biogas technology at one place.

Apart from the responses in the areas of skill gap, most of the respondents also mentioned

the immediate need for finance, accounting and marketing skills across all the sub-sectors.

It has been understood from the members that the sector needs training to develop pitch documents targeting specific investors in the DRE sector such as banks, private debt providers, grant makers, venture capitalists and CSR donors.

This is especially required since there is a mismatch between investor expectations and data/information presented in the project proposal by the DRE enterprises which in turn has led to the development of a 'risky' perception about the DRE sector at large.

In light of the above gaps identified, CLEAN with the support of bp India CSR has developed technical manuals on Household biogas systems, Solar water pumps and a non-technical manual on pitch document for Finance for DRE organisations.



GREENWEAR



PROBLEM:

Hand spun charkhas are the traditional way of producing cotton and silk. But these charkhas take long hours of manual labor and increase drudgery among women. On the grounds of standard time for productivity (eight hours), no woman is able to run a charkha for eight hours at a go and hence the actual production of cotton or silk yarn reduces down to 50-60 grams per day. Additionally, to reduce the burden, women often have to set up a pulley which is connected to an AC motor which in turn increases the electricity cost for the family and adds to the carbon footprint. The time (8 hours per day) and effort that a woman puts into a manual charkha gives a meagre income of INR 20-50 per day, while also conflicting with her household chores.

INTERVENTION:

Greenwear provides forward linkages and value addition to the cotton & silk yarns produced by rural women using solar charkhas.

The solar charkhas are compact spinning ring frames installed at household levels running on solar energy. They can produce four times more yarn than a manual new model charkha.

The drudgery involved is significantly lesser than the manual charkhas and the women who operate the solar charkhas can carry on their domestic activities simultaneously while the spinning goes on. This whole ecosystem has given rise to what is called a solar vastra.

IMPACT:

Greenwear's solar charkha is empowering people under various processes:

- **SPINNING:** A rural woman can produce 1 kg cotton yarn in 8 hours and get paid INR 200 per kg for the work. One woman can easily operate two solar charkhas together. Hence, each woman is empowered to earn INR 6000 to INR 12000 per month. Greenwear procures these yarns from Bhartiya Harit Khadi Gramodaya Sansthan and uses that for further value additions. At present, Greenwear is the sole buyer of this yarn and the only company which deals in solar charkha yarn at scale in India. In one year, it has procured 49,500 kgs yarn produced by 590 rural women from Nawada (Bihar) and Varanasi (UP).

- **WEAVING:** Greenwear distributes the solar charkha yarns to various traditional textile clusters e.g., Gaya (Bihar), Bhagalpur (Bihar), Varanasi (UP), Bijnor (UP) and Barabanki (UP) where it is woven by traditional weavers into fabrics. For plain weaving, Greenwear assigns Solar Looms and for crafted weaving, it engages handlooms. At present, weaving is also done in the form of job work for Bhartiya Harit Khadi Gramodaya Sansthan as mainstream fashion brands like W and Aurelia (TCNS Clothing Co. Ltd.) procure Solar Vastra from the society. In one year, Greenwear has produced around 2.25 lakh meters of fabric, engaging 370 weaving artisans spread across three clusters. These artisans earn an average monthly income of INR 9000 and are learning to get familiar with Solar Sets.

- **TAILORING:** Greenwear has its own garment manufacturing unit in Safedabad (Barabanki, UP) where it creates garments for its own retail store and school uniforms along with Job work for W and Aurelia brands. Currently Greenwear has a manufacturing capacity to provide jobs to 170+ people with average earnings of INR 10000 per month. In one year, Greenwear stitched 90,000 sets of school uniforms and 10,000 units of designer garments.

- **VALUE ADDITION:** Greenwear is also engaged in research and development of a range of organically dyed Solar Vastra and exploring opportunities of traditional surface ornamentation techniques on these. With indigenous ways of clothing value additions, Greenwear is working with cluster specific traditional designs which will become part of its own retail store hence, providing livelihood to traditional artisans and reviving some languishing crafts.

- **PRODUCT QUALITY:** The product that is produced on a solar charkha is more consistent and hence has better quality.

ABOUT THE ORGANIZATION:

Greenwear was established in March 2019 with a close association with Bhartiya Harit Khadi Gramodaya Sansthan – a KVIC certified society which implemented the pilot project for the Ministry of MSME's flagship scheme known as "Mission Solar Charkha". A dedicated 'Solar Vastra Cell' has been formed by KVIC to take care of this scheme. Greenwear's mission is to create 5000 jobs for women in rural India by 2025 and right now working with 1180 jobholders in the state of UP and Bihar. The jobholders engaged currently have value income and the flexibility in working hours allows them to manage household obligations.



