cKinetics
Accelerating Sustainability

DRE for Livelihoods

Translating Potential to Action

State of the Sector Report

2025









About the report

This Report provides an overview of the current landscape of PURE interventions and entails a comprehensive assessment of PURE interventions to identify 'addressable /serviceable potential' across key states in the country detailing out the underlying technology and business models as also financing solutions and specific policy recommendations to scale the growth of the sector

About cKinetics

cKinetics is a mission driven Sustainability Insight, Innovation & Capital Advisory Firm. We work with businesses, investors, industry groups as well as thought leaders to continually generate market insight and catalyze change. cKinetics leverages thought processes for accelerating sustainable business and investing practices that include: (a) Closed loop systems, (b) Decentralized production and consumption, and (c) Resource conservation.

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Photo Credit: Devidayal Solar, S4S technologies, New Leaf Dynamics

Executive Summary

PURE interventions represent potential for transformative impact triggered by transition from pilot to scale

Distributed Renewable Energy (DRE) has emerged as a critical enabler of rural transformation in India. When applied across agriculture, livestock, and small-scale rural enterprises, DRE technologies open new avenues for economic advancement and sustainability. These applications, referred to as Productive Use of Renewable Energy (PURE) interventions, offer a structured means to integrate clean energy into core livelihood activities, creating more resilient and diversified rural economies.

Over 200 institutions, cutting across commercial and social enterprise space are currently engaged in the formulation and deployment of PURE solutions. However, most interventions are still in early stages, with few technologies reaching commercial scale. The potential for transformative impact is clear, but the transition from pilot to scale needs a strategic rethink.

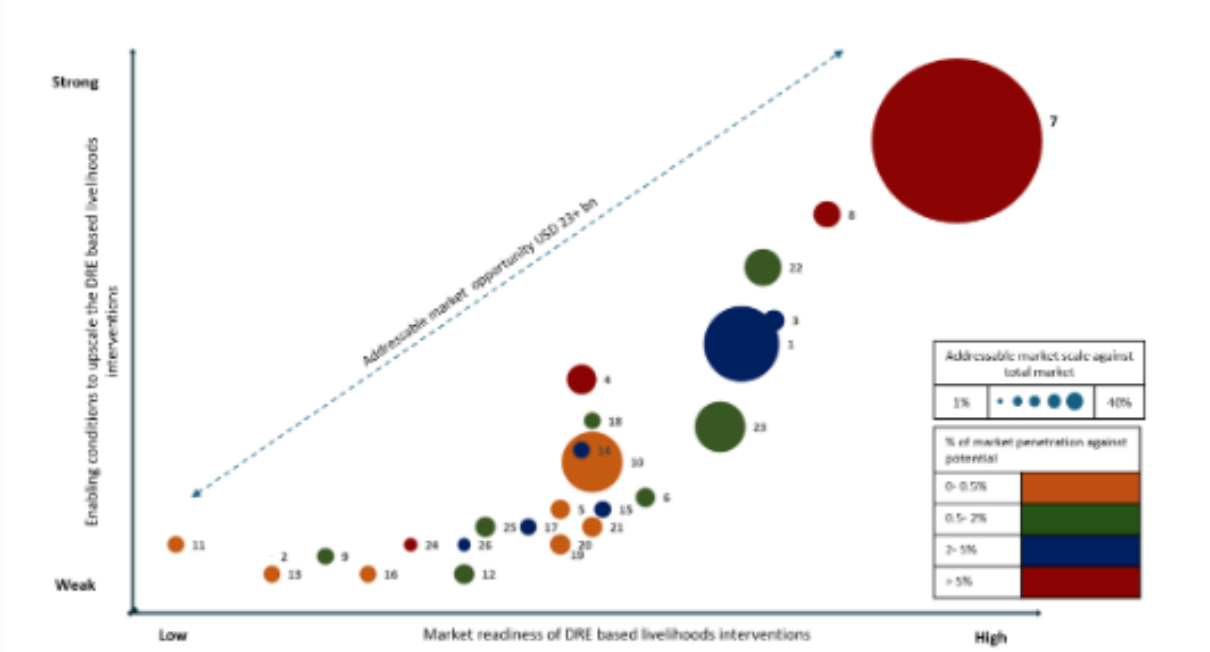
Emerging PURE applications with requisite market readiness present a substantial untapped opportunity of over USD 4.6 bn over the next decade

Solar water pumps, micro cold storage units, agri-residue based bioenergy solutions, and solar dryers are among the most promising technologies. Beyond agriculture, applications extend to dairy processing, poultry and fisheries, textile production, rural retail, and food processing.

Livelihood area	Livelihood Intervention	DRE Interventions	Serviceable installations potential	Serviceable market (mn USD)	High potential States for the deployment
Agriculture	Post harvest management	RE powered Micro-Cold Storage	~115,000+	2600+	Uttar Pradesh, Maharashtra, Bihar, Andhra Pradesh, Odisha, Madhya Pradesh
	Food processing	Solar Dryer	~570,000+	910+	Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, Odisha
Livestock	Dairy	RE powered Bulk Milk Chiller	~44,000+	465+	Uttar Pradesh, Madhya Pradesh, Maharashtra, Odisha
Non-farm enterprises	Local shops/ appliances	Solar Refrigerator/ Deep freezer	~439,000+	422+	Uttar Pradesh, Bihar, Maharashtra
	Agri based	Solar powered rice huller, polisher and mills	~162,000+	584+	Odisha, Andhra Pradesh, Maharashtra, Uttar Pradesh
		Solar powered Flour mills	~108,000+	844+	Uttar Pradesh, Bihar, Maharashtra, Madhya Pradesh

Table 1: Serviceable/ Addressable potential of prioritized interventions

A mapping of the PURE technologies based on their market readiness vs. the enabling conditions required for scale-up is presented below. The potential has inspired a growing base of technology providers developing solutions tailored to rural needs. However, field-level deployment is uneven, and awareness among end-users remains low.



1 Micro-Cold Storage	**6** Pellet Maker	**11** Ice Flake Plant	**16** Solar juicer	**21** Solar powered Rice mills
2 Animal Deterrent	**7** Solar Pumps	**12** Solar Egg Incubator	**17** Solar Water Purifier	**22** Solar powered Flour mills
3 Solar Dryer	**8** Bulk Milk Chiller	**13** Solar Aerator	**18** Solar Refrigerator/ Deep freezer	**23** Solar powered looms
4 Bio-digester	**9** Solar milking machine	**14** Biomass Cookstoves	**19** Solar powered rice huller	**24** Solar Reeling Machine
5 Torrefaction Unit	**10** Solar hydroponic fodder machine	**15** Solar Cooker	**20** Solar powered rice polisher	**25** Solar Charkhas
				26 Solar Sewing Machines

Barriers to Scale

A number of persistent challenges hinder the broader adoption of PURE technologies. High upfront costs remain a key constraint for rural users, many of whom lack access to affordable credit or financing mechanisms. Financing institutions are often reluctant to lend to informal or first-time entrepreneurs, particularly SHGs and women-led groups, due to concerns around creditworthiness, collateral, and repayment risk. Existing subsidy-linked schemes are underutilized, in part due to procedural complexity and low visibility among intended beneficiaries.

On the supply side, distribution channels are fragmented, and last-mile servicing infrastructure is often weak or non-existent. Technologies may not be appropriately adapted to local energy needs or seasonal use patterns, limiting their usefulness or efficiency in practice. **Most current offerings remain supply-driven rather than demand-centric**, reducing their relevance to users' actual conditions.

Interventions	Adoption model	Observed challenges				
		Demand	Financing	Utilization	Technology	Local capacity
RE powered Micro-Cold Storage	HB					
Animal Deterrent	CU					
Solar Dryer	HB					
Bio-digester	CU					
Torrefaction Unit	TS					
Pellet Maker	TS					
Solar Pumps	HB					
RE powered Bulk Milk Chiller	HB					
Solar milking machine	HB					
Solar Vertical hydroponic fodder machine	HB					
Ice Flake Plant	CU					
Solar Egg Incubator	CU					
Solar Aerator	CU					
Biomass Cookstoves	CU					
Solar Cooker	CU					
Solar juicer	CU					
Solar Water Purifier	TS					
Solar Refrigerator/ Deep freezer	CU					
Solar powered Mills	HB					
Solar powered looms	CU					
Solar Reeling Machine	CU					
Solar Charkhas	CU					
Solar Sewing Machines	CU					

Policy has provided some triggers to address the above however a comprehensive framework is a much-felt need

Programs such as PM-KUSUM, MGNREGS, and the National Bioenergy Programme have facilitated deployment of select technologies, particularly solar pumps and biodigesters. However, many high-potential applications, such as solar-powered dairy chilling or solar dryers for food processing remain outside the scope of these schemes. A lack of coordination

between sectoral programs and limited budgetary support further slows down progress.

An overview of the key policies /schemes targeting the different intervention segments and resultant momentum is presented below.

Segment	Central policies/ schemes priority	State policies/ scheme priority	Policy depen dency	Policies/ schemes for market uptake	Gaps
Post Harvest Management (RE powered Micro-Cold Storage)	▶	▶	▲	▼	Adequate allocation and effective policies for market uptake remain insufficient, fragmented support and different incentives across the states
Agri Waste to biofuels (Biodigesters)	▲	▲	▲	▶	Applicable in different central schemes and states bioenergy policies; major focus on large scale bio-gas plants
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine, Solar milking machines)	▼	▼	▶	▼	Central schemes primarily focus on grid-powered or diesel-powered systems. While the sector is largely regulated by NDDB, most of the available support is directed toward cooperatives, leaving limited assistance for private entrepreneur
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development, only large uptake implementation plan is from UPSRLM-DEWEE program
Food processing (Solar Dryers)	▶	▶	▲	▼	Adequate allocation and effective policies for market uptake remain insufficient, some schemes/ policies have included the solution but large-scale implementation with specific targets are yet to operationalize
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)	▼	▼	▶	▼	Lack of dedicated schemes/ policies for market development, inclusion in schemes like AIF for mills, and SMAM for rice mills, priority sector lending but none of the schemes have upfront capital support
Fishery- Solar Aerators, RE powered Ice flake plants	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development, state scheme like MKUY supports Ice flake plants but individual allocation is low for market uptake
Textile - Solar powered looms, Solar Reeling Machine, Solar Charkhas, Solar Sewing Machines	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development at central level, National Handloom Development program supports Solar reeling machines but lacks defined targets and adequate allocation for market uptake

Table 1: Overall policies/ schemes outlook for DRE livelihoods interventions

▲ High dependency /Prevalence ▶ Adequate alignment ▼ Low prevalence

Realizing the Potential for PURE: Pathways for Unlocking Growth

Key concerns regarding viable business models, pace of scale and dependence on government subsidies pose challenges for the growth of PURE segments. To bridge the gap between potential and adoption, a strategic shift is needed across several fronts. The table below outlines the key interventions to address constraints limiting specific PURE applications.

Action Areas	Micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators	Milk chiller
Demand aggregation	✓	✓			
Training and capacity building	✓	✓	✓	✓	
Market linkage support	✓		✓		
Standardization and quality assurance	✓	✓	✓	✓	✓
Strengthen distribution and service ecosystem	✓			✓	✓
Access to affordable end user financing	✓	✓	✓	✓	✓
R&D and incubation support for tech suppliers to optimise product specs.	✓	✓		✓	

There is a clear need for a **unified policy approach** that ensures **convergence, efficiency, and long-term commitment**.

The sector needs **innovation in business and financing models as also de-risking instruments** such as credit guarantees to address this adequately and catalyze enterprise as also end user financing. Given that the demand, while large, is unorganized and scattered, bundling finance with demand aggregation approaches is a key pre-requisite. The potential strategy would help diversify the associated risk as also provide the opportunity to address the demand at scale.

Appropriately tenured low-interest loan products and credit guarantees tailored to rural users can unlock much-needed capital for PURE adoption. Service-based models, such as pay-per-use or lease-to-own arrangements, are also being explored, as they align more closely with rural cash flows and reduce upfront investment burdens. However, **these models are dependent on local investment as also ecosystem readiness viz. system suppliers with requisite focus on the region, enterprise support systems, local technicians, and after-sales infrastructure**.

Technology standardization and local service capacity can help reduce costs and improve delivery efficiency. Building user awareness, supporting field-level demonstrations, and involving SHGs and farmer collectives in design and deployment will further increase relevance and adoption. Philanthropic and CSR capital can play a catalytic role not just by funding pilots, but by investing in market development, local capacity building, and value-chain integration.

PURE technologies offer a compelling path forward, with the ability to improve incomes, reduce drudgery, and support rural resilience in the face of economic and climate-related challenges. By advancing the adoption of PURE solutions through coordinated policy, financing innovation, and on-the-ground ecosystem support, India can accelerate its transition toward a greener, more equitable rural economy.

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Glossary

Acronym	Details
ADB	Asian Development Bank
AIF	Agriculture Infrastructure Fund
AMC	Annual maintenance cost
APICOL	Agricultural Promotion and Investment Corporation of Odisha Ltd
CGTSME	Credit Guarantee Trust for Small and Medium Enterprises
CSR	Corporate Social Responsibility
DAHD	Department of Animal Husbandry and Dairying
DAFW	Department of Agriculture and Farmers Welfare
DHFP	Department of Horticulture and Food Processing
DRE	Distributed Renewable Energy
F&ARDD	Fisheries and Animal Resources Development Department
BRLPS	Bihar Rural Livelihoods Mission
JREDA	Jharkhand Renewable Energy Development Agency
MAFW	Ministry of Agriculture and Farmers Welfare
MDWS	Ministry of Drinking Water and Sanitation
MEDA	Maharashtra Energy Development Agency
MNRE	Ministry of New and Renewable Energy
MoFPI	Ministry of Food Processing Industries
MoRD	Ministry of Rural Development
MSAMB	Maharashtra State Agricultural Marketing Board
MUDRA	Micro Units Development and Refinance Agency
NBFC	Non-Banking Financial Company
NDDB	National Dairy Development Board
OCTDMS	Odisha Community Tank Development and Management Society
OEM	Original Equipment Manufacturer
OLM	Odisha Livelihoods Mission
OREDA	Odisha Renewable Energy Development Agency
PMFME	Prime Minister Formalization of Micro Food Processing Enterprises
PURE	Productive Use of Renewable Energy
PSL	Priority sector Lending
RE	Renewable Energy
UPNEDA	Uttar Pradesh New and Renewable Energy Development Agency
UPSRLM	Uttar Pradesh State Rural Livelihood Mission
UT	Union Territory

1 Introduction

Productive Use of Renewable Energy- a promising lever to support livelihoods

There has been a growing push for coupling of DRE (Distributed Renewable Energy) solutions with global sustainable development goals pertaining to economic growth, good health and well-being and livelihoods. Interventions in this sphere have witnessed an increase over the past few years. These interventions collectively characterized as Productive Use of Renewable Energy (PURE) aim at enhancing income generation opportunities and productivity.

Productive use includes use-cases for Agriculture, Livestock and Non-farm enterprises-based activities each addressing key challenges in the rural economy. An overview of the different interventions in the sector is synthesized below.

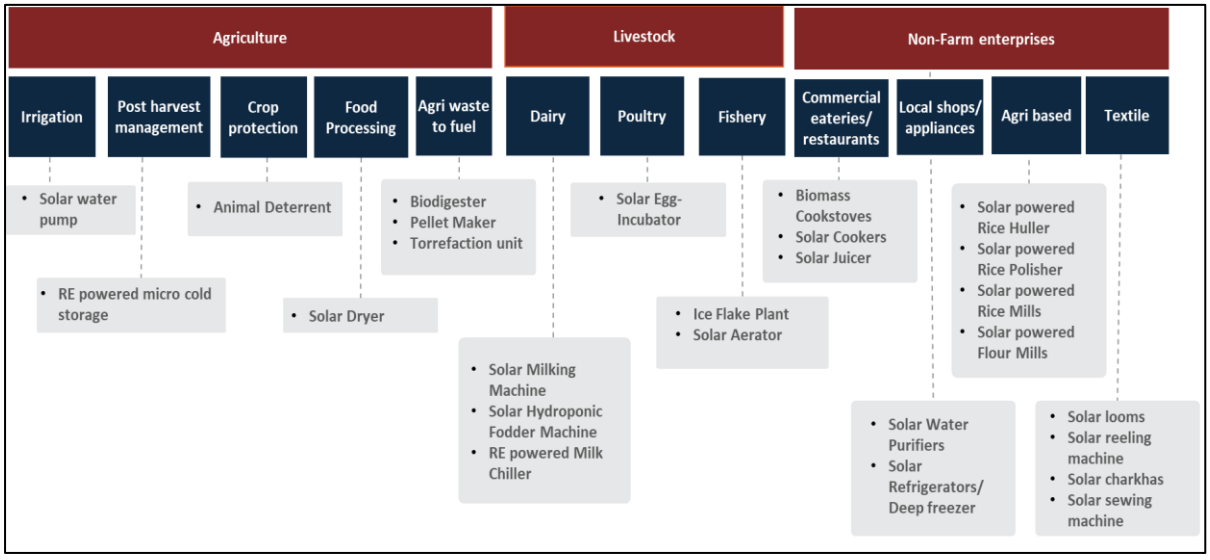


Figure 1: Segment classification and key DRE solutions catering to different livelihood areas

Even as more than 200 institutions (cutting across commercial and social enterprise space) are actively engaged in formulating and deploying DRE interventions for livelihoods, the product and customer development ecosystem for such DRE solutions is still evolving and not matured. Only a few solutions /segments are at commercial /near commercial scale.

Several of the DRE livelihoods intervention areas represent significant potential, however a comprehensive strategy to trigger adoption at scale is needed. This requires a thorough mapping of the PURE segments to identify:

a) 'addressable /serviceable potential' of various technologies
b) specific elements to scale the growth of different applications /segments
c) segments poised for significant growth in the next 3-4 years and the exact models, policy triggers and catalytic interventions needed to ensure translation of potential into resilient market demand

Despite growing availability of PURE technologies tailored to rural livelihood needs, several constraints persist that limit uptake

Given the potential and evolving opportunity, over the years, several schemes for catalyzing adoption- from solar-powered agricultural equipment to textile machineries - have been implemented with varying levels of efficacy, however significant gaps in resource allocation, demand development, and scheme efficacy have been noted in several of these initiatives thus constraining growth of the sector. A synthesis of existing policies indicates a fragmented, though desirous, ecosystem taking shape. A few points in case are discussed below:

- The adoption of solar pumps is a prominent focus across the states, and the uptake is majorly supported by the KUSUM scheme, however states like Bihar still have to adopt the PM KUSUM where considerable demand for the solar pumps exists.
- Clear targets exist in some schemes and policies (e.g. PM KUSUM, Jharkhand state solar policy etc.), enabling measurable progress tracking. However, majority of the schemes/ policies lack explicit targets adversely impacting focused outlook for scale.
- Integration and convergence across schemes are observed only in rare cases thus underlining the need to streamline efforts and improve beneficiary reach and impact.
- Even as financing mechanisms directed at some of the PURE interventions have been set up under schemes like CGTMSE, MUDRA, AIF and others, the coverage remains low due to awareness gaps as also lack of adequate entrepreneurial capacity.

This Report provides an overview of the current landscape of PURE interventions and entails a comprehensive assessment of PURE interventions to identify 'addressable /serviceable potential' across key states in the country detailing out the underlying technology and business models as also financing solutions and specific policy recommendations to scale the growth of the sector.

A robust policy framework targeting a demand led segment build out key for enabling scale

The recommendations cover priority interventions as relevant for key states segments where policy and market development interventions can help catalyze scale-up.

Market readiness has been framed per serviceable market opportunity, ease of replication across the State and current market penetration level against respective potential while the enabling conditions have been assessed per the policy efficacy, supplier readiness/ adequacy of tech support and end user financing availability.

In particular, the report looks at ways to aggregate the rather distributed demand and ways to channelize capital at scale into these areas. The findings are being framed into specific recommendations for policymakers at state/national level encompassing the facets indicated below.



2 Approach and Methodology

The report entails a holistic assessment of DRE based livelihood segments to identify 'addressable /serviceable potential', current sectoral and segment wise momentum as also specific elements to scale the growth of the sector.

The research entailed framing a bottom-up assessment of the DRE/ PURE potential for generating rural livelihoods across different kind of interventions and assessing the level of demand and supply preparedness to appropriately address the potential.

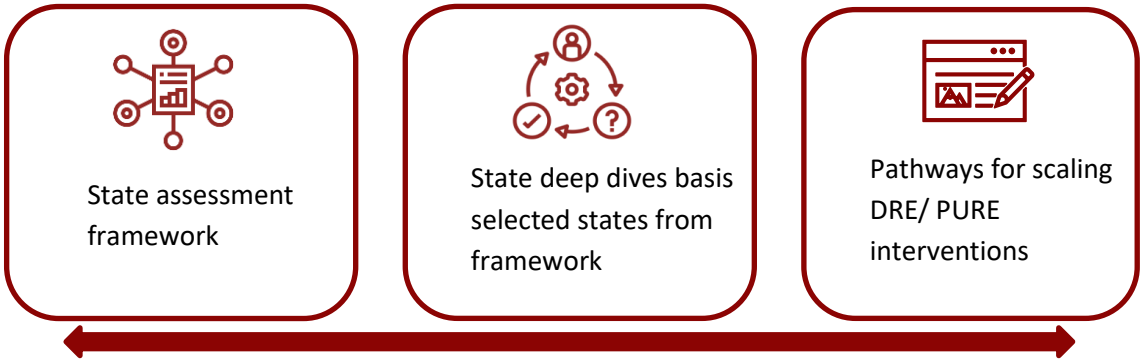


Figure 2: Methodology overview

The analysis synthesized the key factors influencing rural livelihoods leveraging DRE (i.e. PURE segment) to frame a perspective on policy efficacy for adequate replication and scale-up.

The analysis has helped identify geographies where the interventions have relatively ready market /retrofittable demand and assess the 'serviceable market opportunity' for select interventions and pathways for demand aggregation in these states.

The pathways for scaling DRE/ PURE interventions have been developed leveraging a combination of secondary research as well as primary interviews covering state government departments/ agencies, private enterprises, NGOs, technology suppliers that are active in the Decentralized Renewable Energy (DRE) and/or Rural livelihoods space in India.

2.1 Methodology for identifying States of Relevance for Deep-dive

The purposive sampling method was adopted for shortlisting states for deep dive; and the indicators adopted for the same are illustrated below.



Figure 3: Purposive sampling indicators

The wide-set screening of all states and union territories covering economic, geographic, demographic, and renewable energy factors to shortlist 14-15 states for deep dive entailed assessing the different states and Union Territories (UTs) on the indicators as discussed below.

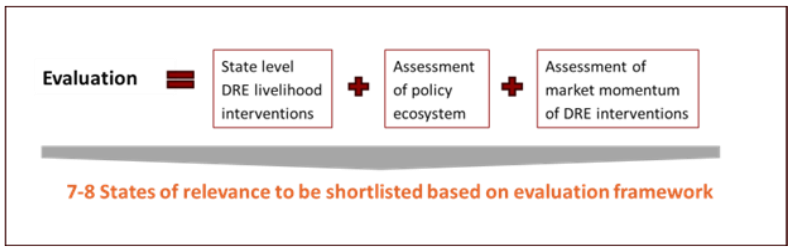


Figure 4: Assessment components of state evaluation framework

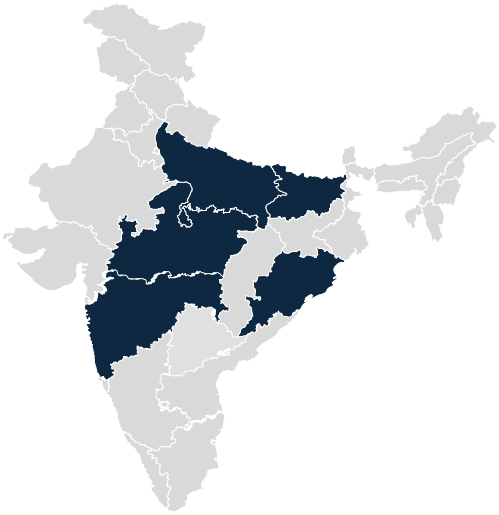
1. **Geographic Coverage:** States grouped based on climatic and ecological diversity. Each State/ UT categorized based on:
   a) Size (Small, Medium, Large)
   b) Geographic Location (North, South, East, West)
   c) Geoclimatic Zones (e.g., Warm and Humid Climate, Composite Climate, Hot-Dry, Cold climate, Temperate climate)
2. **Rural Population Density & Marginalized Communities:** Identified states with a high concentration of vulnerable populations.
3. **Rural Livelihood:** States with higher rural unemployment and potential for livelihood generation are considered.
4. **Renewable Energy Potential:** States with high solar irradiance and biomass availability were prioritized.

The synthesis is presented in Annexure 10.1. Based on the above considerations, 14 states /UTs were analyzed for their PURE potential and the enabling conditions for scale-up of priority interventions. **The assessment was undertaken on the basis of:**

a) Rural Livelihoods with energy as a core enabler
b) District wise potential viz. identified livelihood areas
c) Govt. schemes and targets related to the identified livelihoods
d) Focus of other catalysts and donors viz. the identified livelihoods in the corresponding rural areas
e) Current deployment of the concerned DRE interventions and overall market momentum /sentiment for the concerned DRE segment

The evaluation helped gauge the readiness and capability across different states viz. deploying DRE interventions and ability to truly enhance livelihoods at a ground level; leading to a **shortlist of 5 states for a deep dive per the elements discussed further along:**

1. Uttar Pradesh
2. Maharashtra
3. Odisha
4. Bihar
5. Madhya Pradesh



2.2 Approach for the state deep dive

State analysis factored in aspects of current economic development status, RE resource availability, livelihood potential in the concerned geography and presence /maturity of value chains that can effectively leverage these interventions. The analysis helped synthesize the potential of concerned PURE models in the State and spotlight:

- Overview of supply and demand factors, incl. distribution and service networks for key applications
- Potential to develop viable business case(s) for the end users
- Validation on alignment with the state priorities- mandates/policy support from states, schemes released by the state etc.

Shortlisting of intervention segments where enabling conditions and demand factors are fructifying

The analysis synthesized the key factors influencing PURE based appliances and systems to frame a perspective on policy efficacy for adequate replication and scale-up.

The selection criteria for DRE interventions across states were based on a set of supply-side and demand-side ecosystem indicators. The indicators are presented alongside.

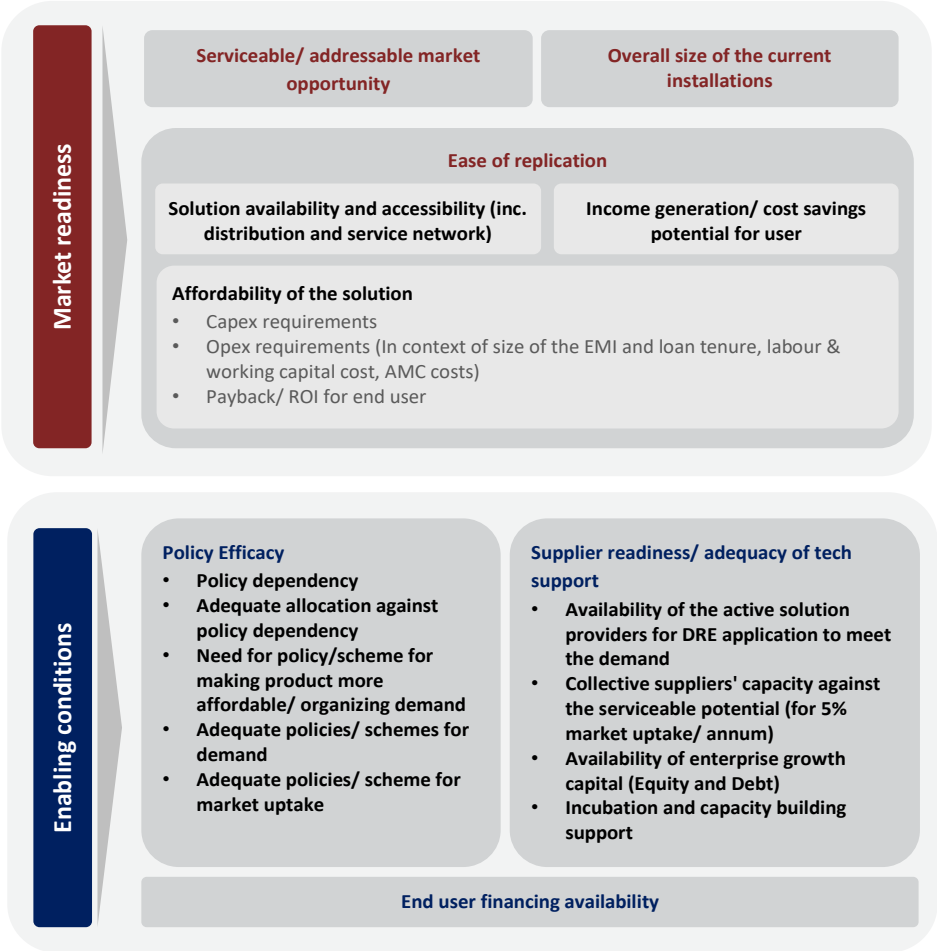


Figure 5: Parameters for DRE interventions assessment framework

Developing the state level recommendations for each key state

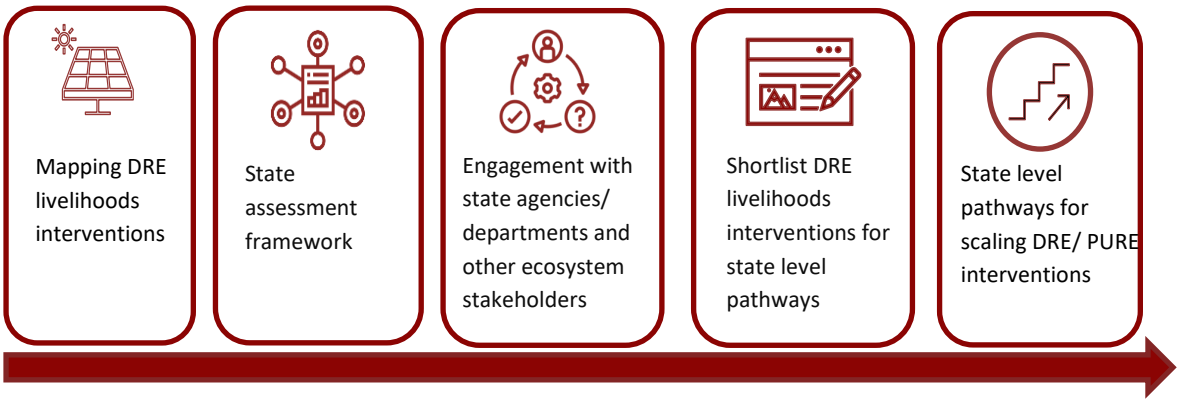


Figure 6: Process followed to develop state level pathways

The process adopted for developing state level recommendations is presented below. The recommendations were crafted based on findings emerging from the research as also validated through interactions with concerned state government departments/ agencies, suppliers, program proponents etc.

3 PURE interventions represent a unique development pathway delivering economic and green growth

3.1 Key solution segmentation reveals a broad set of opportunity areas enabled by PURE

Different livelihood areas have been mapped at state- level based on the livelihoods sector supported under the National Livelihood mission- NRLM. Further, segment classification has been undertaken within the livelihood activities to identify the ones where DRE /productive use appliances for livelihoods are a core feature.

This mapping identifies core sectors where rural communities, particularly women and self-help group (SHG) members, are actively engaged and where the integration of DRE solutions holds the potential to enhance productivity, reduce drudgery, increase incomes, and savings. Productive use includes use-cases for Agriculture, Livestock and Non-farm enterprises-based activities as presented in the synthesis below.

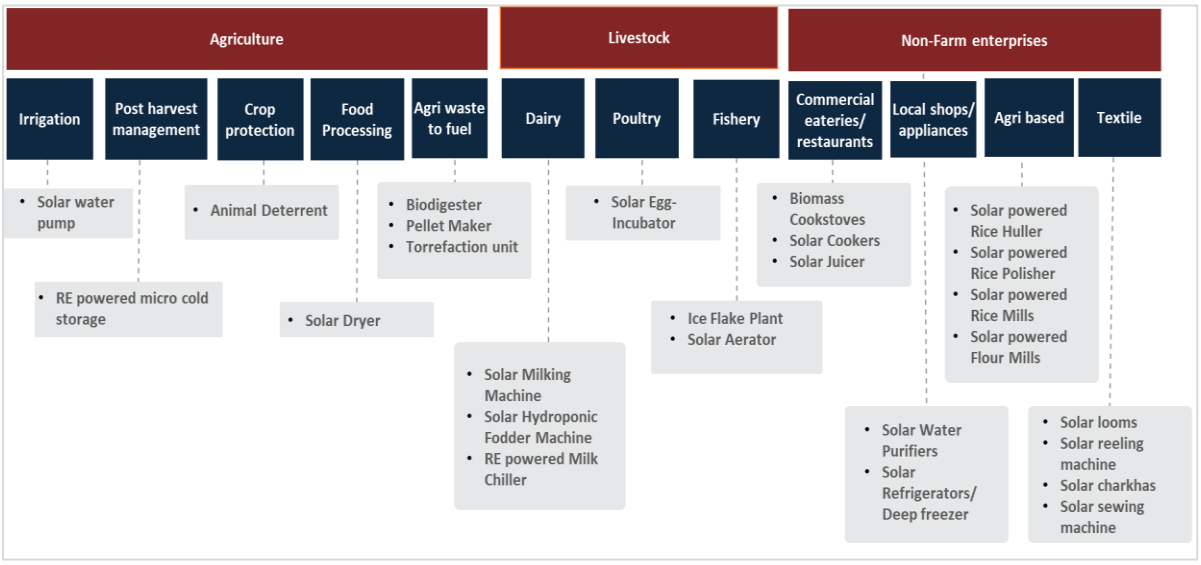


Figure 7: Segment classification and key solutions catering to different livelihood interventions

To assess the potential for DRE deployment, the livelihood sectors have been further segmented into sub-activities based on their use cases and different models. The segmentation helps in prioritizing interventions that not only align with livelihood promotion objectives but also lend themselves to productive use appliance adoption powered by decentralized renewable energy systems (e.g., solar, biomass

The classification focuses on three key livelihood verticals: Agriculture-based activities such as irrigation, post-harvest processing, and storage; Livestock-based activities including dairy processing, poultry feed preparation, and aquaculture; Non-farm and micro-enterprise activities, which include tailoring, food processing, commercial eateries, and other rural enterprises. Each of these verticals is matched with energy-enabled solutions that are either currently in use or show strong potential for scale.

3.2 Technology Provider Landscape: PURE interventions attracting a range of system suppliers and newer tech entrepreneurs

The landscape of PURE technology providers is diverse, encompassing a wide range of enterprises. The space has also witnessed the emergence of several new enterprises/ entrepreneurs attempting to seize the opportunity arising from the perspective of product design and innovation to suit the requirement of various use-cases. An illustrative list of system suppliers and technology installers across different PURE intervention segments is summarized in the table below.

Segment	Products	Manufacturers/ System integrators (illustrative)	Service providers (illustrative)
Post harvest Management	RE powered Micro Cold Storages	Ecozen, Inficold, New Leaf Dynamic, Pluss Technologies, CHDK technology, TESSOL etc.	Coolcrop, Oorja Development Solutions, etc.
Crop Protection	Animal Deterrent	Katidhan, Kyari	
Food Processing	Solar Dryer	Kraftwork Solar, Rudra Solar, Geetanjali solar, Saptakrishi	Guna Organics, Raheja Solar, S4S Technologies, Taru Naturals
Agri waste	Bio-digester	Systema Bio	Grassroots Energy, Samuchit Envirotech
	Torrefaction unit and Pellet maker	Aganvay Technologies	A2P Energy Solution
Irrigation	Solar Water Pump	Shakti Pumps, Rotomag, Tata power Solar, Premier Solar, CYGNI Energy, Ecozen solutions, Karmatech, Onergy Solutions & Kethworks (Micro pumps) etc.	Claro energy, Oorja Development Solutions, etc.
Dairy	RE powered Bulk Milk Chillers	Inficold, Promethean Power Systems, New Leaf Dynamics	
	Solar powered milking machine	Ksheera Enterprises, Lifeway Solar etc.	
	Solar Hydroponic Fodder Machine	Hydrogreens	
Poultry	Solar Egg Incubator	Lifeway Solar, Pushan Renewable Energy	
Fishery	RE powered Ice Flake Plant	New Leaf Dynamics	
	Solar Aerator	Synergy Aqua, DAPL Agri products	
Commercial eateries/ restaurants	Biomass Cookstoves	Agnisukh Energy Solutions, Biolite, Bluematch Solutions, Ecosense Appliances, Enersol Biopower, Envirofit, Greenway Appliances, Orjabox etc.	Himalayan Rocket Cookstove
	Solar Powered Juicer	Battighar Sustainable Solution, Dharambir Food Processing Technologies etc.	
Local shops/ appliances	Solar Refrigerator/ Deep Freezer	Devidayal Solar, Tan 90, Diamond Renewable Solutions, Rockwell Industries, Exaltra, etc.	
Agri based non-farm	Solar powered rice huller/ Polisher/ mills/ Flour mills	Alto Precision, Deyhaat Connect LLP, Anya Green Energy , Exalta, Ornate Solar, Rahyni Solar, OMC Power etc.	Oorja Development Solutions (Flour)
Textile	Solar powered looms, Reeling machines, Sewing machine, Charkha	Flextron, Microspin, Envo Renewable Energy Services	Resham Sutra Pvt. Ltd

Table 2: System suppliers and technology installers across different PURE interventions

3.3 Access, Affordability and System support

Despite growing availability of DRE technologies tailored to rural livelihood needs, several constraints persist that limit uptake. While a wide array of DRE-based productive-use technologies (e.g., solar dryers, micro cold storage) are available in the market, the supply chain remains fragmented and highly localized. The limited presence of last-mile distributors and service providers often leads to inconsistent product quality, subpar installation, and inadequate maintenance services, which directly impact the operations.

Many end users encounter, and report restricted options viz. availability of appliances well customized to their needs. ***Product selection is often supply-driven, rather than need- or user-driven, leading to low utilization rates***. Moreover, most solutions lack modularity or adaptability to varying energy loads, seasonal use, or user skills, further narrowing their functional relevance. The table below presents an analysis of the supplier ecosystem readiness for the DRE applications:

DRE Interventions	Supplier readiness/ adequacy of tech support	Active solution providers	Suppliers' capacity to achieve the serviceable market	Availability of enterprise growth capital	Incubation and capacity building support
RE powered Micro-Cold Storage					
Animal Deterrent					
Solar Dryer					
Bio-digester					
Torrefaction Unit					
Pellet Maker					
Solar Pumps					
RE powered Bulk Milk Chiller					
Solar Milking Machine					
Solar Vertical hydroponic fodder machine					
Ice Flake Plant					
Solar Egg Incubator					
Solar Aerator					
Biomass Cookstoves					
Solar Cooker					
Solar juicer					
Solar Water Purifier					
Solar Refrigerator/ Deep Freezer					
Solar powered Rice Huller					
Solar powered Rice Polisher					
Solar powered Rice Mills					
Solar powered Flour Mills					
Solar powered looms					
Solar Reeling Machine					
Solar Charkhas					
Solar Sewing Machines					

Adequate	Moderate	Low

The high upfront capital expenditure of many DRE livelihood solutions remains a major barrier, particularly for SHGs and first-time entrepreneurs. Operating costs, including AMC and working capital also influence the outlook on affordability- especially when income from the appliance is uncertain or seasonal.

Even as government schemes such as Prime Minister's Employment Generation Programme (PMEGP), Pradhan Mantri MUDRA Yojana (PMMY) and National Agriculture Infra Financing Facility (AIF) provide subsidized loans, uptake is hampered by complex application procedures, limited awareness, and low creditworthiness of users.

There is growing experimentation with Service models, lease-to-own, and SHG/ producer-group owned asset deployment to help address some of these core concerns. These models help reduce financial risk for individual users, but so far have seen an uptake at a modest scale, often dependent on donors or project-based support. **For these models to scale, stronger market linkages, credit risk mitigation mechanisms, and enterprise capacity building are essential**.

3.4 PURE segment as a catalyst for Social and Economic empowerment

PURE solutions offer promising pathways to address social and economic challenges while promoting sustainability. For instance, within the agriculture sector which supports livelihood of a majority of the rural population, the use of solar pump for the purpose of irrigation and RE powered micro cold storage system for cooling of produce which can directly unlock substantial benefits for farmers by improving income, reducing post-harvest loss etc,. PURE solutions not only enable communities access to clean and stable source of energy for productive use but also contribute to multiple SDGs (Sustainable Development Goals) by raising living standards, improving income, reducing drudgery, and increasing resilience to external shocks and stresses.

3.4.1 Illustration of Social & Economic impacts for PURE segments

In addition to contribution towards SDG7 (access to affordable, reliable, sustainable and modern energy) as a direct outcome of adoption of PURE solutions, there are several other benefits emanating out of productive use of energy that are connected to multiple SDGs, for example- application of PURE solutions in agri value chain represent not only directly contribute to poverty reduction but also decreases but also contributes in achieving hunger reduction goals. Also, other applications of PURE solution in textile value chain directly contribute to poverty reduction goal, gender equality goal etc. Over 15 SDGs have at least one direct or indirect contribution from DRE livelihood appliances mapped in the report. This demonstrates that DRE is not only an energy access enabler (SDG 7) but also a development multiplier.

To understand the interlinkages between SDGs and impact created through solutions, interlinkages between SDGs and impact created through various PURE solutions are represented in the graphic overleaf

DRE Interventions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Solar powered Micro Cold Storages	✓	✓					✓	✓	✓			✓			
Animal Deterrent		✓					✓								
Solar Dryer		✓			✓		✓	✓				✓	✓		
Agri residue based							✓						✓		
Solar Water Pump	✓	✓				✓	✓								✓
RE powered Bulk Milk Chillers	✓	✓					✓					✓			
Solar powered milking machine		✓			✓		✓								
Solar Hydroponic Fodder Machine	✓	✓				✓	✓					✓			
Solar Egg Incubator	✓	✓					✓								
Ice Flake Plant		✓					✓					✓			
Solar Aerator							✓							✓	
Biomass Cookstoves, Solar Cookers			✓		✓		✓						✓		
Solar Powered Juicer							✓	✓							
Solar water purifier			✓	✓		✓	✓								
Solar Refrigerator/ Deep Freezer	✓	✓	✓				✓					✓			
Solar powered mills	✓	✓					✓	✓	✓			✓			
Textile machineries	✓				✓		✓	✓			✓				

Table 3: Alignment of PURE solutions with SDGs

3.4.2 PURE as a catalyst of livelihoods

PURE technologies have significant potential to impact livelihoods. The livelihood impact of various PURE technologies /segments can be gauged on the basis of 3 broad pillars:

- Job creation Potential – Increase in proliferation of PURE technologies is directly proportional to increase in indirect jobs associated with systems operation and maintenance. for example – Deployment of MCS, Millls will require employees for managing the assets on a regular basis.

  In addition, PURE technologies present significant potential for creation of direct jobs due to increase in income generation opportunities.
- Monetary Saving potential - Application of PURE technologies presents significant opportunity for reduction of operational expenses typically associated with use of conventional sources of energy. For example – replacement of diesel dependent mill with solar powered mills can lead to high monetary savings
- Income Generation Potential – Application of PURE technologies can increase income through increased productivity, reduced waste etc. For instance, the MCS and Dryers can increase the income of F&V farmers by reducing wastage.

Solutions/Products	Job Creation Potential	Monetary Saving Potential	Income Boost Potential	Rationale
Agri Pumping				• SWPs replacing diesel pump presents high potential for saving expense made on diesel • Increases income of farmers in rainfed areas which practice single cropping cycle due to high dependency on rainfall
Agri residue-based enterprises				• Biodigesters present significant potential to savings as all the by-products of the bio-digestion present opportunity for monetization
Cooling Solutions				• Utilization of MCS for storage of Fruits & Vegetables can significantly reduce the wastage and better price realization for same produce can be achieved • Significant potential for savings due to replacement opportunity of conventional BMC
RE powered appliances (Eg. Solar Cookstoves)				• Replacement of conventional cookstove with biomass cookstove will reduce the expenditure • Proliferation of solution present limited direct job creation potential however solution can help improve income of end users significantly
Agri non-farm enterprises				• These technologies offer significant job creation potential by establishing local processing units, which can employ individuals across various skill levels ranging from machine operation to maintenance and entrepreneurs
Solar Dryer				• Application of solar dryer can improve farmers income by reducing the wastage, segment has a potential for installation of around 0.59 mn units, therefore, represent considerable potential for direct job creation
Solar Powered Textile				• Solution presents relatively lower potential for livelihood impact in near term as installation are primarily driven by govt initiative in timeframe of 2-3 years





3.5 Policy triggers growth in PURE segments, but a comprehensive framework is still lacking

While policy landscape has evolved over the years, a comprehensive framework addressing the wide array of PURE interventions is still to evolve. In the recent past, the Ministry of New and Renewable Energy (MNRE) initiated efforts to address this; however, further work is needed to develop a comprehensive and actionable framework. Amongst the interventions of priority, Solar irrigation pumps and Biodigesters are the most common PURE solutions targeted by state and central policies, with notable examples being PM-KUSUM, National Bio Energy Program, and various state-level renewable energy policies/ schemes. DRE adoption across states reflects strong policy priority towards Solar pump and biodigesters.

An overview of the major policies/ schemes supporting the DRE interventions is presented below

Schemes/ Policies	Department	Direct enabling policies/ schemes	Indirect enabling policies/ schemes	Incentives/ Features
Central schemes/ policies				
Gobardhan' (Galvanizing Organic Bio-Agro Resources Dhan)	MDWS	AW		Central finance assistance of INR 7,500 to INR 35,000 got individual household biogas plant with capacity up to 1 to 25 CUM, Under Swacthh Bharat Mission (G) INR 50 lakhs per district is allocated for community level/ cluster level biogas plant
Integrated Scheme for Agricultural Marketing (ISAM)	MoA&FW		PHM	The scheme provides a back-ended capital subsidy of 25% (subject to a maximum of INR 25 lakhs) to 33.33% (subject to a maximum of INR 30 lakhs) of the project cost.
Mission on Integrated Development of Horticulture (MIDH)	MoA&FW	PHM, FP		MIDH is being implemented in the states as the State Horticulture Mission (SHM). As per the MIDH Guidelines 2025, beneficiaries are eligible for 35% back-ended financial assistance for solar cold rooms
Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)	MoRD	AW		Support installation of biodigester at household level and community level
National Bio-energy Program (Biogas Programme)	MNRE	AW		Provides support in setting up of small biogas plants (1 to 25 CUM) with Central finance assistance of INR 9,800/- to INR 70,400/-, and for power generation (25 – 2500 cubic meter/day plant capacity) with CFA of INR 35,000/- to INR 45,000/- per kilowatt for power generation
PM Formalisation of Micro Food Processing Enterprises Scheme	MoFPI		PHM, DR	To provide financial, technical, and business support for the upgradation of existing micro food processing enterprises. The scheme provides credit-linked grants to 35% of the project cost for developing common infrastructure including cold storage

PHM	Post harvest management- RE powered micro cold storage	DR	Dairy- RE powered bulk milk chillers, Vertical hydroponic fodder machine
FP	Food processing- Solar Dryers	LA	Local shops/ appliances- Solar Refrigerators/ freezers
AW	Agri waste to biofuel- Biodigesters	AB	Agri based enterprises- Solar powered rice huller, polisher and mills, Solar powered Flour mills
FS	Fishery- Solar Aerators, RE powered Ice flake plants	TX	Textile - Solar powered looms, Solar Reeling Machine, Solar Charkhas, Solar Sewing Machines

Schemes/ Policies	Department	Direct enabling policies/ schemes	Indirect enabling policies/ schemes	Incentives/ Features
Sub-Mission on Agricultural Mechanization (RKVY)	DAFW	FP, AW, DR	AB	Proposed component for updated guidelines to include financial assistance @50% of the cost of the machine for small and marginal farmers, SC, ST and women farmers. 40% for all other farmers
Submission on Feed and Fodder Development	DAHD		DR	50% percent capital subsidy towards project cost to the beneficiary for Infrastructure development related to hay/silage at village level/ Fodder blocks making units
State schemes/ policies				
Circular Dairy Programme	NDDB	AW		250 District dairy cooperatives to be supported to set up 10,000 biodigesters in the next 4 years covering 15 states including UP
Decentralized Renewable Energy for Women Economic Empowerment (DEWEE)	UPSRLM, UPNEDA	PHM, FP, DR, LA, AB		In 1st Phase, 10,000 women led enterprises will be promoted to various DRE applications, 3304 solar manufacturing and repairing shops will be opened along with Surya Sakhi at every gram panchayat
Food Processing Industry Policy 2022-2027	DHFP- Govt. of UP		PHM	Support for Cold Chain and Value Addition Infrastructure including storage, pack houses, pre-cooling units, ripening chambers, and transport infrastructure at 35% of the project cost
Hon. Balasaheb Thackeray Agribusiness & Rural Transformation (SMART)	World Bank, Agri Dept- MH	PHM, FP		Provides upfront capital assistance for 60%, 30% bank loan facilitation under AIF (interest subvention) and CGTSME (collateral free) and remaining contribution of 10% by beneficiary
Jharkhand State Solar Policy 2022	JREDA	PHM, FP, TX		Provision of large-scale deployment of solar applications such as solar food dryers shall be promoted to generate solar energy locally
Maharashtra Agribusiness Network (MAGNET)	MSAMB, ADB	PHM, FP		The scheme focuses on Horticulture value chain, provides upfront capital assistance for 60%, and remaining 40% contribution from the beneficiary
MMKY- Popularization of fisheries machinery/ equipment	F&ARDD, Govt. of Odisha		FS	The beneficiary is eligible for back ended subsidy of 40% on the unit cost and promote establishing machinery and equipment at fishery value chain
Mukhyamantri Krushi Udyog Yojana (MKUY)	APICOL	PHM, AW	DR	Supports a maximum capital investment subsidy upto INR 1 Cr (with maximum project cost being INR 50 Cr and minimum project cost of INR 5 Lakh) for setting up Commercial Agri Enterprises; subsidy being 40% of the fixed capital investment for general male entrepreneurs and 50% for SC/ ST/ Women/ Trans/ PWD entrepreneurs