OOORJA DEVELOPMENT SOLUTIONS

PROBLEM:

According to the Census 2011, there are about 263 million agricultural workers in India and of which 37% i.e., 98 million are women. Of all women workers in the country, 71% are engaged in farming. Despite the number of women working in the fields increasing over time, they remain as the “invisible contributor” in the backdrop of patriarchal societal and cultural environments. Additionally, as male farmers are now migrating to urban centres for livelihood opportunities, there has been a feminization of agriculture, resulting in more women getting involved in the labour-intensive activities of production and harvesting of crops. Though predominant at every level of the agricultural value chain, women still face challenges with accessing agricultural inputs, markets and improved clean energy technologies as they are unable to afford the upfront cost. They lack access to credit owning

to their negligible land rights and are often excluded from decision-making on account of limited education, training, and financial literacy.

INTERVENTION:

Oorja with an aim to promote gender equality in the agri-energy sector and within the communities serves women by engaging them along the entire value chain of its operations, i.e., as employees, operators of solar assets, technicians, service agents and customers.

To achieve this, it has introduced an inclusive and women-centric business model that caters to the pressing needs of women farmers.

Some of the other gender-lens interventions that Oorja is employing to empower women farmers at the last-mile includes:

- In the states of Uttar Pradesh and Bihar where Oorja operates, Oorja has developed a comprehensive gender mainstreaming plan that includes various integration strategies to involve more women as

customers, pump/mill/cold storage operators and as payment collectors and service agents (Krishi Didi's). This is done by modifying the sales and marketing materials and making them more women-friendly (flyers, brochures, explainer videos, etc.), improving the site selection and customer onboarding processes to attract women and showcasing the gender-inclusive value proposition for service users.

To increase the percentage of women in the field team, Oorja offers them flexible working hours so that they can also fulfill household responsibilities.

- Provision of agronomy advisory to female farmers to help them in intensifying and diversifying their cropping practice, cultivate in more seasons and transition to more high-value horticulture crops to increase agricultural productivity and income from farming.
- Capacity building and training workshops to enhance self-esteem, agency and voice among the community and a forum to play a more active role in decision-making for improving existing services and introducing new ones.

The milling service has allowed them to save 50% on agro processing costs and the cooling service helps prevent up to 15% of post-harvest loss of horticulture crops.

- These integrated services have created the conditions for diversifying their cropping patterns and increase agricultural productivity by 15% and income by up to 30%.
- The availability of on and near-farm hassle free services year-round on demand have led to reduction in drudgery and time poverty for women farmers and girls.
- **Job creation:** Oorja was successful in hiring and upskilling a female operator Rita Devi to run its solar-powered cold storage in Muzaffarpur, Bihar.

She feels this livelihood opportunity has socially and economically empowered her.
- Oorja has saved 14,004 liters of diesel and 36,812 kg of CO₂eq so far from its operations.

ABOUT THE ORGANIZATION:

Oorja is a Farming-as-a-Service (FaaS) company working at the intersection of renewable energy and sustainable agriculture.

Its mission is to replace polluting and expensive diesel engines and motors used to serve the energy needs of agriculture with solar-powered systems. It engineers, finances, installs, operates and maintains solar assets to provide reliable and affordable irrigation, milling and cooling services to small and marginal farmers on a pay-per-use basis without any upfront cost to them.

IMPACT:

- Increase in women as direct customers for the solar irrigation service from 3% to 15%. The proportion of women as customers for the solar milling service is 65%.
- The pay-per-use irrigation service has enabled women farmers to transition sustainably away from diesel-based methods, reducing their expenditure on irrigation by 20-25%.



POLLINATE GROUP

PROBLEM:

Hanmanthamma's family used to be among the 180 million people in India and Nepal who live in informal settlements, on less than \$1.90/day. They had no access to basic resources like electricity, running water, health services and reliable communication. Making the most of all available resources, and cooking over an open flame, she understood that the brunt of any crisis was borne unevenly by her and the women around her. With over 20% of the world's population facing energy poverty and relying on dangerous and expensive kerosene for light, more than 1.5 million women and children globally die each year from breathing toxic kerosene fumes. At 40 and widowed with 3 children, Hanmanthamma and her family lived in the dark after sunset, relying on expensive and temporary solutions like candles and kerosene lamps. To make matters worse, Covid-19 pandemic and subsequent lockdowns created a further set-back for her, depriving her of her income and any opportunities for progress.

INTERVENTION:

Pollinate Group works with communities like Hanmanthamma's that live on less than \$1.90 a day to identify and train women as clean energy entrepreneurs to distribute life-improving products. Pollinate Group invests in training women as leaders over a period of 12-18 months to make them economically independent in the future. The products are chosen in a way that they would help low-income families access better living conditions while saving time and money.