PHM	Post harvest management- RE powered micro cold storage	DR	Dairy- RE powered bulk milk chillers, Vertical hydroponic fodder machine
FP	Food processing- Solar Dryers	LA	Local shops/ appliances- Solar Refrigerators/ freezers
AW	Agri waste to biofuel- Biodigesters	AB	Agri based enterprises- Solar powered rice huller, polisher and mills, Solar powered Flour mills
FS	Fishery- Solar Aerators, RE powered Ice flake plants	TX	Textile - Solar powered looms, Solar Reeling Machine, Solar Charkhas, Solar Sewing Machines

Schemes/ Policies	Department	Direct enabling policies/ schemes	Indirect enabling policies/ schemes	Incentives/ Features
Odisha Renewable Energy Policy, 2022	OREDA	PHM, AW		Provision of large-scale deployment of solar applications such as solar food dryers shall be promoted to generate solar energy locally and in a decentralized manner to encourage its use for livelihood activities and to enable development of bio energy-based projects
Odisha Integrated Irrigation Project for Climate Resilient Agriculture (OIIPCRA)	OCTDMS, DWR- Govt. of Odisha, World Bank	PHM, FP		Solar cold room of 5 MT capacity and Grid electricity connected cold room of 30 MT are eligible under the project, the selection of beneficiary is as per MIDH guidelines and the pattern of assistance may/ may not be credit linked and will support 95% of the project cost maximum up to INR 14,25,000 per project
State Integrated Strategy for Non-Transmission Projects for Generation of Power from New and Renewable (Unconventional) Energy Sources – 2020	MEDA	PHM		Financial assistance from the Central Government, amounting to 30% of the project cost, is available for the establishment of solar-based cold storage plants, initially set the target of establishing 800 solar powered cold rooms
Uttar Pradesh Solar Energy Policy 2022	UPNEDA		PHM	Provision for setting up solar cold storage with the help of Agricultural University of State and Uttar Pradesh Mandi Vikas Parishad, Initiated 25 pilots for solar cold rooms (6 MT) in 2023

Table 4: Key schemes/ policies supporting DRE applications for livelihoods

PHM	Post harvest management- RE powered micro cold storage	DR	Dairy- RE powered bulk milk chillers, Vertical hydroponic fodder machine
FP	Food processing- Solar Dryers	LA	Local shops/ appliances- Solar Refrigerators/ freezers
AW	Agri waste to biofuel- Biodigesters	AB	Agri based enterprises- Solar powered rice huller, polisher and mills, Solar powered Flour mills
FS	Fishery- Solar Aerators, RE powered Ice flake plants	TX	Textile - Solar powered looms, Solar Reeling Machine, Solar Charkhas, Solar Sewing Machines



Several of these policies /schemes for catalyzing adoption- from solar-powered agricultural equipment to textile machineries- have been implemented with varying levels of efficacy. The table overleaf synthesizes momentum triggered by these policies across the targeted intervention segments.

The analysis factors in facets of resource allocation, demand development, and ease of scheme access amongst the targeted beneficiaries to gauge the overall efficacy and resultant segment momentum.

Segment	Central policies/ schemes priority	State policies/ scheme priority	Policy dependency	Policies/ schemes for market uptake	Gaps
Post Harvest Management (RE powered Micro-Cold Storage)	▶	▶	▲	▼	Adequate allocation and effective policies for market uptake remain insufficient, fragmented support and different incentives across the states
Agri Waste to biofuels (Biodigesters)	▲	▲	▲	▶	Applicable in different central schemes and states bioenergy policies; major focus on large scale bio-gas plants
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine, Solar milking machines)	▼	▼	▶	▼	Central schemes primarily focus on grid-powered or diesel-powered systems. While the sector is largely regulated by NDDB, most of the available support is directed toward cooperatives, leaving limited assistance for private entrepreneur
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development, only large uptake implementation plan is from UPSRLM-DEWEE program
Food processing (Solar Dryers)	▶	▶	▲	▼	Adequate allocation and effective policies for market uptake remain insufficient, some schemes/ policies have included the solution but large-scale implementation with specific targets are yet to operationalize
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)	▼	▼	▶	▼	Lack of dedicated schemes/ policies for market development, inclusion in schemes like AIF for mills, and SMAM for rice mills, priority sector lending but none of the schemes have upfront capital support
Fishery- Solar Aerators, RE powered Ice flake plants	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development, state scheme like MKUY supports Ice flake plants but individual allocation is low for market uptake
Textile - Solar powered looms, Solar Reeling Machine, Solar Charkhas, Solar Sewing Machines	▼	▼	▼	▼	Lack of dedicated schemes/ policies for market development at central level, National Handloom Development program supports Solar reeling machines but lacks defined targets and adequate allocation for market uptake

Table 5: Overall policies/ schemes outlook for DRE livelihoods interventions

▲ High dependency /Prevalence ▶ Adequate alignment ▼ Low prevalence

Key takeaways are summarized below

- Central and state policies largely support the Solar pump and biodigester interventions, with notable schemes such as PM-KUSUM, MGNREGS, National Bioenergy Programme, and state-specific renewable energy policies driving deployment.
- The adoption of solar pumps is a prominent focus across the states, and the uptake is majorly supported under the Central Govt. PM-KUSUM scheme, though states like Bihar still have to adopt the PM-KUSUM despite potential and expressed demand for solar pumps.
- Even as sectoral focus of several of these policies /schemes extends beyond irrigation and includes cold storages, dairy focused interventions (solar-powered milk chillers, fodder machines), textiles (solar looms, reeling machines), fishery (solar-powered ice plants), and Agri-waste to biofuel (pellet makers besides biodigesters) but the actual progress is much lower in comparison.
- While some of these policies and schemes have laid out clear targets and the same are being tracked (e.g. PM-KUSUM or initiatives under the Jharkhand Renewable Energy Policy), a majority of the schemes/ policies lack explicit DRE intervention targets, adversely impacting focused implementation.
- Integration and convergence of central and state schemes are observed for some of the DRE interventions but overall remains low, highlighting opportunities to streamline efforts and improve beneficiary reach and impact.
- Financing mechanisms under schemes like CGTMSE, AIF and PMFME and others are critical but often underutilized due to awareness gaps and constraints emerging from beneficiary profiles (e.g. unincorporated farmer groups are not covered in several of these schemes).

3.6 Landscape of FIs and Investors active across the PURE Landscape

Currently, financing for DRE livelihoods comes from disparate channels – credit linked subsidies, agriculture/rural development schemes, banks' priority sector loans, NBFC/MFI credit, and philanthropic capital. Financing for DRE livelihoods in India is evolving from a niche experimental phase towards a more structured, multi-stakeholder ecosystem. Subsidies and grants have kick-started the market, but scalability will depend on mobilizing banks, NBFCs, and MFIs to extend appropriate credit to end-users, backed by policy incentives and risk mitigation.

Quantum of capital for DRE enterprises has improved in recent years with scaled-up interest on equity front from accelerator funds, corporate investors as also impact /cleantech funds. Most of the capital flow has been directed at a few enterprises with a focus on segments such as Agri residue, Cooling solutions and Agri pumping.

On the debt front, even as only a few of the enterprises have tapped into debt, there is emerging interest from some specialist NBFCs such as Sammunati and cKers Finance and also some pilots underway for facilitating retail /user-financing at scale.

On the retail finance end, access to finance remains a critical pre-requisite for triggering adoption of DRE technologies. While India's financing landscape has evolved with multiple schemes- such as PMEGP, MUDRA, and the Agriculture Infrastructure Fund (AIF) and Priority Sector Lending (PSL)- the benefits are unevenly distributed across DRE technologies and user segments. Most financing is directed toward high-value, agriculture-aligned assets

such as solar pumps and micro cold storage units. These technologies align well with existing schemes and attract broader institutional support.

In contrast, emerging livelihood technologies- like solar aerators, animal deterrents, and solar egg incubators- face limited access due to eligibility gaps, low lender awareness, and lack of credit history among users. High-cost systems, even after factoring subsidies, are still unaffordable for many marginal farmers without credit.

Barriers related to borrower profile, awareness, institutional reach, and documentation reduce effective accessibility. Key challenges include:

a) Accessing bank loans can be difficult due to collateral or documentation requirements
b) The small ticket size of loans, coupled with extensive documentation requirements, often deters banks- even those with Priority Sector Lending (PSL) obligations- from extending credit to these segments, as they tend to prefer larger, more streamlined loans to established players
c) Limited bank branch penetration in rural areas restricts formal credit access; farmers often depend on informal lenders with higher costs - Rural and remote regions (especially Northeast, tribal areas) suffer from fewer bank branches and limited presence of NBFCs or MFIs, reducing access to formal finance despite available schemes
d) Low awareness about subsidy schemes and credit options reduces uptake
e) Complex loan application processes and lengthy approvals discourage many farmers
f) High interest rates and short repayment tenures from MFIs increase borrower risk and limit uptake

An assessment across the key states of interest indicates:

a) Karnataka, Maharashtra, Rajasthan, Uttar Pradesh have relatively better institutional outreach, credit linkage programs, and NGO support, improving accessibility for various DRE products.
b) State livelihood missions (e.g., BRLPS in Bihar, OLM in Odisha) actively support financing linkages, enhancing access for women's SHGs and farmer groups.
c) Northeastern States, Tribal Areas in states like MP and Odisha, Parts of Bihar and Jharkhand face challenges due to weaker banking infrastructure and limited awareness.

An overview of key financiers and investors and segments /solutions invested in presented below. A detailed mapping is included in Annexure 10.2.

Solution	Equity/Quasi Equity	Debt	Grant	Retail Financing
Solar pumps	1, 4, 6, 13, 15, 16, 17, 18, 21, 27, 29, 32, 2, 5, 13, 15, 20, 22	1, 2, 3, 4, 7, 9	22, 5, 9, 17, 18, 21	1, 2, 3
Biodigesters	2, 5, 6, 10, 24, 34	8	3, 6, 8, 9, 15, 18	7
RE powered micro cold storage	1, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 17, 18, 23, 27, 29, 30, 31, 32, 36, 2, 4, 5, 12, 15, 20, 22, 23	1, 2, 3, 4, 6, 7, 9	22, 25, 5, 9, 15, 16, 18, 21	1, 3, 4, 5,
Solar powered milk chiller	9, 12, 14, 2	1	15, 18	1, 6,
Solar refrigerators and freezers	5	5	5, 16, 17	
Solar Powered Juicing Machine			16	
Biomass cookstoves and Solar Cookers	1, 2, 3, 5, 10, 15, 33, 35, 5		5	

Solution	Equity/Quasi Equity	Debt	Grant	Retail Financing
Solar powered milking machine			14	6
Solar powered sewing machine	1, 11, 13, 16		3, 7, 14, 16	6
Solar powered mills				7, 8
Solar dryers	1, 20, 21, 24, 28, 1, 12, 16		26, 10, 14, 15, 16	
Solar powered egg incubator, aerators etc.			15	

Categorization of Investors/ Financiers based on the type of funding

Investor Type	Names
VC/PE (including impact VCs and Corporate Funding Arms)	1. Acumen Fund, 2. AXA Investment Partners, 3. Blue Ashva Capital, 4. Caspian Impact Investment, 5. Engie, 6. Hivos Triodos fund, 7. Impact India Investment Partners, 8. Infuse Ventures, 9. Invested Development, 10. KawiSafi Ventures, 11. Mela ventures, 12. TotalEnergies Ventures, 13. Omnivore, 14. Rajasthan Venture Capital Fund, 15. Artha Impact, 16. Samridhi Fund
Accelerators/Incubators/Seed Funds/Crowd Funding/Donors	1. Upaya Social Ventures, 2. Sangam Ventures, 3. Technology Development Board of the Government of India, 4. 1crowd, 5. Social Alpha, 6. Rockefeller Foundation, 7. Aurora Trust
DFI/Bank/NBFC/Impact Debt	1. cKers Finance, 2. Maanaveeya, 3. Samunnati, 4. Ashv Finance, 5. S3IDF-US, 6. InCred Capital
Retail Financing	1. RBL Bank, 2. IndusInd, 3. Karur Vysya Bank, 4. Bank of India, 5. Samunnati, 6. Canara Bank, 7. Nabkisan 8. Bhawanipatna Cooperative Bank

Table 6: List of Institutions providing support in DRE segments

Key concerns regarding viable business models, pace of scale and dependence on government subsidies pose challenges for the growth of the segment. *The sector requires credit guarantee and risk mitigation mechanisms, capacity building amongst financiers as well support for emerging business models, amongst other interventions*

3.7 Donor and Catalyst initiatives powering the PURE ecosystem

Key donor and catalyst programs have been a key catalyst for the deployment of PURE interventions across India. Even as the policy thrust is majorly focused on specific interventions like Solar water pump and biodigesters along with some fragmented ecosystem support for systems like Solar powered micro cold storages and Solar dryers, over the past five years, donors and catalysts including CSR backed entities have piloted multiple DRE livelihood initiatives. These programs have demonstrated use cases and crafted a level of sensitization among the beneficiaries; however, market adoption of DRE technologies remains limited due to lack of adequate market development as also shifting priorities amongst donors across different interventions. The following table details out recent donors, catalyst and CSR backed PURE intervention.

Intervention Area	Donor /Catalyst	Program Partner	Nature of intervention/ support	Program Features
Multiple PURE solutions	IKEA Foundation	SELCO foundation	Grant, Technical Assistance	Ongoing support to SELCO Foundation. As of 2025, SELCO has deployed 130+ MCS and several other DRE applications across several states in India[1]
		Sustain Plus Energy foundation	Grant, Technical Assistance	Sustain Plus has deployed 50+ MCS across several states in India and supported solar powered tailoring and food processing pilots. In Jharkhand, deployed 50 solar sewing machines for women-led microenterprises and has received a multi-year support in 2024 of nearly USD 20.4 mn to upscale multiple PURE solutions[2]
		CEEW	Grant, Technical Assistance	Powering Livelihoods phase 2[3]
Multiple PURE solutions	Shell foundation	CEEW- Villgro	Grant, Technical Assistance	Has entailed an overall grant of USD 0.5 Mn in 2021 and USD 1.4 Mn in 2023 for multiple PURE applications. Funding has supported installations of MCS with 70 to 100% Capex subsidy and both biomass (multiple units by NLD) and Solar powered one[4]
RE powered micro cold storage	Water & Energy for Food (WE4F) program and DOEN Foundation	Oorja development services	Grant	Grant support (through seed funding) to Oorja Development services for implementing Cooling as a service models in Bihar (Muzaffarpur)
Solar Dryers	UN Women	S4S Technologies, PRADAN and Chaitanya Foundation	Grant	UN Women supported startup S4S Technologies to install 60 solar conduction dryers and train 60 women in Odisha and Maharashtra[5]
Solar bulk milk chiller	HSBC	WWF, WRI	Grant	A five-year program (2021- 2026) for installing solar milk chillers in dairy clusters. WWF-India, under this partnership, has deployed 38 solar milk chillers (500-liter rapid chillers with battery backup) across Uttar Pradesh and Rajasthan[6]

1 IKEA Foundation
2 IKEA Foundation; Scaling PURE towards climate resilience
3 IKEA Foundation; Powering livelihoods phase 2
4 Shell Foundation; Report of Trustees and Financial Statements
5 UN WOMEN; Women's entrepreneurship for sustainable energy
6 WWF India; Initiative to solarize dairy cold chain

Intervention Area	Donor /Catalyst	Program Partner	Nature of intervention/ support	Program Features
RE powered micro cold storage	GIZ	Coolcrop	Grant, Technical Assistance	GIZ engaged CoolCrop Pvt. Ltd. to deploy multiple solar cold rooms (8-20 MT) for apple farmers in Himachal Pradesh and also other pilots in Maharashtra. Also deployed one solar powered cold storage through Coolcrop at the Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, in Nauni (April 2025)[7]
RE powered micro cold storage	India Climate Collaborative (ICC)	Selco Foundation	Grant	ICC funded SELCO Foundation to pilot three community-run solar cold storages in Odisha[8]
RE powered micro cold storage	The Walmart foundation	SM Sehgal Foundation	Grant	The Walmart foundation has supported several farmer livelihood projects via grants to NGOs. In a project implemented by S M Sehgal Foundation, Walmart's grant funded five solar-powered micro cold storage units (5 MT each) in Kolar district, Karnataka[9]
Solar Powered looms	Indus Towers	TERI	Grant	TERI installed HSCUs at weavers' premises in a phased rollout- 134 in 2020-22, and 73 in 2022-23. Each HSCU powers four looms. Additionally, 60 units of DC-powered solar looms were also set up, supporting the weavers[10]
RE powered micro cold storage	EKOenergy	TERI	Grant	TERI implemented a solar cold storage project in Sadali village, Karnataka with a grant of €33,801 from EKOenergy's Climate Fund. A 5 metric-tonne solar cold room (5 kW solar PV) was installed to cater 34 villages (5-gram panchayats) and ~5,617 small farmers[11]
Solar Flour mills	EKOenergy	Agha Khan Rural Support Program	Grant	EKOenergy's Climate Fund granted €31,284 to AKRSP (India) to install 10 solar-powered flour mills in remote Uttar Pradesh villages. Each village got a 5-kW solar system powering a flour mill (and some received additional solar spice grinders)[12]
Solar cooker	Gates Foundation (as BMGF)	EKI Energy Services Ltd	Grant	Pilot grant to support the rollout of the Surya Nutan solar cooking device in tribal and underprivileged regions of Madhya Pradesh, Uttar Pradesh, and Maharashtra dependent on biomass for cooking and to test its adoption and impacts on the health[13]

7 GiZ; India green innovation centers- agriculture food sector
8 Tata Trust; India Climate Collaborative cold storage solution
9 SM Sehgal Foundation; Agriculture development
10 TERI; Energy access livelihoods promotion
11 TERI; solar powered cold storage system
12 EKO Energy; Climate Leaflet 2023
13 Gates Foundation; Grants 2024

Intervention Area	Donor /Catalyst	Program Partner	Nature of intervention/ support	Program Features
Solar Egg Incubator	UNDP GEF	Lifeway solar	Grant	Supported deployment of solar incubator units in 11 tribal villages in Madhya Pradesh, training women SHGs for chick hatching[14]
RE powered micro cold storage	Asian Development Bank (ADB)	EESL	Grant	Energy Efficiency Services Limited (EESL) developed its first solar-powered micro cold storage unit at the Progeny-cum-Demonstration Orchard in Bajaura in Kullu district. Ambition is to develop and implement a 500+ Solar cold room program[15]

Table 7: Overview of major donor/ catalyst programs across the DRE livelihoods segment

3.8 Scaling Potential and Market Readiness to translate the potential

Several of the PURE intervention areas represent significant potential- analysis of the serviceable/ addressable opportunity over next 5-6 years indicates a prospective market of nearly USD 23 bn[16]. The agriculture value chain covers the largest share of the total serviceable market with USD 15.2 bn in opportunities for DRE interventions, accounting for nearly two-thirds (66%) of the total addressable market with Solar pumping, RE powered micro cold storage and Agri waste to biofuels interventions presenting the maximum scale. The growing market potential for non-farm enterprises (USD 5.1 bn) signifies the increasing diversification of rural economies beyond traditional agriculture.

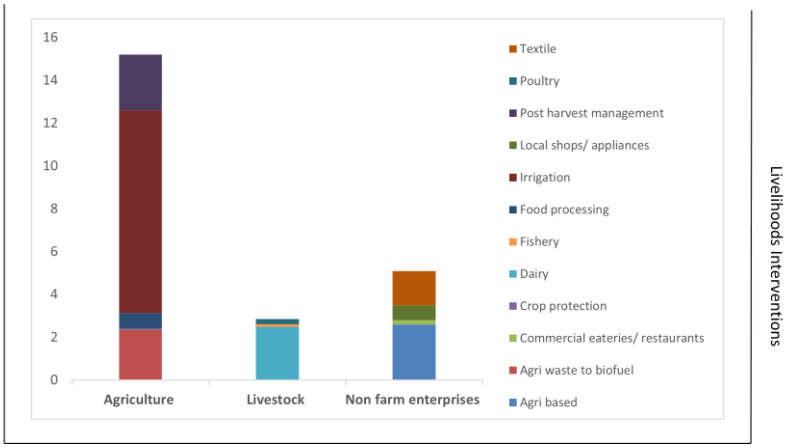


Figure 8: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions

Market readiness has been framed per serviceable market opportunity, ease of replication across the State and current market penetration level against respective potential while the enabling conditions have been assessed per the policy efficacy, supplier readiness/ adequacy of tech support and end user financing availability.

An overview of the assessment of different interventions on these elements is presented overleaf.

[14] UNDP Small Grants Program; Project No: IND/SGP/OP7/Y3/CORE/CC/2023/09
[15] EESL; Solar powered cold storage program
[16] cKinetics analysis

DRE Interventions	Readiness to translate potential to demand	Serviceable market opportunity	Ease of replication	Level of penetration vs. Potential
RE powered Micro-Cold Storage				
Animal Deterrent				
Solar Dryer				
Bio-digester				
Torrefaction Unit				
Pellet Maker				
Solar Pumps				
RE powered Bulk Milk Chiller				
Solar milking machine				
Solar Vertical hydroponic fodder machine				
Ice Flake Plant				
Solar Egg Incubator				
Solar Aerator				
Biomass Cookstoves				
Solar Cooker				
Solar juicer				
Solar Water Purifier				
Solar Refrigerator/ Deep freezer				
Solar powered rice huller				
Solar powered rice polisher				
Solar powered Rice mills				
Solar powered Flour mills				
Solar powered looms				
Solar Reeling Machine				
Solar Charkhas				
Solar Sewing Machines				

Table 8: Market readiness levels across the DRE livelihoods applications

Readiness to translate potential to demand	Adequate readiness conditions	Moderate readiness conditions	Inadequate readiness conditions
Serviceable market opportunity	Potential > 500 USD mn	Potential >200 USD mn and < 500 USD mn	Potential < 200 USD mn
Ease of replication	High	Moderate	Low
Level of penetration vs. Potential	Penetration > 5% of the serviceable potential	Penetration >1.5% and < 5% of the serviceable potential	Penetration <1.5% of the serviceable potential

Prima-facie, amongst the solutions assessed, only Solar pump demonstrates high readiness to translate potential into demand. However, a comprehensive assessment reveals a nuanced perspective with significant variations across serviceable market opportunities, replication ease, solution affordability, and current installation maturity.

- Interventions like Solar Pumps and Bio-digesters represent a high potential for rapid scale due to established infrastructure and demonstrated user benefits in income generation and cost savings.
- Conversely, interventions like Solar Aerators, Ice Flake Plants, and Solar Milking Machines seem to present limited

market opportunity and replication readiness despite their niche sectoral potential. These technologies require considerable market development effort,

- Several moderate-to-high opportunity interventions like RE powered Micro-Cold Storage and Solar Powered Bulk Milk Chillers need to overcome challenges of high upfront Capex and /or longer payback periods (given that typical utilization is modest) to leverage the strong income generation potential.
- High-potential applications like RE powered Micro-Cold Storage and Solar Powered Flour /Rice Mills remain under-deployed, highlighting bottlenecks in policy enablement, end-user financing, and distribution channels. This gap underscores a need for targeted ecosystem interventions, including supplier capacity building and demand-side ecosystem development.

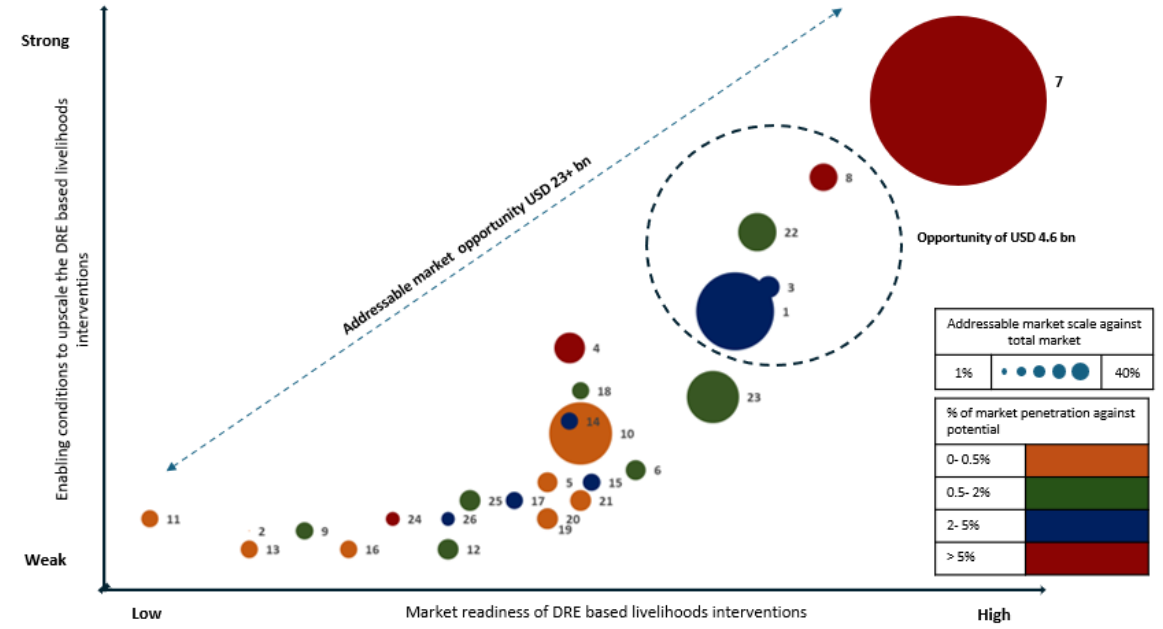
necessitating dependence on policy-driven sensitization and financing innovations to build the ecosystem required for the segment's growth.

- Designing policy and sensitization campaigns for low-market-readiness technologies will accelerate adoption cycles, especially where serviceable potential is large but latent.
- Ice Flake Plants and Solar Aerators could be prioritized for cluster-based interventions in specific geographies (e.g., fisheries in Odisha and Andhra Pradesh) where contextual demand and ecosystem synergies exist.



4 Catalyzing PURE interventions where enabling conditions and demand factors are fructifying

A mapping of the PURE technologies discussed in earlier sections based on their market readiness vs. the enabling conditions required for scale-up is presented below



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Rice mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Flour mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 9: Market readiness and Enabling conditions evaluation framework

		Enabling Conditions		
	Scale	Strong	Moderate	Weak
Market Readiness	High	Solar Pumps		
	Moderate		RE powered Micro-Cold Storage, Solar Dryers, , RE powered Bulk Milk Chiller, Solar powered flour mills, Solar Refrigerator/Deep freezer, Solar powered looms, Bio-digester	Solar powered rice huller, polisher, mills, Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Vertical hydroponic fodder machine, Solar Cooker, Solar Water Purifier
	Limited			Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer, Solar Reeling Machine, Solar Sewing Machines, Solar Egg Incubator, Solar Charkhas

As is evident from the mapping, while certain solutions like Solar Pumps, RE-powered Micro-Cold Storage, Solar dryers and Bio-Digesters demonstrate strong market feasibility and enabling conditions, others such as Animal Deterrents, Solar Aerators etc., have weak enabling conditions and low market readiness.

The addressable potential at All India level, along with key geographies of potential demand, for these priority PURE interventions (with evolving market readiness as also intensifying enabling conditions) is summarized below.

Livelihood area	Livelihood Intervention	DRE Interventions	Serviceable installations potential	Serviceable market (mn USD)	High potential States for the deployment
Agriculture	Post harvest management	RE powered Micro-Cold Storage	~115,000+	2600+	Uttar Pradesh, Maharashtra, Bihar, Andhra Pradesh, Odisha, Madhya Pradesh
	Food processing	Solar Dryer	~570,000+	910+	Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, Odisha
Livestock	Dairy	RE powered Bulk Milk Chiller	~44,000+	465+	Uttar Pradesh, Madhya Pradesh, Maharashtra, Odisha
Non-farm enterprises	Local shops/ appliances	Solar Refrigerator/ Deep freezer	~439,000+	422+	Uttar Pradesh, Bihar, Maharashtra
	Agri based	Solar powered rice huller, polisher and mills	~162,000+	584+	Odisha, Andhra Pradesh, Maharashtra, Uttar Pradesh
		Solar powered Flour mills	~108,000+	844+	Uttar Pradesh, Bihar, Maharashtra, Madhya Pradesh

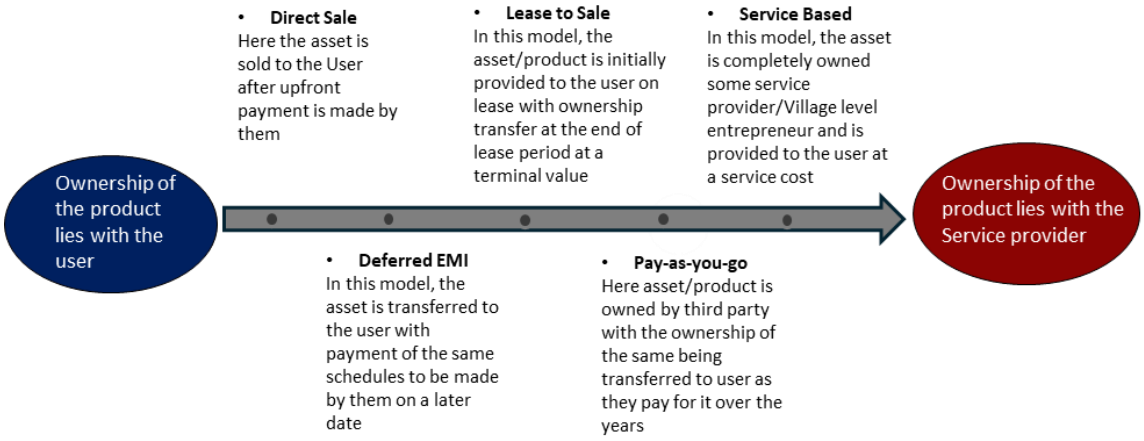
Table 9: Serviceable/ Addressable potential of prioritized interventions

The states of Uttar Pradesh, Maharashtra, Bihar, Madhya Pradesh, Odisha, and Andhra Pradesh emerge as priority regions based on their serviceable market potential among the states shortlisted for the study. Concentrated policy support, investment, and capacity building in these states are essential to accelerate adoption and maximize impact. Targeted upscaling efforts should focus on these geographies to leverage the existing demand and enable efficient deployment of DRE interventions.

4.1 Business cases for PURE interventions

Current models of deployment

There are a number of deployment models being attempted by different providers. Often the deployment model evolves based on the system cost, appetite for upfront financing, target customer segments and availability of financing. For instance, even as system manufacturers and/or installers may prefer a CAPEX model, several customers prefer service models and /or deferred payment models to align with the cash flows resulting from the use of the systems and /or in ensure adequate comfort with the technology performance. Given the emergence of solutions with higher ticket size specifically in Irrigation, post-harvest management and RE powered micro industries segment, service-led models are seeing greater focus. Few of the commonly deployed models are discussed below:



Interventions	Adoption model	Observed challenges				
		Demand	Financing	Utilization	Technology	Local capacity
RE powered Micro-Cold Storage	HB					
Animal Deterrent	CU					
Solar Dryer	HB					
Bio-digester	CU					
Torrefaction Unit	TS					
Pellet Maker	TS					
Solar Pumps	HB					
RE powered Bulk Milk Chiller	HB					
Solar milking machine	HB					
Solar Vertical hydroponic fodder machine	HB					
Ice Flake Plant	CU					
Solar Egg Incubator	CU					
Solar Aerator	CU					
Biomass Cookstoves	CU					
Solar Cooker	CU					
Solar juicer	CU					
Solar Water Purifier	TS					
Solar Refrigerator/ Deep freezer	CU					
Solar powered Mills	HB					
Solar powered looms	CU					
Solar Reeling Machine	CU					
Solar Charkhas	CU					
Solar Sewing Machines	CU					

Adoption models
CU Captive-Use
TS Trader /Service models
HB Hybrid- both CU & TS

Degree of challenge

High

The business case and models being adopted are characterized by system capital cost, operational expenditure, subsidy support, financing structures, and dependence on broader market linkages to ensure adequate asset utilization. The table below synthesizes the typical considerations to ensure a feasible case for each of the priority interventions shortlisted.

Business case considerations for priority PURE interventions

PURE Intervention	Source of Energy	Typical Size	Capex (INR mn)	Opex (INR mn / Annum)	Typical Utilization - Days	Capacity Utilization (Batch/days)	Operational Capacity Utilization (%)	Loan Tenure (years)	Interest rates
RE powered Micro-Cold Storage	Solar	10 MT	1.8 – 1.9	0.15- 0.20	180	1 batch/ 10 days		3	15%
RE powered Micro-Cold Storage	Biomass	20 MT	1.2 – 1.25	0.45- 0.55	180	1 batch/ 10 days	17	3	15%
Solar Dryer	Solar	100 Kgs	0.13– 0.14	0.06- 0.10	270	1 batch/ week		2	25%
RE powered Bulk Milk Chiller	Solar	1000 Lt.	0.9 – 0.95	0.08- 0.10	330	1 batch/day		3	15%
Solar Refrigerator / Deep freezer	Solar	100 Lt.	0.09- 0.10	-	360	24 hrs./day		2	25%
Solar powered rice huller and polisher	Solar	1.5 HP VFD	0.3- 0.35	0.40- 0.45	180	4 hrs./day		3	15%
Solar powered mills (Oil expeller + spice grinding)	Solar	20 HP VFD	1.4 – 1.5	0.50- 0.55	240	6 hrs./day		3	15%

Basis the use cases and typical installation sizes, the financial case for the priority PURE interventions across varying VGF and loan % (compared to system cost) scenarios are synthesized below.

Solar powered Micro Cold Storage

Financing Conditions \ Viability Gap Funding Support Conditions	40%	50%
60%		
50%	10%	
40%	20%	10%

Biomass powered Micro Cold Storage

Financing Conditions \ Viability Gap Funding Support Conditions	30%	35%	40%
60%	10%	5%	
50%	20%	15%	10%
40%	30%	25%	20%

Solar powered Bulk Milk Chiller

Financing Conditions \ Viability Gap Funding Conditions	30%	35%	40%
60%	10%	5%	
50%	20%	15%	10%
40%	30%	25%	20%

Solar Dryers

Financing Conditions \ Viability Gap Funding Conditions	20%	30%	35%	40%
70%	10%			
60%	20%	10%	5%	
50%	30%	20%	15%	10%
40%		30%	25%	20%

Solar Refrigerator/ Deep Freezer

Financing Conditions \ Viability Gap Funding Conditions	10%	20%	30%	35%	40%
70%	20%	10%			
60%	30%	20%	10%	5%	
50%		30%	20%	15%	10%
40%			30%	25%	20%

Solar Rice Huller and Polisher, Mill

Financing Conditions \ Viability Gap Funding Conditions	30%	35%	40%
60%	10%	5%	
50%	20%	15%	10%
40%	30%	25%	20%

Solar Flour mill (add. Oil expeller and spice grinding)

Financing Conditions \ Viability Gap Funding Conditions	30%	35%	40%
60%	10%	5%	
50%	20%	15%	10%
40%	30%	25%	20%

Annotation	
Payback period	
3	2
% value in each block represents Infra owner contribution	

[17] Utilization capacity is considered at 25% for 20 MT system to levelized the utilization capacity of 10 MT solar powered MCS

4.2 Key conditions for market readiness for targeted interventions

Based on stakeholder interactions and analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions. The table below outlines intervention-specific gaps- both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

These include operational challenges, limited financing mechanisms, fragmented policy support, and low beneficiary awareness among others. Addressing these gaps is critical to unlocking the full potential of RE-powered solutions in rural livelihood ecosystems.

Livelihoods interventions	Barriers for market readiness	Barriers for enabling conditions
RE powered Micro Cold Storage	• Underutilization of the asset due to lack of adequate market linkages at the first mile - structured market led demand still missing • Lack of confidence in technology and awareness on the use cases- lack of wide array of standardized products and inability of first mile end-users to verify claimed specifications • Turnaround time for service by OEMs is higher due to underdeveloped distribution and service networks • User groups (Farmer/ FPO/ SHG/ VOs) are not yet confident in the technology, given concerns about reliability, cost, and maintenance, and have had limited exposure to operational and business models	• High dependency on govt. tendered / donor supported subsidy schemes for crafting demand • Current schemes/ policies creating an initial benchmark but not enough demand aggregation • Limited technical capacity among the implementation agencies • Variation in incentives across different schemes leading to confusion among the beneficiaries; and consequently, slower adoption • Limited knowledge among the beneficiaries for available end user financing options • Many FPOs operate on leased land or shared facilities without formal agreements, which disqualifies them from standard financing
RE powered huller, polishers, and Mills	• Beneficiaries are hesitant to adapt to the newer technology due to unfamiliarity with the solution; as also perceived concerns on ability to operate during rainy season vs the diesel counterpart • Strong potential for income generation/ savings is offset by significant upfront costs, along with longer payback	• Lack of dedicated scheme/ policy at central and state level • Limited incubation and capacity building support for technology providers and installers to formulate requisite demand aggregation • End-users financing options seen as limited due to higher loan sizes, outside the typical range of MFI /SHG financing ecosystem, and require collateral
Solar Dryers	• Limited uptake by individual farmers due to lack of market linkages for offtake of the dried produce • Lack of training and usage support for end users for product usage • Lack of standardized products and verification process • Limited after sales support due to tech providers operating from distant locations	• Lack of dedicated targets /allocations in current schemes • Access to credit available through PSL, MUDRA, AIF but underutilized due to limited awareness among the farmers

Livelihoods interventions	Barriers for market readiness	Barriers for enabling conditions
Solar Refrigerator/ Deep freezer	• Significant upfront cost compared to grid powered refrigerator/ freezer • Lack of awareness and confidence in technology among the beneficiaries • Limited standardized products and specifications	• Access to credit available through PSL, MUDRA, underutilized due to limited awareness among the beneficiaries • Lack of dedicated scheme/ policy at central and state level
RE powered Bulk Milk Chiller	• Significant upfront costs, along with longer payback limiting adoption among the small and marginal dairy farmers • Lack of awareness about RE powered milk chiller applications; majority installations in organized sector with grid powered systems and diesel backed grid powered systems in erratic supply areas • Due to high upfront costs, smallholder farmers frequently rely on second-hand systems as a more affordable alternative	• Lack of dedicated scheme/ policy at central and state level promoting RE powered milk chiller • Support available under central schemes focused on diesel powered systems • Majority of the milk value chain promotes BMCs through cooperative with already established cost norms with high subsidy on diesel powered systems

Table 10: Limitations to upscale the prioritized DRE interventions

4.2 Interventions proposed across prioritized PURE applications

Key concerns regarding viable business models, pace of scale and dependence on government subsidies pose challenges for the growth of PURE segments. The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. The table below outlines the intervention suggested across the prioritized PURE applications and overview of the areas in which actions are deemed necessary for the uptake.

Action Areas	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators	RE powered milk chiller
Demand aggregation	✓	✓			
Training and capacity building	✓	✓	✓	✓	
Market linkage support	✓		✓		
Standardization and quality assurance	✓	✓	✓	✓	✓
Strengthen distribution and service ecosystem	✓			✓	✓
Access to affordable end user financing	✓	✓	✓	✓	✓
R&D and incubation support for tech suppliers to optimise product specs.	✓	✓		✓	

The sector needs innovation in business and financing models as also de-risking instruments such as credit guarantees to address this adequately and catalyze enterprise as also end user financing. Given that the demand, while large, is unorganized and scattered, bundling finance with demand aggregation approaches is a key pre-requisite. The potential strategy would help diversify the associated risk as also provide the opportunity to catalyze the demand at scale. In the sections further along these findings have found the basis of specific recommendations for policy makers at the state level to ensure efficacy in the schemes rolled out in the years ahead

State deep dive: Catalyzing PURE across priority geographies











Odisha



5 Building Momentum: Odisha's emerging landscape for DRE livelihoods

Odisha, located in eastern India, spans 155,707 sq. km and has a largely rural population of over 34 million (2024). The state's economy is primarily agrarian, with a majority of its people dependent on agriculture and allied sectors for their livelihoods.

Despite this strong agricultural base, Odisha faces persistent challenges in agrarian development. Low levels of farm mechanization, frequent post-harvest losses, and unreliable electricity supply continue to limit productivity and income for smallholder farmers. These structural gaps hinder value addition, reduce market access, and make rural livelihoods vulnerable to external shocks.

At the same time, Odisha holds significant potential for DRE solutions that support agricultural livelihoods. With an average solar irradiance of 4.77 kWh/m²/day, the state is well-suited for solar-powered applications. The DRE ecosystem in Odisha is beginning to take shape, with interventions through government programs and philanthropic initiatives, though the market remains in an early stage. Given the scale of agrarian need and the state's renewable energy potential, Odisha presents a strong opportunity for deploying scalable, livelihood-focused DRE technologies that can drive long-term rural prosperity.

5.1 Potential opportunities along with the prioritized use cases in Odisha

Several of the DRE livelihoods intervention areas analyzed for the State of Odisha, represent significant potential- analysis of the serviceable/ addressable opportunity over the next 5-6 years indicates a prospective market of nearly USD 550+ mn.

However, there is a lack of clarity on the segments poised for significant growth in the next 3-4 years and the exact models, policy triggers and catalytic interventions needed to ensure the translation of the potential into actual sectoral size. In this context, a comprehensive approach for scaling up interventions which present the most opportunity in the near to mid-term and have relevance across large parts of the state has been identified.

The agriculture value chain covers the largest share of the total serviceable market with USD 250 mn in opportunities for DRE interventions with RE powered micro cold storage, Agri waste to biofuels and Solar dryer interventions being the lead segments. **The growing market potential for non-farm enterprises (USD 220 mn) signifies the increasing diversification of rural economies beyond traditional agriculture.**

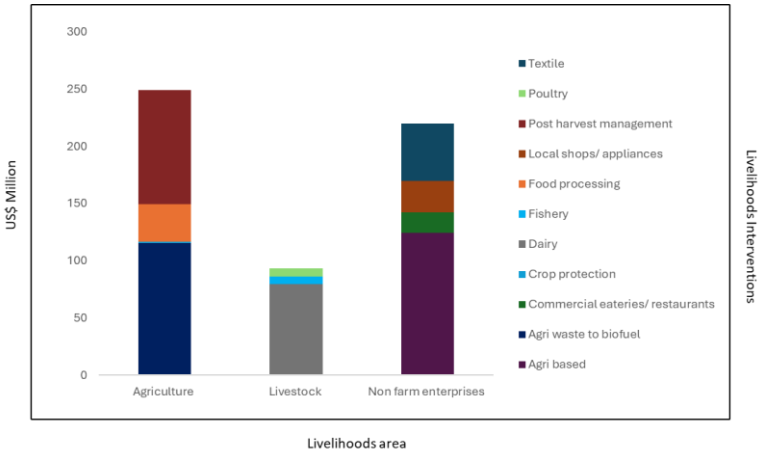
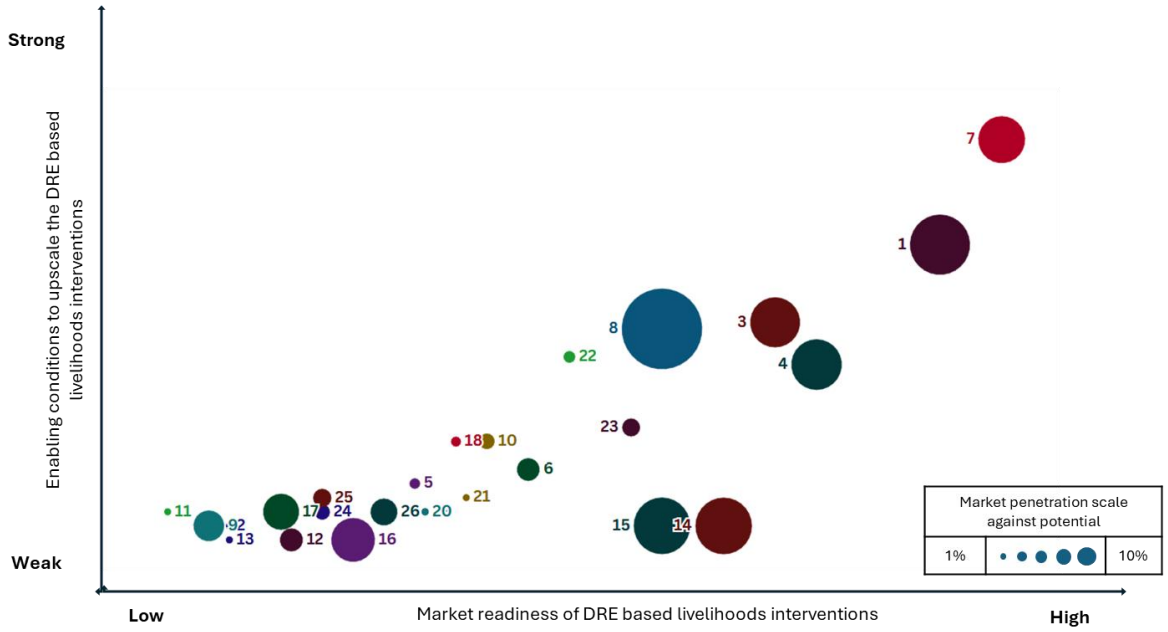


Figure 10: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions

5.2 Interventions with evolving enabling conditions and fructifying demand

The framework below presents a synthesis of technologies of priorities based on their market readiness vs. the enabling conditions required for scale-up; and helps gauge the policy and market development interventions needed to ensure scale-up.



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Flour mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Rice mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 11: Market readiness and Enabling conditions evaluation framework

Market Readiness	Enabling Conditions			
	Scale	Strong	Moderate	Weak
	High	Solar Pumps		
	Moderate		RE powered Micro-Cold Storage, Solar Dryers, Solar powered rice huller, polisher, Rice mills, Solar powered flour mills, Solar Refrigerator/Deep freezer, Bio-digester, RE powered Bulk Milk Chiller, Solar powered looms	Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Vertical hydroponic fodder machine, Solar Cooker, Solar Water Purifier
	Limited			Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer, Solar Reeling Machine, Solar Sewing Machines, Solar Egg Incubator, Solar Charkhas

Market readiness has been framed per serviceable market opportunity, ease of replication across the State and current market penetration level against respective potential while the enabling conditions have been assessed per the policy efficacy, supplier readiness/ adequacy of tech support and end user financing availability.

Given the current market landscape and enabling conditions for DRE interventions, the sector exhibits a diverse range of readiness levels, policy support, and scalability potential for different livelihoods applications in the state.

Out of the DRE livelihoods interventions assessed, even as the solar pump segment is broadly market ready with enabling conditions for upscaling in place, its pace has been hampered by thrust towards solarization of agri feeders through tail-end plants.

Outside of this, RE-powered micro-cold storage, solar dryers, and solar mills present potential, however intensification of enabling conditions is needed to truly catalyze scale. In case of RE powered micro cold storages, significant sensitization and market linkage connects are needed to trigger resilient demand (and in turn usage) in the F&V segment. The demand for the same in milk, sea food and fisheries has been continuously building up. Related to this, RE powered ice flake plants and solar aerators could emerge as key solutions to strengthen the fisheries ecosystem in the State (Odisha ranks fourth in fish production in the Country). There is potentially a great opportunity for solar aerators but a policy to catalyze sensitization and adoption is needed to translate the high serviceable potential (~20% of the total addressable market in India).

For other interventions such as animal deterrents and solar egg incubators, the overall enabling ecosystem as also the market readiness is on the lower end.

5.3 Potential geographies of opportunities for priority interventions

Odisha, being one of the top states in terms of DRE opportunities, has significant high potential clusters to support livelihood enhancement across agriculture, livestock, and non-farm sectors. The overleaf highlights the list of prioritized DRE based livelihoods interventions with high potential in the state.

Livelihood Intervention	DRE Interventions of interest	Market (Mn USD)	High potential clusters for deployment
Post harvest management	RE powered Micro-Cold Storage	100+	Ganjam, Sambalpur, Cuttack, Bargarh, Mayurbhanj
Food processing	Solar Dryer	32+	Ganjam, Sambalpur, Cuttack, Bargarh, Mayurbhanj
Fishery	Solar Aerators	7+	Ganjam, Mayurbhanj, Baleshwar, Bargarh, kalahandi
Agri based non-farm enterprises	Solar powered rice huller, polisher, mills	28+	Mayurbhanj, Ganjam, Balasore, Bargarh, Kalahandi
	Solar powered grain mills	41+	Sundargarh, Koraput, Balangir, Gajapati

Table 11: Serviceable/ Addressable potential of prioritized interventions in Odisha

In post-harvest management, districts such as Ganjam, Sambalpur, Cuttack, Bargarh, and Mayurbhanj show significant potential for RE-powered micro-cold storage, addressing critical needs to reduce produce loss and improve storage capacity. Food processing applications, particularly solar dryers, have promising deployment opportunities in the same clusters, facilitating improved drying efficiency and value addition.