IMPACT:

Hanumanthamma was a construction site worker when she was first introduced to people from the Pollinate group. She initially bought some products as a money saving investment and a tool that would free her home from darkness. A simple solar light helped her save a lot of money that was usually spent on candles and kerosene. It was also transformational because this was the first time her household had access to a reliable source of energy.

Moved by her first experience with clean-energy products, she was motivated to join the Pollinate Group, besides the fact that it could help her increase her household income.

Over the next few months, she regularly met with the team and acquired the skills and training required to become a clean-energy entrepreneur. Unfortunately, during the lockdowns, she had no work and was forced to move back to her village. Once she came back, she realized that her income as an entrepreneur can be far more reliable. Now, she only goes for construction work twice or thrice a week and spends the remaining time building her skills and helping those in need gain access to life-improving products. Today, she is a clean energy entrepreneur, who has brought first-time energy access to her entire community.

Throughout the pandemic, she combatted the loss of her wages by making sales and bringing home an income.

Pollinate Group has trained over 1000 women in India and Nepal as clean energy entrepreneurs who each have put tens and hundreds of families on the grid without negatively impacting the environment.

ABOUT THE ORGANIZATION:

Pollinate Group is a global organisation with implementing partners in India (Asha Kiran) and Nepal (Kalpavriksha). They provide implementing partners with access to products to be sold, technology to process and track orders and credit for customer payment plans.

Pollinate Group also operates Fellowship Programs and raises philanthropic funds.



In order to increase the flow of capital for both enterprise end user financing, we propose the following areas which need to be actioned upon to uplift the DRE sector as India builds back better:

- Alternate investment opportunities and routes which need to be tempered to cater to the funding needs and demands of the DRE sector such as impact investors, peer-to-peer lending platforms, clean energy focussed impact bonds and blended finance structures involving government schemes and subsidies.
- The catalytic role of DRE /clean energy in all aspects of socio-economic development is not being leveraged enough amongst donors, investors and debt providers. Through sensitization efforts the multi-dimensional nature of the sector is likely to attract a larger pool of capital at a lower cost to aid the growth of DRE enterprises in India.
- Concomitantly, DRE enterprises need to be trained and sufficient capacity is required to be built to measure and showcase their multi-SDG impact. This is especially useful to catch the attention of international donors who are finding avenues to support clean energy enterprises and bridge the demand-supply gap.
- Given that the ticket size of transactions is small, the transaction costs at the end of the fund providers are on the higher side. Aggregation amongst the credit needs of DRE enterprises is key to make transactions financially feasible for large

lenders. In addition to this, measures such as guarantee creation will provide lenders with comfort and begin the flow of affordable, unrestricted mainstream capital into the DRE sector.

The announcement of an increase in GST rates from 5% to 12% has led to an increase in the costs of DRE products. While the sector as a whole has been negatively impacted from this step, B2C organisations have been majorly impacted. Considering that a large chunk of consumers of DRE products fall under the low-income category, sales have seen a decline. Moreover, import duties add further financial strain on organisations.

In order to continue growth in the sector, GST rates are required to be as close to 5% as possible.

While the announcement and updating of the “Draft Policy Framework for Developing and Promoting DRE Livelihood Applications” has been a positive step towards building support for the sector, its launch would make a large positive impact on both DRE sector enterprises and end consumers/local economies who stand to benefit from the solutions.

Given that the benchmark costs have consistently seen a reduction over the last few years, supportive mechanisms are required to ensure an increase in sales and deployment. This would enable organisations to continue providing good quality products at lower costs to end consumers via economies of scale.

The wave of innovators and entrepreneurs are contributing with a variety of DRE livelihood applications and energy management mechanisms that are not only energy-efficient but also commercially feasible is the driving factor in addressing grassroots challenges whether it is in electrical or clean cooking space (thermal energy needs).

The sector would strengthen if a focussed committee is set up to engage with DRE entrepreneurs and other stakeholders to ensure enhanced efficiency and develop performance standards of productive use applications as a way forward to ensure genuinity and robustness in the sector.

The PLI schemes announced for solar panel and battery manufacturing have received overwhelming appreciation by the sector.

It has been collated that support to local manufacturing in other renewable energy sectors such as wind, biogas and pico/micro hydro should also be taken into consideration.

The CLEAN member enterprises have opined that the DRE for Livelihoods policy should be finalized soon as this will help the sector to scale and create a robust rural economy contributing to various goals set by the Government of India.

The sale and deployment figures of DRE livelihood applications has extensively increased which reiterates that the focus and need is on decentralized economic activities.

The support the sector needs is the opportunity to scale with formulation of financing mechanisms, formalization of business models and supply chain.

Community demonstrations and the establishment of DRE shared facility centres in certain regions are proven to be the most effective methods for raising awareness, creating demand, and encouraging microentrepreneur growth. It is necessary to raise awareness among end users as well as government officials about the necessity for and utility of DRE-powered applications.