The fishery sector in districts with highest inland fish production in state like Ganjam, Mayurbhanj, Baleshwar, Bargarh, and Kalahandi offers scope for solar aerator installations, which can enhance fish production and support sustainable aquaculture practices.



Figure 12: High potential districts for prioritized DRE interventions in Odisha

For agri-based non-farm enterprises, solar-powered rice hullers, polishers, and mills in Mayurbhanj, Ganjam, Balasore, Bargarh, and Kalahandi are one of the highest rice producing districts offering opportunities to develop and strengthen the rice processing value chain. Additionally, solar-powered grain mills have considerable potential for millet value chain (can be leveraged with Odisha Millet Mission) in districts such as Sundargarh, Koraput, Balangir, and Gajapati.

5.4 Analysis of key policies/ schemes influencing the DRE livelihoods solutions in Odisha

Odisha's policy environment presents a growing, though fragmented, foundation for promoting DRE solutions across different livelihoods segments majorly in agriculture

and allied sectors. A range of central and state schemes currently provide financial incentives, capital subsidies, and other ecosystem development support. However, the support remains fragmented, and opportunities for convergence and scale are yet to be fully realized. The overleaf presents the analysis of schemes/ policies for key DRE segments.

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
Post Harvest Management (RE powered Micro-Cold Storage)						
						State schemes are primarily focused on system installations, with subsidies reaching up to 95% in some programs. Various state schemes and programs, such as MKUY, installations under the Department of Horticulture, and OIIPCRA, support micro cold storage solutions at different subsidy rates
Agri Waste to biofuels (Biodigesters)						
						Bioenergy scheme launched by MNRE and Gobardhan scheme launched by Ministry of Jal Shakti are key policy enablers
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine)						
						There is no specific scheme or policy promoting renewable energy-powered appliances within the dairy

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
						sector. An emerging segment in the dairy value chain is solar-powered vertical hydroponic fodder systems, which are supported under central schemes
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)						
						Although the serviceable opportunity for the solution is high, there are no schemes/ policies to scale the solutions. Also, the solution is covered under the MUDRA scheme and Priority sector lending, but uptake is low
Food processing (Solar Dryers)						
						Along with micro cold storage solutions, this has been incorporated into major schemes and policies related to the horticulture value chain and is supported under central schemes such as MIDH and SMAM, as well as state-level programs like OIIPCRA
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)						
						Even as some schemes like SMAM have included the solutions for support, no concrete policies have been formulated to support the RE powered Agri-based enterprises directly



5.5 Impetus and Catalytic Actions across different interventions

Odisha has emerged as a state of focus for DRE based livelihoods, consistently drawing attention from donor agencies, catalytic platforms, and mission-driven enterprises. This can be reflected on the past programmatic interventions from donor and catalyst organizations that have focused on leveraging clean energy for rural development, especially from tribal communities, and strengthen rural value chain. While these interventions have showcased potential, many remain at an early or exploratory stage, with limited scale and a need for stronger institutional anchoring

In 2021, UN Women, in partnership with S4S Technologies, implemented 30 solar dryers in the aspirational districts of Koraput and Rayagada deployment program targeting women farmers. Similarly, in the Tasar silk value chain, the Odisha Livelihoods Mission (OLM) partnered with social enterprise Resham Sutra to introduce solar-powered reeling machines in select clusters such as Mayurbhanj, replacing traditional manual

thigh reeling methods. In 2022, Mission Shakti, the state's flagship women SHG platform, proposed a comprehensive initiative titled Mission RE-SHAKTI, in collaboration with GIZ. The proposal envisions widespread electrification of SHG-run rural enterprises using DRE technologies. As part of early-stage pilots, solar-powered spinning wheels (charkhas) and solar looms have been tested in weaving clusters to improve productivity and reduce drudgery for women artisans. Taken together, these initiatives reflect a growing recognition of DRE as an enabler for women-centric livelihoods in Odisha. However, most interventions so far have remained projectized, with limited mainstreaming into government schemes or commercial financing channels.

5.6 Key challenges and barriers to the opportunity for the uptake of DRE based livelihoods intervention in Odisha

Based on stakeholder interactions and analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions. The table overleaf outlines intervention-specific gaps - both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar aerators
Barriers for market ecosystem				
Underutilization of the asset due to lack of adequate market linkages	✓			
Lack of confidence in technology and awareness on the use cases among the beneficiaries	✓		✓	✓
Lack of awareness about the business models and return on investment	✓	✓	✓	
Underdeveloped distribution and service networks	✓			✓
Significant upfront costs, along with longer payback	✓	✓	✓	✓
Lack of training and usage support for end users on product usage	✓			
Lack of standardized products and verification process	✓	✓	✓	✓
Barriers for enabling conditions				
Lack of dedicated scheme/ policy at state level		✓		✓
Lack of dedicated incentives in policies/ schemes		✓		✓
Lack of dedicated targets /allocations in current schemes	✓		✓	
Limited technical knowledge among the implementing agencies	✓			
Limited access to affordable financing	✓	✓	✓	
High dependency on govt. tendered / donor supported subsidy schemes for crafting demand	✓			
Current schemes/ policies creating an initial benchmark but not enough demand aggregation	✓		✓	
Limited technical capacity among the implementation agencies	✓	✓	✓	✓
Limited incubation and capacity building support for technology providers		✓		✓

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar aerators
Variation in incentives across different schemes leading to confusion among the beneficiaries	✓			

5.7 Policy elements and programmatic framing for upscaling the prioritized DRE livelihoods interventions in Odisha

The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. The findings are being framed into specific recommendations encompassing the facets indicated below. An overview of the areas in which actions are deemed necessary for the uptake and prioritization of these technologies in Odisha is summarized below.

Policy Elements	Key Programmatic Components	Key Institutions
RE powered Micro cold storage at on farm/ near farm within the horticulture value chain		
Demand Assessment & Project Development	• OREDA to enable demand assessment and right beneficiary selection; can be sharpened by institutional convergence across key state agencies *(as indicated under Key Institutions)* to avoid fragmented efforts by different departments • Conduct demand assessment and identify priority blocks from the high potential deployment clusters i.e. Ganjam, Sambalpur, Cuttack, Bargarh, Mayurbhanj etc. via Odisha Livelihoods Mission leveraging SHG/ Producer companies' network at block level • Map existing SHGs and producer companies led income generating activities in fruit and vegetable clusters and assess the extent of post-harvest losses in those clusters. This can be undertaken in collaboration with OLM, which has active SHG members engaged in vegetable-related livelihoods including mushroom cultivation (8,024 members), floriculture (875 members), and hybrid vegetables (7,096 members) - already linked with the Directorate of Horticulture and also the 49,900 producer companies' members • Include micro cold storage demand in State Agriculture Plan (SAP) and District Agriculture Plan (DAP) • Set up block-level Horticulture Cold Chain Working Groups with representatives already active at the district level from OLM, ORMAS, Horticulture, APICOL, and KVKs • Directorate of Horticulture to identify crop cycles- include produce-specific seasonality, region-wise horticulture surplus, and market access gaps in the high potential clusters. ○ Assess the availability and functional status of existing cold storage infrastructure in these clusters to identify critical gaps and avoid redundant investments	OREDA, Odisha Livelihoods Mission, Directorate of Horticulture, DAFE, APICOL

Policy Elements	Key Programmatic Components	Key Institutions
	○ Evaluate the distance from key market linkages and aggregation points to prioritize locations where cold storage solutions can enable quicker uptake, reduce post-harvest losses, and improve market integration for producers	
Supplier Innovation & Standardization	• Mandate integration of MNRE and NCCD cold storage specifications in future tenders for product performance assurance • Prioritize empanelment of vendors in tenders that maintain a local service presence and can ensure a defined turnaround time of no more than 36 hours, given the limited shelf life of perishable produce. This will help minimize downtime and prevent post-harvest losses • Mandate a comprehensive Annual Maintenance Contract (AMC) for a minimum duration of 3 years, with a preference for extending it to 5 years, to ensure sustained performance and timely servicing of deployed assets • Mandate integration of IoT-based remote monitoring systems to enable real-time tracking of asset functioning and utilization, thereby supporting proactive maintenance and optimizing performance	OREDA
Skill Development & Capacity Building	• The Skill Council for Green Jobs (SCGJ) under NSDC could collaborate for capacity building among employment-related training institutes such as Rural Self-Employment Training Institutes (RSETIs) and the National Institute of Rural Development (NIRD) to leverage their existing focus on rural entrepreneurship in the cold storage sector • Enhance and integrate training modules for on-ground technicians by incorporating cold storage systems into existing skilling programs, such as the Surya Mitra Skill Development Program under the National Institute of Solar Energy (NISE), to ensure technical readiness and field-level service capacity • Train local technicians on installations, repair, maintenance checks and infra specifications for RE powered micro cold storage systems under Rural Self-Employment Training Institutes, National Institute for Rural Development, Skill India and Surya Mitra scheme • OUAT to develop crop-specific handling and post-harvest operation modules for ICAR institutes, KVKs, and ICER institute to deliver location-wise, commodity-specific cold storage training for SHGs, FPOs and create district-level training program to scale outreach • District Industries Centre (DIC) to extend support to entrepreneurs on project feasibility and develop financial	NSDC, NISE, NIRD, RSETIs, OUAT, ICAR institutes, KVKS, ICER institute, DIC, ORMAS

Policy Elements	Key Programmatic Components	Key Institutions
	proposals in line with the prerequisites from the financial institutions • Strengthen beneficiary capacity by enabling structured market linkages via ORMAS, ensuring consistent off-take and optimal asset utilization.	

Access to Finance	• To mitigate concerns on high upfront capital burden as also access for the same, promote lease-to-own or pay-as-you-go models to enhance economic viability end beneficiary for the and improve asset utilization
	  ○ Vendors may partner with financing entities to offer a lease-to-own model for FPOs and SHGs. Vendors can secure financing from these institutions to deploy the model
	  ○ The model can be supported by offering partial risk guarantees to financiers or viability gap funding for the installer during the initial years of operations
	• Convergence of schemes such as MIDH/ PMFME can be leveraged for credit-linked subsidies, while AIF can be utilized to avail interest subvention benefits
	• NABARD can play a key role in facilitating capacity-building programs for financial institutions, focusing on business models and the range of relevant schemes through which loans for MCS can be accessed
	• Credit guarantee fund managed by Nabsanrakshan can further enhance the access to finance by providing credit guarantees for loans extended to FPOs thereby reducing the perceived risk for lenders and encouraging credit flow for the first time borrowers
		NABARD, OLM, OCSB

Solar powered mills in rural areas (Rice, Millets, Wheat etc.)		
Demand Assessment & Project Development	• For retrofit, identify the existing diesel mill usage across PVTG PVTG (Particularly Vulnerable Tribal Groups) clusters via OPELIP. Use OMM's block-wise database to map existing diesel and manual flour/rice/millet mills in Kandhamal, Rayagada, Koraput, Keonjhar, Nuapada, and other high millet production clusters • Map all PVTG cluster-level diesel mill installations especially in districts like Malkangiri, Nabarangpur, and Gajapati to prioritize locations where existing mills are underutilized and face challenges due to erratic electric supply • OREDA to promote the adoption of solar-powered milling units in the identified clusters, aligning with the objectives of the Odisha Renewable Energy Policy, which emphasizes the use of solar energy for promoting use of solar energy for livelihood activities	OPELIP, OMM, OREDA, OLM

Policy Elements	Key Programmatic Components	Key Institutions
	○ Integrate inclusion/ upgradation of Solar into existing Odisha Millet Mission already targeting establishment of processing units for millets ○ Promote the inclusion of solar-powered mills in the Odisha PVTG Empowerment & Livelihoods Improvement Programme (OPELIP) to improve access to milling facilities in areas ○ Implement block-level pilots under OREDA to showcase viability and lifecycle cost benefits of solar-powered retrofitting • Promote the integration of solar-powered milling units with SHGs and paddy procurement clusters supported by OLM. Solar mills may be positioned in proximity to existing Paddy Procurement Centres (PPCs) and Millet Aggregation Points to ensure higher utilization and operational efficiency	
Supplier Innovation & Standardization	• To prevent the VOC of the solar array to drop on cloudy days, which may lead to mismatch or failure to start the motor- the VFD rating to defined • Standardize the selection and specification of Variable Frequency Drives (VFDs) in solar-powered rice hullers, polishers, and rice/ grain milling units to ensure compatibility with local solar array designs, particularly considering VOC (Open Circuit Voltage) and cloudy-day performance ○ MNRE may issue national technical guidelines for solar agro-processing systems, similar to those under PM-KUSUM/ RE powered cold storage ○ BIS (Bureau of Indian Standards) to develop performance standards for VFDs and solar-powered mills • APICOL, as the state nodal agency for agri-enterprise promotion under schemes like MKUY, may integrate these technical specifications for VFD compatibility and solar array design requirements into vendor empanelment criteria and subsidy eligibility guidelines	MNRE, BIS, OREDA, APICOL
Skill Development & Capacity Building	• Work with the Skill Council for Green Jobs (SCGJ) and MoFPI to develop and deliver capacity-building programs specifically focused on solar-powered mills. This could include partnerships with RSETIs and NIRD, which already focus on rural entrepreneurship • State level training institutes of RSETI and NIRD to impart training to district level resource institutions which shall further train the beneficiaries at district level on operations, maintenance procedures and also the technical specifications of Solar array system and mechanical milling operations	SCGJ, MoFPI, RSETI, NIRD, SLTIs

Policy Elements	Key Programmatic Components	Key Institutions
Access to Finance	• Encourage system installers to co-develop bundled solution offerings in partnership with financial institutions, wherein product deployment is integrated with pre-approved end-user financing packages • Appropriate long-term asset financing to be facilitated to the beneficiary as the business returns are dependent on the future cash flows	OREDA, Financial institutions
Solar Dryers		
Demand Assessment & Project Development	• Conduct demand assessment and identify priority blocks from the high potential deployment clusters i.e. Ganjam, Sambalpur, Cuttack, Bargarh, Mayurbhanj etc. via Odisha Livelihoods Mission leveraging SHG/ Producer companies' network at block level • Promote installations under Van Dhan Yojana already enabling entrepreneurship among tribal communities and identify horticulture dominant VDVK clusters with TDCCOL and, SC/ST Development Department	OLM, OREDA, Directorate of Horticulture, TDCCOL, SC/ST Development Department, ORMAS

Supplier Innovation & Standardization	• Develop and roll out technical standards and quality benchmarks for various types of solar dryers to be led by NISE and BIS and OREDA to adopt these standards in local context
	  ○ Define output parameters like moisture content targets, drying time ranges, temperature consistency, load capacity and drying time
	  ○ To maintain compliance with food-grade material standards and post-harvest hygiene requirements
		OREDA

Skill Development & Capacity Building	• OUAT to develop post-harvest processing modules for ICAR institutes, KVKs, and ICER institute to deliver training to the district level resource institutions/ partners • Facilitate structured training support through ground partners/ resource institutions for SHGs and farmers on the operational protocols, hygiene maintenance practices, and commodity-specific techniques for cutting, chopping and slicing to optimize the drying time • Conduct exposure visits to mandis/ wholesale markets to familiarize the beneficiaries with the prices, helping them manage and reduce input costs, and facilitate access to eNAM platform • Leverage ORMAS to strengthen market linkages by facilitating structured market access for farmers, enhancing produce offtake through organized retail channels, and integrating farmer networks with established food processing value chains	OUAT, KVK, ICER Institute, ORMAS

Policy Elements	Key Programmatic Components	Key Institutions
Access to Finance	• Establish financial linkages (under MUDRA, AIF etc.) through the existing networks of OLM's Business Correspondence Agents (BCA) in districts to reach unbanked and underbanked gram panchayats • Use OLM's Business Correspondent Agents to conduct financial literacy and loan facilitation at Gram Panchayat level	OLM, OGB, OSCB
Solar Aerators		
Demand Assessment & Project Development	• Conduct demand assessment and implementation site identification through FISHFED for clusters using diesel aerators, high potential clusters to be looked at i.e. Ganjam, Mayurbhanj, Baleshwar, Bargarh, kalahandi • OREDA to Incentivize for transition from diesel-based aerators to solar based systems • Implement pilot demonstrations for solar retrofitting of diesel-powered aerators through OREDA and the department of fisheries to leverage the state's potential for aerators in inland waterbodies • Integrate inclusion/ upgradation of Solar into existing Mukhyamantri Matsya jibi Kalyan Yojana (MMKY) already promoting machinery and equipment at fishery value chain	OREDA, Dept of Fisheries, FISHFED, OLM
Supplier Innovation & Standardization	• Implement Solar aerator designs suited for Odisha's pond ecosystem with anti-corrosion, DO-sensor and Standard Oxygen Transfer Rate (SOTR) monitoring integration for future installations • Enforce minimum quality benchmarks in tenders for rotational speed, oxygen delivery, and solar panel durability	OREDA
Skill Development & Capacity Building	• Extend training support to end user beneficiaries on operational protocols, maintenance, aeration techniques, monitoring of water parameters like dissolved oxygen levels (DO) through ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA), Fisheries Training Institute (FTI), Balugaon and other sectoral partners	ICAR-CIFA, FTI
Access to Finance	• Solar-powered aerators may be considered for inclusion in the eligible equipment list under MMKY to support energy-efficient and sustainable aquaculture practices	Fisheries & Animal Resources Development Department

Uttar Pradesh



6 Catalyzing livelihoods opportunities through DRE in Uttar Pradesh

Uttar Pradesh represents one of India's most significant opportunities for developing a robust DRE livelihood ecosystem. Spanning 240,928 sq. km in northern India, the state is home to nearly 144 million rural population, with a notably high rural population density of 594 persons per sq. km. It also faces a pressing challenge, with over 8 million unemployed individuals in rural areas.

At the same time, Uttar Pradesh holds substantial renewable energy potential. The state has an estimated 21.6 million tonnes of unutilized biomass and receives favourable solar irradiance of around 4.8 kWh/m²/day. These natural advantages position it well for the large-scale deployment of biomass- and solar-powered DRE livelihood technologies.

Harnessing these resources through DRE applications can unlock sustainable livelihood opportunities and strengthen rural resilience, making Uttar Pradesh a key state for scalable and impactful DRE interventions.

6.1 Potential opportunities along with the prioritized use cases in Uttar Pradesh

Several of the DRE livelihoods intervention areas represent substantial economic potential.

Analysis of the serviceable/addressable market over the next 5- 6 years suggests a prospective opportunity exceeding USD 675 mn.

Agriculture continues to dominate the landscape, with a combined market potential of over USD 310 mn driven by interventions in post-harvest management, agri-waste to biofuels, and food processing. The livestock sector, with a projected value of USD 47 mn, highlights focused opportunities in dairy, poultry, and fisheries. Meanwhile, non-farm enterprises reflect a rising trend of rural economic diversification, offering a cumulative potential of over USD 315 mn, led by agri-based enterprises, textiles, and local retail. In this context, a comprehensive approach for scaling up interventions which present the most opportunity in the near to mid-term and have relevance across large parts of the state has been identified

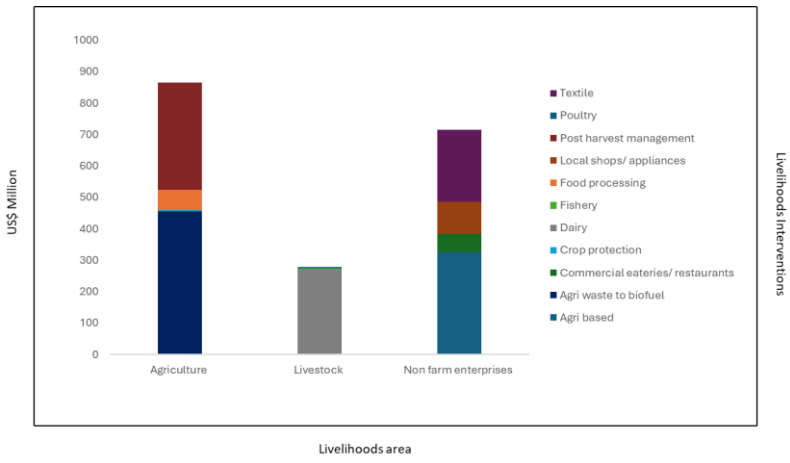
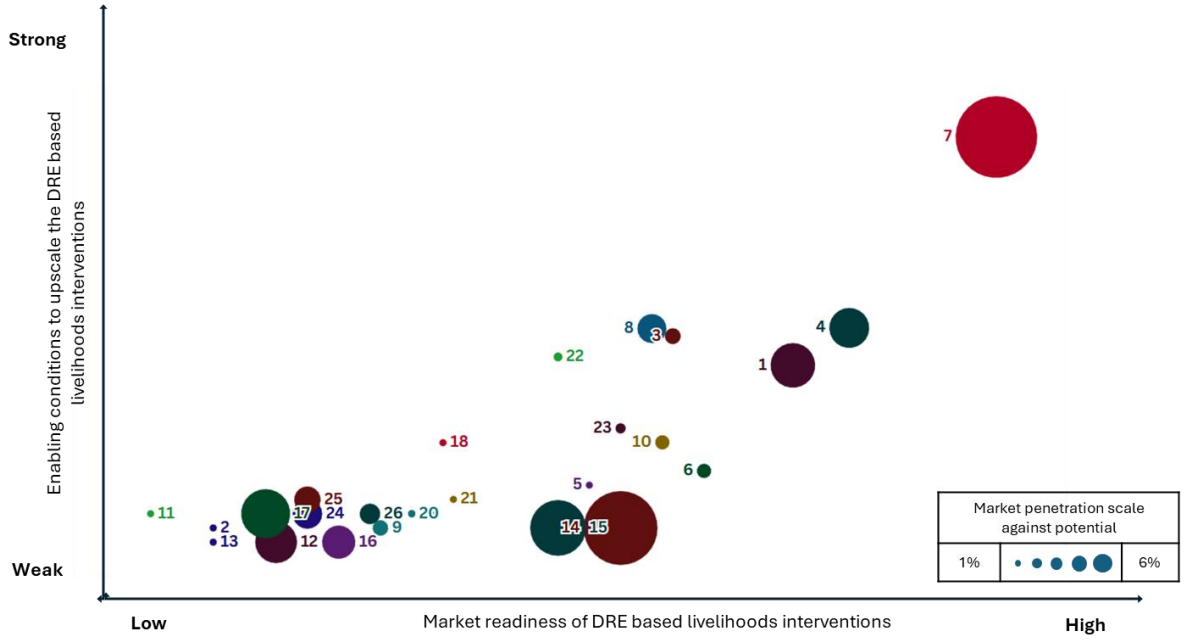


Figure 13: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions in UP

6.2 Interventions with evolving enabling conditions and fructifying demand

The below presents a synthesis of technologies of priorities based on their market readiness vs. the enabling conditions required for scale-up; and helps gauge the policy and market development interventions needed to ensure scale-up in the state.



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Rice mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Flour mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 14: Market readiness and Enabling conditions evaluation framework for UP

Market Readiness	Enabling Conditions			
	Scale	Strong	Moderate	Weak
	High	Solar Pumps		
	Moderate		RE powered Micro-Cold Storage, Solar Dryers, Bio-digester, RE powered Bulk Milk Chiller, Solar powered flour mills, Solar Refrigerator/Deep freezer, Solar powered rice huller, polisher, mills, Solar powered looms	Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Vertical hydroponic fodder machine, Solar Cooker, Solar Water Purifier
	Limited			Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer, Solar Reeling Machine, Solar Sewing Machines, Solar Egg Incubator, Solar Charkhas

6.3 Potential geographies of opportunities for priority interventions

As the largest state in terms of DRE opportunity, Uttar Pradesh hosts several high-potential clusters that can drive livelihood enhancement across agriculture, livestock, and non-farm sectors. The table overleaf presents a list of prioritized DRE-based livelihood interventions with strong potential for scalable impact in the state.

Livelihood Intervention	DRE Interventions	Market (Mn USD)	High potential clusters for deployment
Post harvest management	RE powered Micro-Cold Storage	342+	Pratapgarh, Prayagraj, Lucknow, Barabanki, Mirzapur
Food processing	Solar Dryer	63+	Pratapgarh, Prayagraj, Lucknow, Barabanki, Mirzapur
Dairy	RE powered Bulk Milk Chiller	75+	Bulandshahr, Agra, Aligarh, Meerut, Saharanpur
Local shops/ appliances	Solar Refrigerator/ Deep freezer	60+	
Agri based	Solar powered rice huller, polisher and mills	95+	Shahjahanpur, Kheri, Azamgarh, Gazipur, Pilibhit
	Solar powered Flour mills	137+	Hardoi, Shahjahanpur, Budaun, Jaunpur, Unnao

Table 12: Serviceable/ Addressable potential of prioritized interventions in UP

In post-harvest management, significant deployment potential exists in districts such as Pratapgarh, Prayagraj, Lucknow, Barabanki, and Mirzapur. These regions, based on district-wise horticulture and fruit production areas, face considerable post-harvest losses. In food processing, the solar dryer intervention offers similar promise, addressing the need for efficient drying methods in these same agricultural clusters.

In the dairy sector, districts like Bulandshahr, Meerut, Agra, Aligarh, and Saharanpur offer substantial opportunities for intervention. As major dairy producers, these regions are home to numerous dairy cooperatives, making them ideal locations for the deployment of RE-powered bulk milk chillers and vertical hydroponic fodder machines. The RE-powered bulk milk chillers can enhance milk storage capacity, reduce spoilage, and improve overall dairy processing, while vertical hydroponic fodder machines can provide sustainable and efficient fodder solutions, further improving dairy productivity in these high-production zones. For non-farm agri-based enterprises,

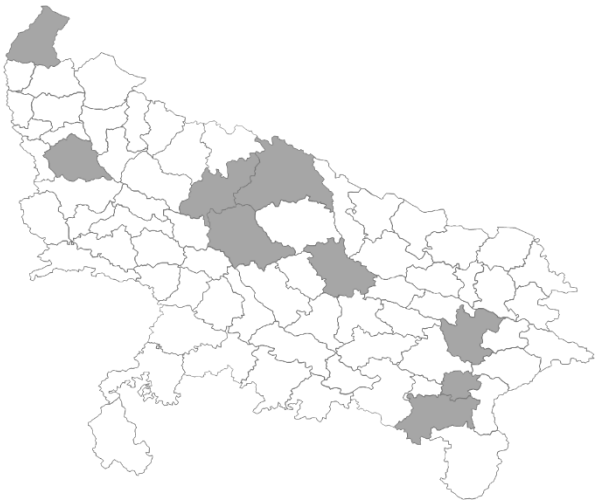


Figure 15 : High potential districts for prioritized DRE interventions in UP

districts such as Shahjahanpur, Kheri, Azamgarh, Gazipur, and Pilibhit, which are major contributors to rice production, are well-suited for the deployment of solar-powered rice hullers, polishers, and mills. Similarly, solar-powered flour mills in districts like Hardoi, Shahjahanpur, Budaun, Jaunpur, and Unnao, which are key wheat-producing areas, present opportunities to enhance food processing value chain and promote DRE solutions for rural non-farm enterprises.

6.4 Analysis of key policies/ schemes influencing the DRE livelihoods solutions in the state

The overleaf presents the analysis of schemes policies for key DRE segments

entral Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
Post Harvest Management (RE powered Micro-Cold Storage)						
						Although the serviceable opportunity for the solution is high, there are no schemes/ policies to scale the solutions in the state, UPNEDA piloted few solar powered micro cold storages, but current focus is less on MCS solutions
Agri Waste to biofuels (Biodigesters)						
						Bioenergy scheme launched by MNRE and Gobardhan scheme launched by Ministry of Jal Shakti are key policy enablers
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine)						
						There is no specific scheme or policy promoting renewable energy-powered appliances within the dairy sector. An emerging segment in the dairy value chain is solar-powered vertical hydroponic fodder systems, which are supported under central schemes
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)						
						State livelihoods mission is promoting the solution at their SHG canteens. Also, the solution is covered under the MUDRA scheme and PSL
Food processing (Solar Dryers)						
						Along with micro cold storage solutions, this has been incorporated into major schemes and policies related to the horticulture value chain and is supported under central schemes such as MIDH and SMAM
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)						
						Even as some schemes like SMAM have included the solutions for support, no

entral Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
						concrete policies have been formulated to support the RE powered Agri-based enterprises directly despite the high market potential in the state



6.5 Impetus and Catalytic Actions across different interventions in UP

Uttar Pradesh has witnessed a growing number of DRE interventions aimed at strengthening rural livelihood. Since 2021, a five-year collaboration between WWF-India, WRI India, and HSBC has focused on solar-powered milk chilling in rural dairy clusters. The initiative targets village-level milk collection centers, where the absence of reliable grid electricity often leads to quality degradation and spoilage. As of now, 30 solar PV systems totaling 110 kWp have been deployed across Uttar Pradesh (inc. Rajasthan, enabling cooling for around 17,000 liters of milk daily at source. This intervention not only addresses energy access gaps but also helps enhance incomes by reducing milk rejection and preserving quality.

In the silk weaving sector, a separate effort led by TERI, from 2017 to 2023, introduced hybrid solar charging units (HSCUs) and DC solar-powered looms in the weaving communities of Varanasi.

6.6 Key challenges and barriers to the opportunity for the uptake of DRE based livelihoods intervention in Uttar Pradesh

Based on stakeholder interactions and analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions. The table overleaf outlines intervention-specific gaps - both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerator / Deep Freezers
Underutilization of the asset due to lack of adequate market linkages	✓			
Lack of confidence in technology and awareness on the use cases among the beneficiaries	✓		✓	
Lack of awareness about the business models and return on investment	✓	✓	✓	
Underdeveloped distribution and service networks	✓			✓
Significant upfront costs, along with longer payback	✓	✓	✓	✓
Lack of training and usage support for end users on product usage	✓		✓	
Lack of standardized products and verification process	✓	✓	✓	✓

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerator / Deep Freezers
Limited after sales support due to tech providers operating from distant locations			✓	
Lack of dedicated scheme/ policy at state level	✓			
Lack of dedicated incentives in policies/ schemes	✓	✓		
Lack of dedicated targets /allocations in current schemes			✓	
Limited technical knowledge among the implementing agencies	✓		✓	
Low mandate/ current plan to integrate programs under state mission	✓	✓		
Limited access to affordable financing	✓	✓		
Current schemes/ policies creating an initial benchmark but not enough demand aggregation			✓	
Limited knowledge among the beneficiaries for available end user financing options	✓	✓	✓	✓
Limited incubation and capacity building support for technology providers		✓		

6.7 Policy elements and programmatic framing for upscaling the prioritized DRE livelihoods interventions in Uttar Pradesh

The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. An overview of the areas in which actions are deemed necessary for the uptake and prioritization of these technologies in Uttar Pradesh is summarized below

Policy elements	Programmatic components to drive adoptions	Key Institutions
RE powered Micro cold storage at on farm/ near farm within the horticulture value chain		
Demand Assessment & Project Development	• UP's Department of Horticulture and UPNEDA (Uttar Pradesh New and Renewable Energy Development Agency) to enable demand aggregation. Institutional convergence will be crucial, involving departments like Agriculture, Horticulture, and UPSRLM • Specific targets for RE powered micro cold storage in the high potential clusters to be included under the already initiated DEWEE program promoting other DRE livelihoods interventions across the state implemented by UPSRLM • Conduct demand assessment across high-potential districts such as Pratapgarh, Prayagraj, Lucknow, Barabanki, Mirzapur, focusing on areas with significant horticultural activity and high post-harvest losses. • Set clear targets for deploying RE-powered micro cold storage units in identified high-potential horticulture clusters. These	UPNEDA, UPSRLM, KVKs, Department of Horticulture and Food processing

Policy elements	Programmatic components to drive adoptions	Key Institutions
	targets may be integrated into the ongoing DEWEE program, currently being implemented by UPSRLM, which already supports other DRE-based livelihood interventions across the state • Identify existing CLFs/ SHGs and producer companies led income generating activities in fruit and vegetable clusters and assess the extent of post-harvest losses in those clusters. This can be undertaken in collaboration with UPSRLM, which has active CLFs/ VOs engaged in horticulture-related livelihoods and UP Horticulture department • Set up cross-functional working groups at the district level, with representatives from the Department of Horticulture, UPNEDA, and KVKs • Department of Horticulture and Food processing to identify crop cycles, region-wise surplus, and post-harvest losses. This will also include a review of existing cold storage infrastructure to prevent redundant investments and prioritize areas where cold storage can most effectively reduce losses and improve market integration	
Supplier Innovation & Standardization	• Ensure future tenders for cold storage solutions adhere to MNRE and NCCD guidelines, for product performance assurance • Prioritize vendors with local service presence to ensure 36-hour service turnaround in case of system failures, minimizing downtime in perishable produce sectors. • Implement IoT-based remote monitoring systems in cold storage solutions to track temperature, utilization levels, humidity, and energy consumption, enabling predictive maintenance and improving performance optimization	UPNEDA
Skill Development & Capacity Building	• Enhance and integrate training modules for on-ground technicians by incorporating cold storage systems into existing skilling programs like Surya Sakhi with UPNEDA to ensure technical readiness and field-level service capacity • Train local technicians on installations, repair, maintenance checks and infra specifications for RE powered micro cold storage systems under DEWEE program's block level solar shops • Chandra Shekhar Azad University of Agriculture and Technology (CSAUAT) and Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT) to develop crop-specific handling and post-harvest operation modules for ICAR institutes and KVKs, to deliver location-wise, commodity-specific cold storage training for SHGs, FPOs and create district-level training program to scale outreach • Provide crop-specific post-harvest handling and cold storage training for CLFs/ SHGs and FPOs ensuring that stakeholders understand how to operate and maintain cold storage systems • Strengthen beneficiary capacity by enabling structured market linkages via UP Mandi Parishad and APEDA to ensure off-take	UPSRLM, CSAUAT, SVPUAT, ICAR, KVKs, UPNEDA, UP Mandi Parishad

Policy elements	Programmatic components to drive adoptions	Key Institutions
Access to Finance	• UPSRLM may facilitate the interest free loans under CM Udyami yojana to enable financing for the end beneficiary and linkage to the financial institutions • BIRD Lucknow can play a key role in facilitating capacity-building programs for financial institutions, focusing on business models and financing for MCS • Convergence of schemes such as MIDH/ PMFME can be leveraged for credit-linked subsidies, while AIF can be utilized to avail interest subvention benefits • Financing for working capital costs to be facilitated by UP Cooperative bank for timely access to short-term loans or credit facilities to cover recurring operational expenses • UPSRLM can facilitate working capital loans to CLFs, SHGs, VOs, and producer groups under the Community Investment Fund (CIF) • To mitigate concerns on high upfront capital burden as also access for the same, promote lease-to-own or pay-as-you-go models to enhance economic viability end beneficiary for the and improve asset utilization • Vendors may partner with financing entities to offer a lease-to-own model for FPOs and SHGs. Vendors can secure financing from these institutions to deploy the model • The model can be supported by offering partial risk guarantees to financiers or viability gap funding for the installer during the initial years of operations • Credit guarantee fund managed by Nabsanrakshan can further enhance the access to finance by providing credit guarantees for loans extended to FPOs thereby reducing the perceived risk for lenders and encouraging credit flow for the first time borrowers	UPSRLM, BIRD Lucknow, UPCB
Solar powered mills in rural areas (Rice, Millets, Wheat etc.)		
Demand Assessment & Project Development	• Uttar Pradesh has significant wheat-producing regions such as Hardoi, Shahjahanpur, Budaun, Jaunpur, Unnao, and rice producing regions like Shahjahanpur, Kheri, Azamgarh, Gazipur, Pilibhit where small-scale milling is crucial. UPSRLM to identify high-demand rice/ wheat-growing areas for solar-powered mill adoption. • Extend specific targets under DEWEE programs in the high potential clusters and validate requisite information from interested prospects to establish feasibility of the proposed installations • Integrate inclusion/ upgradation of Solar into existing UP food processing policy already targeting promotion of decentralized processing and storage at agri value chain • Identify the existing rice/ wheat flour mills in the existing agro processing clusters, especially in rural areas where there is an over-reliance on inefficient, diesel-powered mills. Focus on districts where the electricity supply is inconsistent and manual labor dependence is high	UPSRLM, UPNEDA, UP Horticulture department

Policy elements	Programmatic components to drive adoptions	Key Institutions
Supplier Innovation & Standardization	• Standardize the design and performance parameters for solar-powered wheat flour mills, ensuring compatibility with solar array systems and Variable Frequency Drives (VFDs). Focus on designs that can operate optimally even during periods of low sunlight or cloudy weather • Work with technical institutions like the National Institute of Solar Energy (NISE) and the Bureau of Indian Standards (BIS) to create specifications for solar milling systems that can meet the energy needs of small-scale flour mills in rural settings • Collaborate with UPSRLM to incorporate these standards into vendor selection criteria and eligibility for installation under DEWEE program	UPNEDA
Skill Development & Capacity Building	• State level training institutes of RSETI and NIRD to impart training to district level resource institutions which shall further train the beneficiaries at district level on operations, maintenance procedures and also the technical specifications of Solar array system and mechanical milling operations- this can be facilitated by UPSRLM for their Surya Sakhi network	UPSRLM
Access to Finance	• Work with state financial institutions such as the UPCB and RRB to develop tailored financing products for solar-powered flour mills. These financial products should include options for smallholders and rural mill operators to access low-interest loans with flexible repayment terms • Integrate these financing schemes into national programs like PMFME to help mill operators access subsidies, low-interest loans, and technical assistance to install solar-powered milling systems	UPCB, RRB Uttar Pradesh
Solar Dryers		
Demand Assessment & Project Development	• Conduct demand assessment and identify priority blocks from the high potential deployment clusters i.e. Pratapgarh, Prayagraj, Lucknow, Barabanki, Mirzapur etc. via UPSRLM leveraging SHG/ Producer companies' network at block level	UPRLM

Supplier Innovation & Standardization	• Develop and roll out technical standards and quality benchmarks for various types of solar dryers to be led by NISE and BIS and UPNEDA to adopt these standards in local context
	  ○ Define output parameters like moisture content targets, drying time ranges, temperature consistency, load capacity and drying time
	  ○ To maintain compliance with food-grade material standards and post-harvest hygiene requirements.
		UPNEDA

Policy elements	Programmatic components to drive adoptions	Key Institutions
Skill Development & Capacity Building	• CSAUAT and SVPUAT to develop post-harvest processing modules for capacity building of implementing agencies to deliver training to the district level resource institutions/ partners • Work with UPSRLM to integrate post-harvest management training into the existing DEWEE program. This will ensure they understand the entire value chain from harvest to drying to marketing. • Facilitate structured training support through UPSRLM for SHGs and farmers on the operational protocols, hygiene maintenance practices, and commodity-specific techniques for cutting, chopping and slicing to optimize the drying time • Training should include pre-treatment methods (e.g., slicing, chopping), temperature control, and moisture management to ensure the drying process optimizes the quality of produce • Strengthen market linkages through UPSRLM by facilitating structured market access for farmers, enhancing produce offtake through organized retail channels, and integrating farmer networks with established food processing value chains	CSAUAT, SVPUAT, UPSRLM
Access to Finance	• Work with UPRLM and UPSCB to establish financial linkages for farmers, enabling them to access MUDRA Loans, Kisan Credit Cards (KCC) • Establish financial literacy programs through UPCB for district-level cooperative bank branches, gram panchayat-level PACS, and end-user beneficiaries to educate them on loan options, eligibility criteria, and the long-term financial benefits of investing in solar dryers • UPSRLM block level network to provide farmers with interest free loan facilitation services through CM Udyami yojana and help farmers submit loan applications and facilitate the approval process • Establish financial linkages through the existing networks of UPSRLM's BC Sakhi Program, or Mission One Gram Panchayat, One BC Sakhi in districts to reach unbanked and underbanked gram panchayats	UPRLM, UPSCB
Solar Refrigerators/ deep freezer		
Demand Assessment & Project Development	• Along with installations at SHG canteens/Didi Cafes at the district level under the DEWEE program, demand assessment by UPSRLM may also be extended to include local shops, eateries, and primary healthcare centers (PHCs), particularly in rural and semi-urban areas • Collaborate with UP Health Department to deploy solar refrigerators in primary healthcare centers and vaccination hubs, ensuring the safe storage of vaccines, medicines, and other temperature-sensitive health products • UPMSCL may introduce procurement mandates requiring that a certain percentage of vaccine storage units (deep freezers) in	UPSRLM, Department of Medical Health and Family Welfare, UPMSCL

Policy elements	Programmatic components to drive adoptions	Key Institutions
	PHCs be solar powered- facilitating the installation of solar refrigerators for storing vaccines and medicines and also reducing reliance on unreliable power grids in rural setting	
Supplier Innovation & Standardization	• Collaborate with system suppliers to ensure that solar refrigerators and deep freezers are suited to UP's climatic conditions and demand patterns. Focus on ensuring low power consumption, durability, and ability to work in low sunlight conditions • Mandate comprehensive AMC support for a minimum duration of 2 years, with a preference for extending it to 3 years, to ensure sustained performance and timely servicing of deployed assets	UPSRLM
Skill Development & Capacity Building	• To ensure the successful adoption of solar refrigerators and deep freezers in livelihood-linked areas, UPSRLM and local institutions can play a vital role in training and capacity building for local shops • Leverage channels such as solar shops, Common Facility Centres (CFCs), and SHG-led retail points under UPSRLM for the distribution and servicing of solar refrigerators and deep freezers- ensuring localized access, user awareness, and post-installation support, particularly in rural and semi-urban areas • Integrate specific training modules on the installation, operation, and maintenance of solar refrigerators and deep freezers into the Surya Sakhi program, enabling trained women entrepreneurs and SHGs to serve as local technicians and service providers in rural areas • Set up training hubs in key districts like Lucknow, Varanasi, and Meerut, where local trainers can teach solar refrigeration maintenance and troubleshooting, ensuring sustainable use of the systems	UPSRLM
Access to Finance	• Collaborate with UBCB, RRB, and MFIs to design financial products specifically for solar refrigerators and deep freezers. These could include low-interest loans, pay-as-you-go models, and lease-to-own schemes for end users • Work with suppliers to offer bundled financing packages that cover the cost of the system, installation, and maintenance over a period of 2-3 years, making it easier for rural business owners and healthcare providers to afford solar refrigeration systems • UPMSCL may include procurement mandates of at least some % of vaccine storage in PHC should be solar powered to install solar refrigerators to store vaccines and medicines, reducing reliance on unreliable power grids • Linkage to government schemes such as CM Udyami Yojana to offer subsidized loans and financial assistance for solar refrigerator installations in the foodservice and healthcare sectors	UPCB, RRB, UPSRLM, Uttar Pradesh Health Department

Maharashtra



7 Maharashtra's PURE potential: Energizing rural growth with tailored DRE solutions

Maharashtra, located in the western part of India, spans a vast geographic area of 307,713 sq. km and is home to a rural population of approximately 58 million, with a density of 188 people per sq. km. Despite its economic strength, the state grapples with persistent rural challenges, including high unemployment affecting nearly 2.5 million people and underutilized agricultural resources. However, Maharashtra also possesses significant renewable energy assets, including the highest solar irradiance among Indian states at 4.99 kWh/m²/day and an estimated 21.49 million tonnes of unutilized biomass annually.

This unique combination of a large rural workforce and abundant renewable resources creates a strong foundation for deploying Distributed Renewable Energy (DRE) technologies. Over the years, Maharashtra has progressively emerged as a leader in integrating DRE solutions across agriculture, livestock, and non-farm rural enterprises. By aligning energy access with sector-specific livelihood needs, the state has expanded its DRE footprint and is poised to further drive inclusive rural development through solar and biomass-based livelihood applications.

7.1 Potential opportunities along with the prioritized use cases in Maharashtra

Several of the DRE livelihoods intervention areas represent significant potential - analysis of the serviceable/addressable opportunity over the next 5-6 years indicates a prospective market of nearly USD 940+ mn in the state.

The agriculture value chain covers the largest share of the total serviceable market with USD 580+ mn in opportunities for DRE interventions with agri waste to biofuels, post-harvest management, and food processing being the lead segments. The growing market potential for non-farm enterprises (USD 230+ mn) signifies the increasing diversification of rural economies beyond traditional agriculture. In this context, a comprehensive approach for scaling up interventions which present the most opportunity in the near to mid-term and have relevance across large parts of the state has been identified.

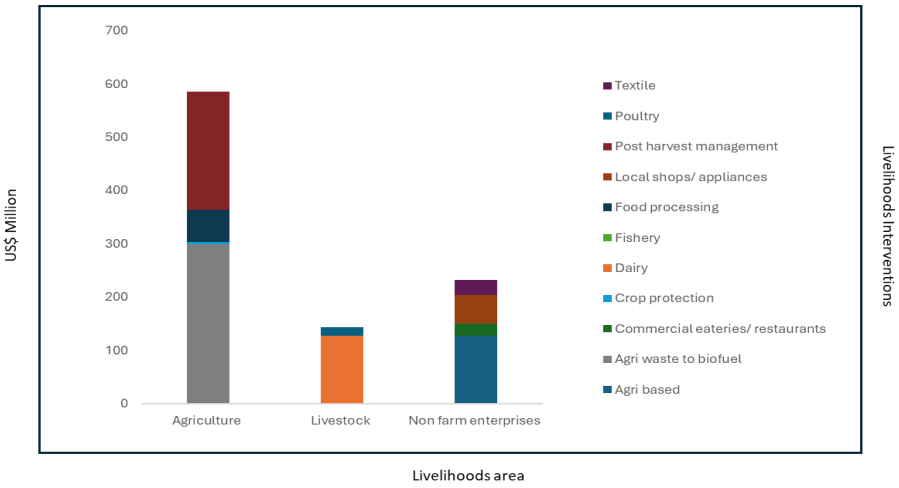
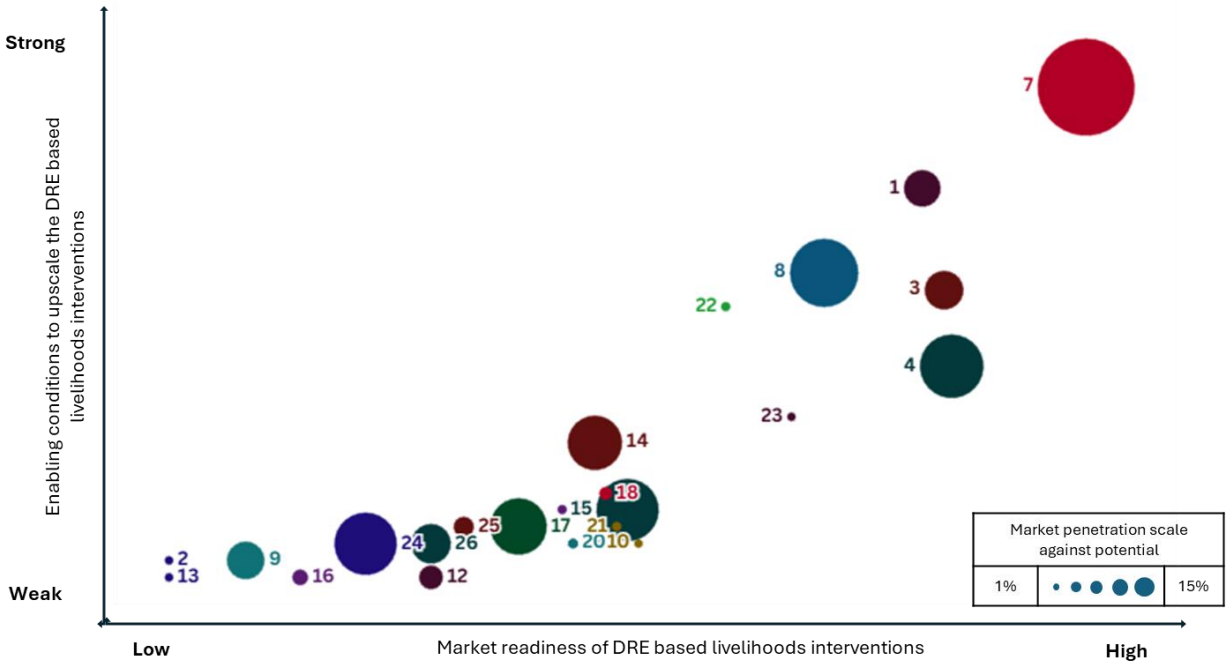


Figure 16: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions in Maharashtra

7.2 Interventions with evolving enabling conditions and fructifying demand

The below presents a synthesis of technologies of priorities based on their market readiness vs. the enabling conditions required for scale-up, and helps gauge the policy and market development interventions needed to ensure scale-up in the state.