The skills and training partners have ensured that students continue to be exposed to renewable energy courses, training and information even during the covid period. In future too, online trainings will help attract students and professionals to enhance their skills in the RE sector.

The future RE workforce needs to know about the changing and emerging technologies, as technology would be one of the key factors for penetration of RE. The sector needs to strengthen the course structure and on field training in order to ensure availability of trained workforce to achieve the RE targets set by India.

Training on minigrid operation and maintenance, as well as livelihood applications, will aid in the establishment of jobs and economic growth.

TABLE 8: Standalone Solar Power Plants/Packs benchmark cost (General States)

GENERAL STATES						
CAPACITY	BATTERY BACKUP (HRS)	2017	2018	2019	2020	2021
Standalone Solar Power Plants/Packs (upto 10 kW)	6 hrs	135	100	94	94	94
	3 hrs	108	80	74	74	74
	1 hr	90	68	62	62	62
Standalone Solar Power Plants/Packs (>10 kW-upto 25 kW)	6 hrs	120	90	84	84	84
	3 hrs	96	72	66	66	66
	1 hr	80	61	55	55	55

TABLE 9: Standalone Solar Power Plants/Packs benchmark cost (North Eastern States/Hill States/Islands/UTs)

NORTH EASTERN STATES/HILL STATES/ISLANDS/UTS						
CAPACITY	BATTERY BACKUP (HRS)	2017	2018	2019	2020	2021
Standalone Solar Power Plants/Packs (upto 10 kW)	6 hrs	135	110	103	103	103
	3 hrs	108	88	81	81	81
	1 hr	90	75	68	68	68
Standalone Solar Power Plants/Packs (>10 kW-upto 25 kW)	6 hrs	120	99	92	92	92
	3 hrs	96	79	72	72	72
	1 hr	80	67	60	60	60

TABLE 10: Street Lights and Solar Lamps benchmark cost (General category states)

GENERAL CATEGORY STATES					
YEAR	2017-18	2018-19	2019-20	2020-21	2021-22
Street Light- Lithium Battery (Rs/Wp)	475	435	299	258.67	173.85
Solar Lamps (Rs/Wp)	340	250	160	158	150.4

TABLE 11: Street Lights and Solar Lamps benchmark cost (North east states/Hill states/Islands UTs)

GENERAL CATEGORY STATES					
YEAR	2017-18	2018-19	2019-20	2020-21	2021-22
Street Light- Lithium Battery (Rs/Wp)	475	475	328	284.533	173.85
Solar Lamps (Rs/Wp)	340	275	176	174.5	150.4

TABLE 12: Standalone Solar Pumps benchmark cost for 2017 and 2018

PUMP CAPACITY		2017	2018	
		PAN INDIA	GENERAL STATES	NER/HILL STATES / ISLAND UTS
Solar Pumps (Rs/HP)	Upto 3 HP (DC)	120000	85000	93500
	> 3 HP - 5 HP (DC)	95000	77000	84700
	> 5 HP - 10 HP (DC)	95000	NA	NA
	Upto 3 HP (AC)	100000	80000	88000
	> 3 HP - 5 HP (AC)	85000	65000	71500
	> 5 HP - 10 HP (AC)	85000	NA	NA

TABLE 13: Standalone Solar Pumps benchmark cost for 2019 and 2020

PUMP CAPACITY	PUMP TYPE	2019		2020	
		GENERAL STATES	NER/HILL STATES / ISLAND UTS	GENERAL STATES	NER/HILL STATES / ISLAND UTS
0.5 HP	AC/DC Surface	53000	58300	53000	58300
	AC/DC Submersible	68000	74800	68000	74800
1 HP	AC Surface	102000	112200	92400	101700
	DC Surface	108000	118800	92400	101700
	AC Submersible	113000	124300	103700	114100
	DC Submersible	119000	130900	103700	114100
2 HP	AC Surface	65000	71500	61100	67300
	DC Surface	73000	80300	61100	67300
	AC Submersible	76000	83600	65700	72300
	DC Submersible	86000	94600	65700	72300
7.5 HP	AC/DC Surface/ Submersible	56000	61600	47000	51700
10 HP	AC/DC Surface/ Submersible	51000	56100	44500	44500

TABLE 14: Standalone Solar Pumps benchmark cost for 2021

PUMP CAPACITY	USPC	2021	
		GENERAL STATES	NER/HILL STATES / ISLAND UTS
1 HP	Without USPC	96877	105509
2 HP	Without USPC	123691	134802
3 HP	Without USPC	166299	181175
	With USPC	199540	217447
5 HP	Without USPC	234618	255647
	With USPC	281542	306796
7.5 HP	Without USPC	326079	355371
	With USPC	374931	408631
10 HP	Without USPC	407897	444536
	With USPC	469054	511202





CLEAN

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