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Rice mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Flour mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 17: Market readiness and Enabling conditions evaluation framework

		Enabling Conditions		
	Scale	Strong	Moderate	Weak
Market Readiness	High	Solar Pumps		
	Moderate		RE powered Micro-Cold Storage, Solar Dryers, Bio-digester, RE powered Bulk Milk Chiller, Solar powered flour mills, Solar Refrigerator/Deep freezer, Solar powered looms, Solar powered rice huller, polisher, mills,	Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Vertical hydroponic fodder machine, Solar Cooker, Solar Water Purifier
	Limited			Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer, Solar Reeling Machine, Solar Sewing Machines, Solar Egg Incubator, Solar Charkhas

7.3 Potential geographies of opportunities for priority interventions

Maharashtra's diverse regional clusters offer substantial opportunities for deploying DRE solutions that can directly support livelihood enhancement across agriculture, livestock, and non-farm sectors. The table overleaf highlights the list of prioritized DRE based livelihoods interventions with high potential in the state.

Livelihood area	Livelihood Intervention	DRE Interventions	Serviceable market (Mn USD)	High potential clusters for deployment
Agriculture	Post harvest management	RE powered Micro-Cold Storage	222+	Nashik, Satara, Jalgaon, Ahilya Nagar, Pune
	Food processing	Solar Dryer	60+	Nashik, Satara, Jalgaon, Ahilya Nagar, Pune
Livestock	Dairy	RE powered Bulk Milk Chiller	31+	Ahilya Nagar, Pune, Solapur, Kolhapur, Sangli
Non-farm enterprises	Local shops/ appliances	Solar Refrigerator/ Deep freezer	32+	
	Agri based	Solar powered rice huller, polisher and mills	47+	Nagpur, Gondia, Bhandara, Chandrapur, Gadchiroli
		Solar powered Flour mills	68+	Ahilya Nagar, Nashik, Solapur, Jalgaon, Satara

Table 13: Serviceable/ Addressable potential of prioritized interventions in Maharashtra

Over the past two years, Maharashtra has installed around 500,000 solar pumps, exceeding the rest of India combined (≈ 400,000). As of April 2025, more than 565,000 solar agricultural pumps have been installed, and another 500,000 are in the pipeline.

In post-harvest management, the high deployment potential to support livelihoods are in the districts like Nashik, Satara, Jalgaon, Ahilya Nagar, and Pune. The analysis is based on district-wise horticulture production areas, which indicate that these regions have significant post-harvest losses and require efficient cold storage solutions to improve shelf-life and reduce waste. In food processing, the solar dryer intervention shows promise in the same agricultural clusters.

In the dairy sector, the interventions offer opportunities in milk-producing districts like Ahilya Nagar, Pune, Solapur, Kolhapur, and Sangli. These regions are home to numerous dairy cooperatives and are significant contributors to the state's milk production. RE-powered bulk milk chiller can improve milk storage capacity, reduce spoilage, and enhance dairy processing and vertical hydroponic fodder machines can support sustainable and efficient fodder availability in these high-production zones.

Technologies like RE powered rice huller, polisher and mills are essential for rice-processing districts like Nagpur, Gondia, Bhandara, Chandrapur, and Gadchiroli, which are known for their significant rice production in the state. The focus of govt. on one district, one product strategies, further highlights the potential for growth in rice-based industries in these clusters, enhancing local agricultural value chains and supporting small-scale

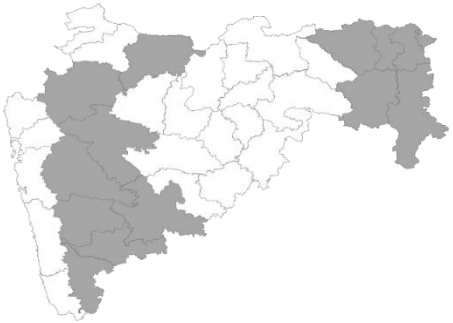


Figure 18: High potential districts for prioritized DRE interventions in Maharashtra

farmers. Flour mills holds potential in districts like Ahilya Nagar, Nashik, Solapur, Jalgaon, and Satara, where wheat and flour production are key agricultural activities, solar-powered flour mills can enhance local food processing capabilities and promote solutions for rural non-farm enterprises.

7.4 Analysis of key policies/ schemes influencing the DRE livelihoods solutions in the state

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
Post Harvest Management (RE powered Micro-Cold Storage)						
						Increasingly this has become a segment of focus in Maharashtra with the launch of SMART and MAGNET programs. Overall, the targets need intensification and consistent budget allocations to ensure requisite momentum as also the selection of beneficiaries under the schemes.
Agri Waste to biofuels (Biodigesters)						
						Bioenergy scheme launched by MNRE and Gobardhan scheme launched by Ministry of Jal Shakti are key policy enablers
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine)						
						The dairy value chain in the state is mature, and there is no specific scheme or policy promoting renewable energy-powered appliances within the dairy sector. An emerging segment in the dairy value chain is solar-powered vertical hydroponic fodder systems, which are supported under central schemes
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)						
						Although the serviceable opportunity for the solution is high, there are no schemes/ policies to scale the solutions in the state.
Food processing (Solar Dryers)						
						Along with micro cold storage solutions, this has been incorporated into major schemes and policies related to the horticulture value chain and is supported under central schemes such as MIDH and SMAM, as well as state-level programs like SMART and MAGNET
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)						

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
						Even as some schemes like SMAM have included the solutions for support, no concrete policies have been formulated to support the RE powered Agri-based enterprises directly

High		Low

7.5 Impetus and Catalytic actions across different interventions

While different schemes/ policies in the states are promoting uptake of the DRE solutions, several donor funded/ catalyst programs have piloted and demonstrated the use cases for these technologies in the state. Maharashtra has shown growing momentum in DRE for livelihoods through various programs. In 2021, UN Women partnered with S4S Technologies to install solar crop dryers in aspirational districts of Maharashtra and 30 solar dehydration units were deployed (as part of 60 units across Maharashtra and Odisha). In 2023, the Mann Deshi Foundation, with funding from HSBC India and support from the state, electrified five off-grid hamlets in Satara (Koyna wildlife sanctuary area) using solar power. This included installing a solar powered flour mill in Taldeo village. In 2023, TERI and Indus Towers Ltd. committed to install 95 hybrid solar power units for looms across parts of Maharashtra, Madhya Pradesh, and Chhattisgarh. This builds on a successful model in Varanasi (UP)- each unit powers 4 looms with solar PV plus battery backup. The expansion (2023–25) to benefit ~380 weavers in Maharashtra and neighboring states.

7.6 Key challenges and barriers to the opportunity for the uptake of DRE based livelihoods intervention in Maharashtra

Based on stakeholder interactions and analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions. The table overleaf outlines intervention-specific gaps - both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators
Barriers for market conditions				
Underutilization of the asset due to lack of adequate market linkages	✓			
Lack of confidence in technology and awareness on the use cases among the beneficiaries	✓		✓	✓
Lack of awareness about the business models and return on investment	✓	✓	✓	
Underdeveloped distribution and service networks	✓			✓
Significant upfront costs, along with longer payback	✓	✓	✓	✓

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators
Lack of training and usage support for end users on product usage	✓		✓	
Lack of standardized products and verification process	✓	✓	✓	✓
Barriers for enabling conditions				
Lack of dedicated scheme/ policy at state level		✓		✓
Lack of dedicated incentives in policies/ schemes		✓		
Lack of dedicated targets /allocations in current schemes			✓	
Limited technical knowledge among the implementing agencies	✓	✓	✓	✓
Low mandate/ current plan to integrate programs under state mission	✓	✓	✓	✓
Limited access to affordable financing	✓	✓		
High dependency on govt. tendered / donor supported subsidy schemes for crafting demand	✓			
Current schemes/ policies creating an initial benchmark but not enough demand aggregation	✓		✓	
Limited knowledge among the beneficiaries for available end user financing options	✓	✓		
Limited incubation and capacity building support for technology providers		✓		✓
Variation in incentives across different schemes leading to confusion among the beneficiaries	✓		✓	

7.7 Policy elements and programmatic framing for upscaling the prioritized DRE livelihoods interventions in Maharashtra

The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. An overview of the areas in which actions are deemed necessary for the uptake and prioritization of these technologies in Maharashtra is summarized below

Policy elements	Programmatic components to drive adoptions	Key Institutions
RE powered Micro cold storage at on farm/ near farm within the horticulture value chain		
Demand Assessment & Project Development	• MEDA to coordinate convergence between Department of Horticulture, Department of Agriculture, MSRLM (UMED), and the SMART and MAGNET project management units (PMUs) to enable demand aggregation and targeted deployment planning • SMART Project to provide district-level FPO and value chain cluster data to identify blocks with dense horticulture activity	MEDA, MSRLM, SMART, MAGNET, MAHAPREIT

Policy elements	Programmatic components to drive adoptions	Key Institutions
	(e.g., Nashik, Satara, Solapur, Pune, Ahmednagar, Jalgaon, Ratnagiri) • MAGNET PMU, hosted by the Department of Horticulture, to facilitate cluster-level horticulture surplus mapping using value chain studies and post-harvest gap assessments (already conducted under MAGNET for 10+ crops). • UMED (MSRLM) to map SHG-led livelihoods, especially women's groups engaged in horticulture (banana fiber, flower cultivation, vegetable nurseries, etc.). Use Community Resource Persons (CRPs) to collect ground-level demand and link to SHG Livelihood Clusters. • MAHAPREIT to either directly or through local Resource Institution Partners, solicit interest from farmers, FPOs, Farmer groups, etc. from within the high potential clusters • FPOs supported under SMART to be mobilized to submit cold storage demand proposals as part of their Common Facility Center (CFC) plans. Cold storage units to be bundled with grading/packing sheds or solar dryers as per local value chain requirement. • Include RE-powered cold storage in District Agriculture Plans (DAPs) and integrate with State Agriculture Infrastructure Fund Implementation plan to enable prioritization under MIDH, PMFME, and AIF.	
Supplier Innovation & Standardization	• Mandate integration of MNRE and NCCD cold storage specifications in future tenders for product performance assurance • Prioritize empanelment of vendors in tenders that maintain a local service presence and can ensure a defined turnaround time of no more than 36 hours, given the limited shelf life of perishable produce. This will help minimize downtime and prevent post-harvest losses • Mandate a comprehensive Annual Maintenance Contract (AMC) for a minimum duration of 3 years, with a preference for extending it to 5 years, to ensure sustained performance and timely servicing of deployed assets • Mandate integration of IoT-based remote monitoring systems to enable real-time tracking of asset functioning and utilization, thereby supporting proactive maintenance and optimizing performance	MEDA
Skill Development & Capacity Building	• Maharashtra State Skill Development Society (MSSDS) to partner with MSRLM and MEDA to roll out skilling and entrepreneurship modules focused on RE-powered cold storage operation, repair, and maintenance • Integrate modules under Skill India and PMKVY programs; link with RSETIs and KVK for hands-on training. Surya Mitra and similar programs to train technicians on solar-powered systems	MSSDS, MSRLM, MEDA, RSETIs, SAUs (MPKV, DBSKKV), KVKs, NIPHT

Policy elements	Programmatic components to drive adoptions	Key Institutions
	• Mahatma Phule Krishi Vidyapeeth (MPKV) and Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth to develop location- and crop-specific post-harvest handling SOPs and training materials • NIPHT to assist with business planning and facilitate DPR preparation and bankable proposals for SHG/FPO-based micro cold storage enterprises. • Facilitate structured market linkage support for beneficiaries through to ensure off-take and reduce asset underutilization • Capacity building of financial institutions especially at rural branches, lack training on schemes such as AIF, PMFME which delays processing and increases rejections	
Access to Finance	• MAHAPREIT to facilitate subsidy /viability gap funding the Capex – this can be tapped through the ongoing Govt. schemes and /or other sources • Enable credit access through cooperative banks, Maharashtra Gramin Bank, and Mahila Arthik Vikas Mahamandal (MAVIM) in remote clusters • Enable capital subsidy and interest subvention through convergence of MIDH/ PMFME, and AIF. Facilitate these linkages via DICs and Agriculture/Horticulture departments. • MEDA and NABARD to explore a guarantee fund to reduce early-stage financing risk for micro enterprises in rural clusters	MAHAPREIT, MGB, MAVIM,
Solar powered mills in rural areas (Rice, Millets, Wheat etc.)		
Demand Assessment & Project Development	• Maharashtra, with key wheat-producing districts like Pune, Solapur, Nashik, Ahmednagar, and Jalna, presents a strong case for the adoption of solar-powered wheat flour mills. The Maharashtra Rural Development Department (MRDD), in collaboration with Maharashtra State Agro-Industries Development Corporation (MSAIDC), should focus on high-demand wheat-growing areas with poor access to reliable power and inefficient milling processes • Map existing wheat flour mills in these clusters especially in remote and underdeveloped regions where diesel-powered mills are still prevalent, and electricity supply is unreliable. These regions should be prioritized for the deployment of solar-powered mills • Pilot projects should be initiated through MEDA focusing on assessing feasibility, lifecycle cost benefits, and the ability of solar-powered mills to mitigate power shortages in the long term. In these pilot areas, engage with Farmer Producer Organizations (FPOs) and Self-Help Groups (SHGs) to make the model more inclusive and community-driven	MRDD, MSAIDC, MUVN
Supplier Innovation & Standardization	• Standardize the design and performance parameters for solar-powered wheat flour mills, ensuring compatibility with solar array systems and Variable Frequency Drives (VFDs). Focus on	MEDA

Policy elements	Programmatic components to drive adoptions	Key Institutions
	designs that can operate optimally even during periods of low sunlight or cloudy weather • Work with technical institutions like the National Institute of Solar Energy (NISE) and the Bureau of Indian Standards (BIS) to create specifications for solar milling systems that can meet the energy needs of small-scale flour mills in rural settings • MEDA may incorporate these standards into their vendor selection criteria and subsidy programs to ensure that only high-quality, efficient, and low-maintenance solar-powered mills are adopted	
Skill Development & Capacity Building	• Collaborate with the Skill Council for Green Jobs (SCGJ) and the Ministry of Food Processing Industries (MoFPI) to design training programs focused on solar-powered wheat flour mills. These programs should target small-scale mill operators, rural entrepreneurs, and SHGs, particularly in districts with significant milling demand like Satara, Chandrapur, and Ahmednagar • Leverage RSETIs (Rural Self Employment Training Institutes) and NIRD (National Institute of Rural Development) to deliver hands-on training on the technical aspects of solar mill operations, maintenance, and post-harvest wheat processing. District-level resource centers should train local resource persons, who can then conduct workshops in villages to build capacity for managing and maintaining the solar-powered systems • Integrating solar-powered flour mills with eNAM could provide rural mills with better market access and improved pricing for processed wheat flour. The integration with eNAM would allow mill operators to engage in price discovery, helping them find better buyers and create steady demand for their products • Create training modules on efficient post-harvest management for wheat milling, specifically designed to meet the high local demand for wheat flour in Maharashtra	SCGJ, MoFPI, RSETI, NIRD, MPKV
Access to Finance	• Work with Maharashtra's state financial institutions like Maharashtra State Cooperative Bank, regional rural banks, and Microfinance Institutions (MFIs) to develop financial products that support solar-powered wheat flour mills. These products should be designed for rural mill operators who often face cash flow challenges • Design flexible loan schemes through MUVN and MSIDC, which can include lease-to-own or pay-as-you-go models, allowing smallholders and mill operators to reduce the initial capital burden. These models will ensure that repayments are spread over a period of 5–7 years, in line with the financial returns from the mills • Incorporate financing models from national schemes such as PMFME (Pradhan Mantri Formalization of Micro Food Enterprises), which can provide subsidies and long-term, low-	Maharashtra State Cooperative Bank, Regional Rural Banks, MFIs, MUVN, MSIDC,

Policy elements	Programmatic components to drive adoptions	Key Institutions
	interest loans for mill operators installing solar-powered systems • Encourage partnerships between solar-powered mills and local wheat procurement centers to ensure consistent demand for processed wheat flour. These partnerships would help to address the logistical challenges associated with wheat procurement and distribution in rural areas	
Solar Dryers		
Demand Assessment & Project Development	• Assess the demand for solar dryers in regions like Nagpur, Amravati, Nashik, Solapur, Aurangabad, Satara, Kolhapur, Raigad, and Palghar. These districts have a significant presence in agriculture, especially horticulture and fruit production, making them ideal potential locations for solar dryer adoption • Use data from Maharashtra State Agriculture Marketing Board (MSAMB) and Maharashtra Agricultural Competitiveness Project (MACP) to pinpoint regions with high post-harvest losses • Leverage the network of MSRLM, Producer Companies, and Self-Help Groups (SHGs) to understand local needs. These groups can help identify local crop patterns and facilitate farmer outreach • Evaluate the local horticulture and crop mix (e.g., tomatoes, onions, garlic, mangoes, grapes, and strawberries) to determine which crops will benefit the most from drying • Utilize Maharashtra's Tribal Development Department (MSTDD) to work with tribal communities, especially in Melghat, Nandurbar, and Gadchiroli, where agricultural practices can benefit from solar drying • Collaborate with Van Dhan Yojana for promoting solar dryers in tribal and remote areas for non-timber forest products (NTFPs), as well as horticultural produce • Focus on horticulture-dominant clusters supported by schemes like Maharashtra State Horticultural Development Corporation (MSHDC), especially in regions with large volumes of perishable crops like grapes, mangoes, and pomegranates	MRLM, MSAMB, MSTDD
Supplier Innovation & Standardization	• Set standards on key performance indicators for solar dryers, such as moisture content (e.g., 5-12% for fruits), drying time (6-10 hours depending on humidity), temperature consistency, load capacity, and drying time for different crops. • Collaborate with NISE (National Institute of Solar Energy) and BIS (Bureau of Indian Standards) to develop these standards, while adapting them for Maharashtra's agro-climatic zones (e.g., semi-arid in Solapur and more humid in Konkan) • Ensure the use of food-grade materials compliant with food safety standards for processing crops such as mangoes, tomatoes, and chillies	MEDA

Policy elements	Programmatic components to drive adoptions	Key Institutions
	• Work with MEDA to roll out Maharashtra-specific standards, especially regarding temperature tolerance and humidity, which may vary in different regions of the state	
Skill Development & Capacity Building	• Collaborate with Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV) and Maharashtra Agricultural University (MAU) to create state-specific post-harvest training programs focused on drying techniques for various crops, such as grapes, tomatoes, chilies, and mangoes • Work with KVKs and ICAR institutes to organize workshops on improving drying efficiency, optimizing crop preparation, and ensuring hygiene maintenance • Provide region-specific training, considering that different areas of Maharashtra (e.g., Vidarbha versus Konkan) have distinct post-harvest needs • Conduct hands-on training for farmers and SHG members on operating solar dryers, maintaining hygiene, and optimizing drying time for different commodities (fruits, vegetables, and spices) • Arrange exposure visits to local mandis (such as Lasalgaon Onion Market, Vashi APMC in Mumbai, Pune Wholesale Vegetable Market) to familiarize beneficiaries with market prices and how drying enhances the shelf life and value of agricultural produce • Leverage Maharashtra State Rural Livelihoods Mission (MSRLM) to facilitate farmer network integration with established food processing value chains and improve market access through structured retail partnerships	PDKV, MAU, KVKs, MSRLM, MSHDC,
Access to Finance	• Partner with Maharashtra State Cooperative Bank (MSCB), NABARD (National Bank for Agriculture and Rural Development), and MSRLM to establish financial products like MUDRA loans, Kisan Credit Cards (KCC), and other rural loan products to support solar dryer adoption • Collaborate with Microfinance Institutions MFIs and SHGs to facilitate micro-loans for smaller farmers who may not have access to formal banking institutions • Work with Business Correspondent Agents (BCAs) at Gram Panchayat level through MSRLM to extend financial literacy programs on loan options, eligibility, and how financing solar dryers can lead to better crop income • Offer subsidized loans or financing options for solar dryers under various government schemes, such as the PM Kisan Yojana or MUDRA • Use the MSRLM's BCA network for loan facilitation at Gram Panchayat level, offering assistance to farmers in filling out applications, securing loans, and understanding the repayment structure	MSCB, NABARD, MSRLM

Policy elements	Programmatic components to drive adoptions	Key Institutions
	• Set up loan repayment plans in alignment with farming seasons to ease the financial burden on farmers, particularly in high-investment months	
Solar Refrigerators/ Deep freezers		
Demand Assessment & Project Development	• Maharashtra, with its diverse agricultural produce, particularly in fruits, vegetables, dairy products, and medicines, presents a strong case for the adoption of solar-powered refrigerators and deep freezers. These systems are especially needed in kirana shops, restaurants, and primary healthcare centers (PHCs) that rely on refrigeration for perishable goods but suffer from unreliable electricity. • The Maharashtra Rural Development Department (MRDD), in collaboration with the Maharashtra State Food Processing and Development Corporation (MSFPDC) and Maharashtra Rural Livelihoods Promotion Society (MRLPS), should spearhead the identification of high-demand areas and drive the adoption of solar-powered refrigeration systems in these sectors. • Identify high-demand areas in rural and semi-urban parts of Maharashtra, such as Nashik, Pune, Aurangabad, Nagpur, and Kolhapur, where small businesses, restaurants, and healthcare centers require refrigeration systems • Focus on developing clusters in districts with a high concentration of kirana shops, local eateries, and healthcare providers, creating demand for solar refrigeration solutions • Integrate solar-powered refrigeration into PHCs, vaccination centers, and small healthcare clinics to store vaccines, medicines, and medical supplies, ensuring a reliable cold chain for health services in rural areas • Collaborate with local supply chains, including milk cooperatives, fruit vendors, and dairy distributors, to integrate solar refrigeration into their operations, reducing spoilage and extending product shelf life.	MRDD, MSFPDC, MRLPS, Maharashtra Health Department
Supplier Innovation & Standardization	• Work with System suppliers to ensure solar refrigerators and deep freezers are adapted to Maharashtra's climate, accounting for issues like variable sunlight in regions such as Vidarbha and Konkan, and ensuring systems are energy-efficient, compact, and low-maintenance. • Focus on developing solar refrigeration solutions that are compact, economical, and efficient for small shops, restaurants, and healthcare providers. Customize these units for various applications, such as dairy storage, food preservation, and medical storage • Work with Bureau of Indian Standards (BIS) to create performance standards that ensure long-term reliability, low energy consumption, and adaptability to rural Maharashtra's varied climatic conditions • Work with Bureau of Indian Standards (BIS) to create performance standards that ensure long-term reliability, low	BIS, MSFPDC, MRLPS

Policy elements	Programmatic components to drive adoptions	Key Institutions
	energy consumption, and adaptability to rural Maharashtra's varied climatic conditions	
Skill Development & Capacity Building	• Collaborate with the Skill Council for Green Jobs (SCGJ) and the Ministry of Food Processing Industries (MoFPI) to develop region-specific training programs for kiranawalas, restaurant owners, and healthcare workers on solar refrigeration operation, maintenance, and troubleshooting • Leverage RSETIs (Rural Self Employment Training Institutes) and NIRD (National Institute of Rural Development) to provide hands-on training to local entrepreneurs and SHGs on the installation, upkeep, and basic repairs of solar refrigeration systems • Develop training modules for PHC staff, health workers, and vaccination centers to ensure that solar refrigerators are properly used to store temperature-sensitive healthcare products like vaccines • Set up district-level resource centers in Pune, Nashik, and Nagpur, where local resource persons can be trained to teach other community members and business owners how to operate and maintain solar refrigerators • Provide training on the integration of solar refrigeration into local supply chains for dairy products, fruits, vegetables, and medicines, helping business owners reduce waste and ensure food and health security	SCGJ, MoFPI, RSETI, NIRD, MRLPS,
Access to Finance	• Collaborate with Maharashtra State Cooperative Bank, regional rural banks, and Microfinance Institutions (MFIs) to design financial products tailored to small businesses, including low-interest loans, pay-as-you-go models for solar refrigerators and deep freezers • Work with system suppliers to offer bundled financing packages that cover the cost of the refrigerator, installation, and maintenance over a period of 5- 7 years, making the system more affordable for rural business owners and healthcare providers • Leverage government schemes like PMFME to provide subsidized loans and financial assistance for solar refrigeration system installations • Develop specific financial products for primary healthcare centers (PHCs) to integrate solar-powered refrigerators for medical storage, including vaccine refrigerators, through grants and low-interest loans.	Maharashtra State Cooperative Bank, Regional Rural Banks, MFIs, MRLPS,

Bihar



8 Enabling rural livelihoods in Bihar through DRE

Bihar, located in the northern region of India, covers a geographic area of 94,163 sq. km and has one of the highest rural population densities in the country- 970 persons per sq. km. With a rural population exceeding 92 million, the state faces considerable livelihood challenges, including an estimated 3.8 million unemployed individuals in rural areas. These challenges are compounded by limited access to reliable energy, which hinders productivity across key sectors.

Despite these hurdles, Bihar holds substantial potential for renewable energy-based interventions. The state receives a solar irradiance of 4.51 kWh/m²/day and has an unutilized biomass potential of 7.98 million tonnes annually. These resources provide a strong foundation for deploying DRE technologies. By integrating DRE livelihood appliances tailored to local needs, Bihar can bridge energy access gaps, create employment opportunities, and foster sustainable rural development through productive use of solar and biomass energy.

8.1 Potential opportunities along with the prioritized use cases in Bihar

Several of the DRE livelihoods intervention areas represent notable market potential, with an estimated addressable opportunity of approximately USD 537 mn over the next 5-6 years.

The agriculture sector leads with a combined value of USD 313 mn, driven primarily by interventions in post-harvest management and agri-waste to biofuels. The livestock segment, while comparatively smaller, presents targeted opportunities worth USD 47 mn, with dairy being the most prominent. Non-farm enterprises continue to show promise, contributing USD 317 mn, underscoring the growing shift of rural economies towards diversified income sources through agri-based businesses, textiles, and local retail services. In this context, a comprehensive approach for scaling up interventions which present the most opportunity in the near to mid-term and have relevance across large parts of the state has been identified.

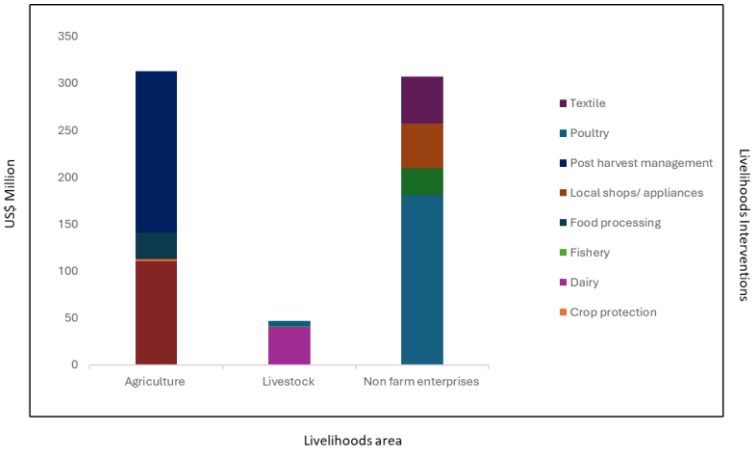
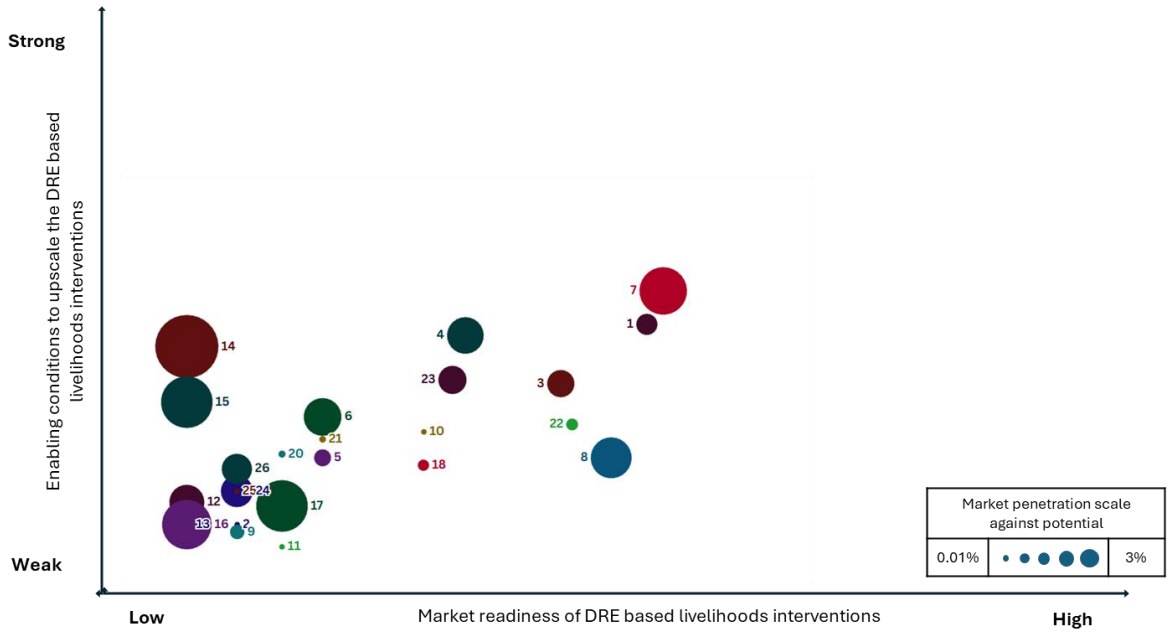


Figure 19: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions in Bihar

8.2 Interventions with evolving enabling conditions and fructifying demand

The below presents a synthesis of technologies of priorities based on their market readiness vs. the enabling conditions required for scale-up; and helps gauge the policy and market development interventions needed to ensure scale-up in the state



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Flour mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Rice mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 20: Market readiness and Enabling conditions evaluation framework for Bihar

		Enabling Conditions		
	Scale	Strong	Moderate	Weak
Market Readiness	High			
	Moderate			Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Vertical hydroponic fodder machine, Solar Cooker, Solar Water Purifier, Solar Pumps, RE powered Micro-Cold Storage, Solar Dryers, Solar powered rice huller, polisher, Rice mills, Solar powered flour mills, Bio-digester, RE powered Bulk Milk Chiller, Solar Refrigerator/Deep freezer, Solar powered looms
	Limited			Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer, Solar Reeling Machine, Solar Sewing Machines, Solar Egg Incubator, Solar Charkhas

8.3 Potential geographies of opportunities for priority interventions

In post-harvest management, districts such as Samastipur, Araria, Patna, Saran, and Nalanda exhibit high potential for RE-powered micro-cold storage solutions. The district-level horticulture production data indicates these regions experience substantial post-harvest losses, underscoring the need for efficient cold storage infrastructure to extend produce shelf life and reduce wastage.

Complementary to this, solar drying technologies also show viable application within the same clusters, enhancing food processing and value addition. The table below highlights the list of prioritized DRE based livelihoods interventions with high potential in the state

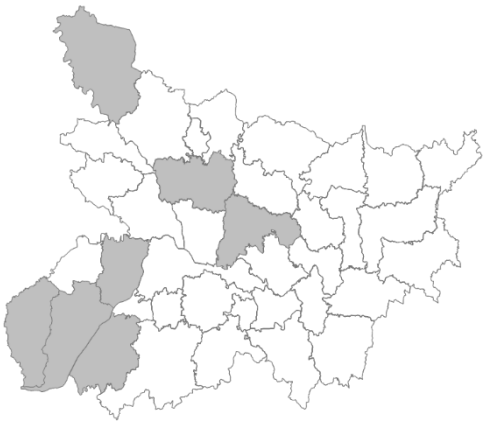


Figure 21: High potential districts for prioritized DRE interventions in Bihar

Livelihood area	Livelihood Intervention	DRE Interventions	Addressable market (Mn USD)	High potential clusters for deployment
Agriculture	Post harvest management	RE powered Micro-Cold Storage	171+	Samastipur, Araria, Salan, Patna, Nalanda
	Food processing	Solar Dryer	29+	Samastipur, Araria, Salan, Patna, Nalanda
Livestock	Dairy	RE powered Bulk Milk Chiller	25+	Patna, Samatipur, Nalanda, Muzzafarpur, Begusarai
Non-farm enterprises	Local shops/ appliances	Solar Refrigerator/ Deep freezer	23+	
	Agri based	Solar powered rice huller, polisher and mills	55+	Rohtansh, Aurangabad, bhabhua, Bhojpur, Pashchim Champaran
		Solar powered Flour mills	80+	Rohtash, Muzaffarpur, Bhojpur, Kaimur, East Champaran

Table 14: Serviceable/ Addressable potential of prioritized interventions in Bihar

Within the dairy sector, the top milk-producing districts-Patna, Samastipur, Nalanda, Muzaffarpur, Begusarai present a strong case for scaling RE-powered BMCs and vertical hydroponic fodder machines. For non-farm agri-based enterprises, Rohtas, Aurangabad, Bhabhua, Bhojpur, and Pashchim Champaran, identified as major rice-producing areas, demonstrate considerable market readiness for solar-powered rice hullers, polishers, and mills. Additionally, districts like Rohtas, Muzaffarpur, Bhojpur, Kaimur, and East Champaran, which contribute significantly to wheat production, are well-positioned for adopting solar-powered flour mills.



8.4 Analysis of key policies influencing the DRE livelihoods solutions in the state

Bihar's policy environment reflects lack of uptake efforts to promote DRE solutions, especially within agriculture and allied sectors, which are critical to the state's predominantly rural economy. While several central schemes which are implemented by several states like PM KUSUM and National bio energy program are yet to be adopted by Bihar limiting the uptake of the DRE potential in the state. The overleaf presents the analysis of schemes/ policies for key DRE segments.

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
Post Harvest Management (RE powered Micro-Cold Storage)						
						Although the serviceable opportunity for the solution is high, there are limited schemes/ policies to scale the solutions, Central schemes are applicable, but uptake is low, State schemes through VEGFED has started to create traction for MCS in the state
Agri Waste to biofuels (Biodigesters)						
						Bioenergy scheme launched by MNRE and Gobardhan scheme launched by Ministry of Jal Shakti are key policy enablers
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine)						
						There is no specific scheme or policy promoting renewable energy-powered appliances within the dairy sector.
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)						
						Although the serviceable opportunity for the solution is high, there are no schemes/ policies to scale the solutions.
Food processing (Solar Dryers)						
						Along with micro cold storage solutions, this has been incorporated into major schemes and policies related to the horticulture value chain and is supported under central schemes such as MIDH and SMAM, but lacks implementation
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)						
						Even as some schemes like SMAM have included the solutions for support, no concrete policies have been formulated to support the RE powered Agri-based enterprises directly in the state

High		Low

8.5 Impetus and Catalytic Actions across different interventions in Bihar

While policy ecosystem lags in implementation, other donor funded/catalyst programs have created a traction for DRE technologies in the state with pilots being implemented for several DRE applications. From 2020 onward, improved biomass cookstoves and solar sewing/spinning technologies have gained traction, largely through women's self-help groups. The World Bank and state rural livelihood mission (BRLPS) have been key drivers, enabling women to become clean energy entrepreneurs. World Bank & BRLPS "Uttam Urja Kendra" Initiative. A pilot launched in 2021 trained rural women in Bihar to market and sell improved biomass cookstoves (low-smoke, efficient models) in their communities. Initially 25 women across 5 districts were trained as "Solar Mart" entrepreneurs, selling stoves and solar lights from women-run shops. By 2024 this women-led distribution network expanded to 372 solar marts, selling 50,000 improved cookstoves across 15 districts. This program, supported by the World Bank (as part of an air quality pilot) and implemented with TERI and BRLPS, not only provided cleaner stoves to 50k households but also empowered hundreds of women with business and technical skills.

8.6 Key challenges and barriers to the opportunity for the uptake of DRE based livelihoods intervention in Bihar

Based on stakeholder interactions and analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions with high potential. The table overleaf outlines intervention-specific gaps - both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators/ Deep freezer
Barriers for market ecosystem				
Lack of confidence in technology and awareness on the use cases among the beneficiaries	✓	✓	✓	✓
Lack of awareness about the business models and return on investment	✓	✓	✓	
Underdeveloped distribution and service networks	✓	✓	✓	✓
Significant upfront costs, along with longer payback	✓	✓	✓	✓
Lack of training and usage support for end users on product usage	✓		✓	
Lack of standardized products and verification process	✓	✓	✓	✓
Limited after sales support due to tech providers operating from distant locations	✓	✓	✓	✓
Significant upfront cost compared to grid powered counterparts	✓	✓		✓

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers	Solar refrigerators/ Deep freezer
Barriers for enabling ecosystem				
Lack of dedicated scheme/ policy at state level		✓	✓	✓
Lack of dedicated incentives in policies/ schemes		✓		✓
Lack of dedicated targets /allocations in current schemes	✓			
Limited technical capacity among the implementing agencies	✓		✓	
Low mandate/ current plan to integrate programs under state mission	✓	✓	✓	✓
Limited access to affordable financing	✓	✓	✓	✓
Limited incubation and capacity building support for technology providers		✓		✓

8.7 Policy elements and programmatic framing for upscaling the prioritized DRE livelihoods interventions in Bihar

The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. An overview of the areas in which actions are deemed necessary for the uptake and prioritization of these technologies in Bihar are summarized below:

Policy elements	Programmatic components to drive adoptions	Key Institutions
RE powered Micro cold storage at on farm/ near farm within the horticulture value chain		
Demand Assessment & Project Development	• Bihar Renewable Energy Development Agency (BREDA) to coordinate convergence between Bihar Horticulture Department and BRLPS for cluster-level planning and beneficiary selection • Conduct district/block-level demand assessment by leveraging BRLPS's SHG and Producer Group network, especially in high horticulture output districts such as Samastipur, Araria, Salan, Patna, Nalanda • Identify existing CLFs/ SHGs and producer companies led income generating activities in fruit and vegetable clusters and assess the extent of post-harvest losses in those clusters. This can be undertaken in collaboration with BRLPS, which has active CLFs/ VOs engaged in horticulture-related livelihoods and Directorate of horticulture • Conduct village-level consultations through primary vegetable cooperative societies (PVCS) under VEGFED and SHG/Producer groups working with BRLPS to assess end-user willingness to pay or co-invest, estimate seasonal demand for cold storage, and identify suitable ownership and operation models such as SHG-managed, community-based, or private entrepreneur-led models	BREDA, BRLPS, Bihar Horticulture Department, Agriculture Department, ATMA, KVKs

Policy elements	Programmatic components to drive adoptions	Key Institutions
	• Set up cross-functional working groups at the district level including officials from BRLPS, Horticulture, ATMA, VEGFED and KVKs to coordinate deployment and usage • Horticulture Directorate to map key crop cycles and identify peak harvest windows, gaps in current storage infrastructure, and linkages to mandis or Farmer Producer Markets	
Supplier Innovation & Standardization	• Mandate integration of MNRE and NCCD cold storage specifications in future tenders for VEGFED installations at PACS for product performance assurance • Prioritize empanelment of vendors in tenders that maintain a local service presence and can ensure a defined turnaround time of no more than 36 hours, given the limited shelf life of perishable produce- this will help minimize downtime and prevent post-harvest losses • Mandate a comprehensive Annual Maintenance Contract (AMC) for a minimum duration of 3 years, with a preference for extending it to 5 years, to ensure sustained performance and timely servicing of deployed assets • Mandate integration of IoT-based remote monitoring systems to enable real-time tracking of asset functioning and utilization, thereby supporting proactive maintenance and optimizing performance	VEGFED
Skill Development & Capacity Building	• Build the capacity of promoting agencies, which currently have limited exposure to operational and business models for MCS • The Skill Council for Green Jobs (SCGJ) under NSDC could collaborate for capacity building among institutes such as RSETIs and BRLPS and develop state specific training module • Enhance and integrate training modules for on-ground technicians by incorporating cold storage systems into existing skilling programs, such as the Surya Mitra Skill Development Program under the National Institute of Solar Energy (NISE), to ensure technical readiness and field-level service capacity • Train local technicians on installations, repair, maintenance checks and infra specifications for RE powered micro cold storage systems for S-MART operators • VEGFED may provide training and extension services to the vegetable growers on crop-specific handling and post-harvest operation, commodity-specific cold storage training for SHGs, FPOs and create district-level training program to scale outreach • Facilitate structured market linkage support for beneficiaries through VEGFED under existing retail outlets channels to ensure off-take at right prices for farmers and also reduce asset underutilization	VEGFED, BRLPS

Policy elements	Programmatic components to drive adoptions	Key Institutions
Access to Finance	• NABARD can play a key role in facilitating capacity-building programs for financial institutions, focusing on business models and financing for MCS • To mitigate concerns on high upfront capital burden as also access for the same, promote lease-to-own or pay-as-you-go models to enhance economic viability and improve asset utilization • Vendors may partner with financing entities to offer a lease-to-own model for FPOs and SHGs. Vendors can secure financing from these institutions to deploy the model. Nabsanrakshan may support this model by offering partial risk guarantees during the initial years of operations • Convergence of schemes such as MIDH/ PMFME can be leveraged for credit-linked subsidies, while AIF can be utilized to avail interest subvention benefits • BRLPS can facilitate working capital loans to CLFs, SHGs, VOs, and producer groups under the CIF	BRLPS, BSCB
Solar powered mills in rural areas (Rice, Wheat etc.)		
Demand Assessment & Project Development	• Bihar has significant wheat-producing regions such as Rohtash, Muzaffarpur, Bhojpur, Kaimur, East Champaran, and rice producing regions Rohtash, Muzaffarpur, Bhojpur, Kaimur, East Champaran where small-scale milling is crucial. BRLPS and Industries department to identify high-demand rice/ wheat-processing areas for solar-powered mill adoption • Map existing wheat flour mills in Bihar, focusing on areas with high diesel consumption and inefficient, manually operated mills, particularly in districts, where access to reliable electricity is a challenge	BREDA, BRLPS, Industries department
Supplier Innovation & Standardization	• Standardize the technical requirements for solar-powered wheat flour mills, ensuring compatibility with solar array systems, VFDs, and the local energy conditions in Bihar. This includes developing solar systems that can handle the specific power demands of rural mills in the state, ensuring efficient operation even during cloudy days or low solar output periods	BREDA
Skill Development & Capacity Building	• State level training institutes of RSETI and NIRD to impart training to district level resource institutions which shall further train the beneficiaries at district level on operations, maintenance procedures and also the technical specifications of Solar array system and mechanical milling operations- this can be facilitated by BRLPS for their S-MART network	BRLPS
Access to Finance	• Develop targeted financial products in partnership with local financial institutions like the Bihar State Cooperative Bank, regional rural banks, and MFI. These financial products should offer affordable financing options for solar-powered wheat flour mills, considering the cash flow cycles of rural mill operators • Facilitate the access of subsidies under PMFME and loans for the installation of solar mills, thereby easing the initial capital burden	BSCB

Policy elements	Programmatic components to drive adoptions	Key Institutions
Solar Dryers		
Demand Assessment & Project Development	• Conduct Demand Assessment and Focus on horticulture-dominant regions in Bihar like Muzaffarpur, Saran, Bhagalpur, Samastipur, Vaishali, Begusarai, and Purnia, where post-harvest losses are significant in fruits, vegetables, and other agricultural produce • BRLPS may leverage its network of SHGs and Producer Companies to identify demand clusters and eligible beneficiaries for adoption, and develop these sites as aggregation hubs for smallholder horticulture farmers	BRLPS

Supplier Innovation & Standardization	• Develop and roll out technical standards and quality benchmarks for various types of solar dryers to be led by NISE and BIS and BREDA to adopt these standards in local context
	  ○ Define output parameters like moisture content targets, drying time ranges, temperature consistency, load capacity and drying time
	  ○ To maintain compliance with food-grade material standards and post-harvest hygiene requirements.
		BREDA

Skill Development & Capacity Building	• Dr. Rajendra Prasad Central Agricultural University (RPCAU) and Bihar Agricultural University (BAU) to develop post-harvest processing modules for capacity building of implementing agencies to deliver training to the district level resource institutions/ partners • Facilitate structured training support for SHGs and smallholder farmers at the district level, ensuring they are educated on drying techniques, maintenance practices, and hygiene practices, and commodity-specific techniques for cutting, chopping and slicing to optimize the drying time • J-Wires may establish an incubation-cum-experience center at its head office to provide hands-on exposure and operational models • Strengthen market linkages through VEGFED by facilitating structured market access for farmers, enhancing produce offtake through organized retail channels, and integrating farmer networks with established food processing value chains	RPCAU, BAU, BRLPS, KVKs, VEGFED
Access to Finance	• BSCB to offer micro-loans and Kisan Credit Cards (KCC) under MUDRA tailored to the needs of smallholder farmers. These loans can be used for purchasing solar dryers, with low-interest rates and flexible repayment options • Leverage BRLPS's Business Correspondent model at Gram Panchayat level to facilitate loan for farmers in rural Bihar, especially in remote areas. BCs can also educate farmers about loan eligibility, terms, and the potential long-term benefits of using solar dryers • PSL targets through BSCB to support financing for small food processing units, farmer groups, and self-help groups to purchase and install solar dryers for value addition and post-harvest management	BSCB, BRLPS
Solar refrigerators/ Deep freezers		

Policy elements	Programmatic components to drive adoptions	Key Institutions
Demand Assessment & Project Development	• Demand assessment by BRLPS may also be extended to Didi ki Rasoi along with the local shops, eateries, and PHCs/CHCs, particularly in rural and semi-urban areas • Collaborate with Bihar Health Department to deploy solar refrigerators in PHCs/ CHCs and vaccination hubs, ensuring the safe storage of vaccines, medicines, and other temperature-sensitive health products • BMSICL may introduce procurement mandates requiring that a certain percentage of vaccine storage units (deep freezers) in PHCs be solar powered- facilitating the installation of solar refrigerators for storing vaccines and medicines and also reducing reliance on unreliable power grids in rural setting	BRLPS, BMSICL
Supplier Innovation & Standardization	• Solar-powered refrigerators and deep freezers need to be reliable, energy-efficient, and tailored for the specific needs of rural livelihood-linked areas. With BRLPS working on community-based solutions, these systems can be customized for local environments, such as kirana shops, restaurants, and PHCs • Mandate comprehensive AMC support for a minimum duration of 2 years, with a preference for extending it to 3 years, to ensure sustained performance and timely servicing of deployed assets	BREDA, BRLPS
Skill Development & Capacity Building	• Build the capacity of promoting agencies, which currently have limited exposure to operational and business models • To ensure the successful adoption of solar refrigerators and deep freezers in livelihood-linked areas, BRLPS and local institutions can play a vital role in training and capacity building for local entrepreneurs ` • Leverage channels such as SHG/ VO-led S-MARTs under BRLPs for the distribution and servicing of solar refrigerators and deep freezers- ensuring localized access, user awareness, and post-installation support, particularly in rural and semi-urban areas • Extend support for solar refrigerators and deep freezers into the Satat Jeevikoparjan Yojana, enabling VO/ SHGs to build confidence through assistance in asset selection and entrepreneurship training for business development	BRLPS
Access to Finance	• Collaborate with Bihar State Cooperative Bank, regional rural banks, and MFIs to design financing products, including low-interest loans, pay-as-you-go financing, and lease-to-own models for solar refrigerators and deep freezers • Work with suppliers to offer bundled financing packages that cover the cost of the system, installation, and maintenance over a period of 2-3 years, making it easier for rural business owners and healthcare providers to afford solar refrigeration systems • PSL targets through BSCB to support financing for small food service providers and healthcare centers to purchase and install solar-powered refrigeration systems.	BSCB, RRB

Madhya Pradesh



9 Building Momentum: Madhya Pradesh's emerging landscape for DRE livelihoods

Madhya Pradesh, located in central India, spans a geographic area of 308,252 sq. km and has a rural population exceeding 51 million. With a rural population density of 167 persons per sq. km, the state faces notable livelihood challenges, including over 5.8 million unemployed individuals in rural areas and a high rate of youth unemployment. These challenges are further exacerbated by limited access to reliable energy, which constrains productivity and income generation in key rural sectors.

With these barriers, Madhya Pradesh holds considerable potential for renewable energy-based interventions. The state receives an average solar irradiance of 5.15 kWh/m²/day and has an unutilized biomass potential of 19.93 mn tonnes annually. These resources present a strong foundation for the deployment of DRE technologies. By integrating DRE livelihood appliances aligned with local needs, Madhya Pradesh can bridge critical energy access gaps, generate employment, and drive inclusive rural development through the productive use of solar and biomass energy.

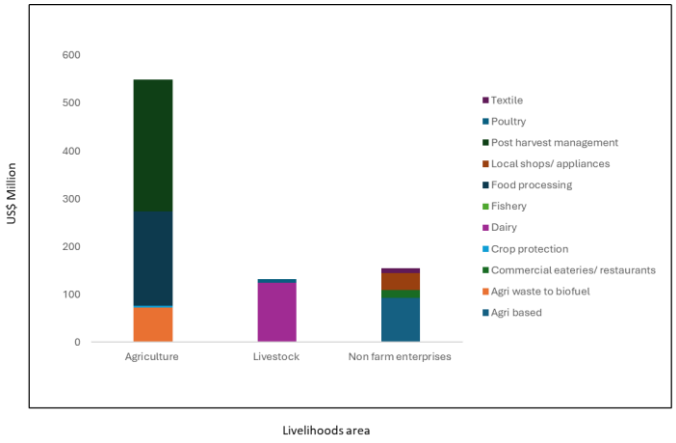


Figure 22: Serviceable/ Addressable potential of DRE solutions for key livelihoods interventions in Madhya Pradesh

9.1 Potential opportunities along with the prioritized use cases in MP

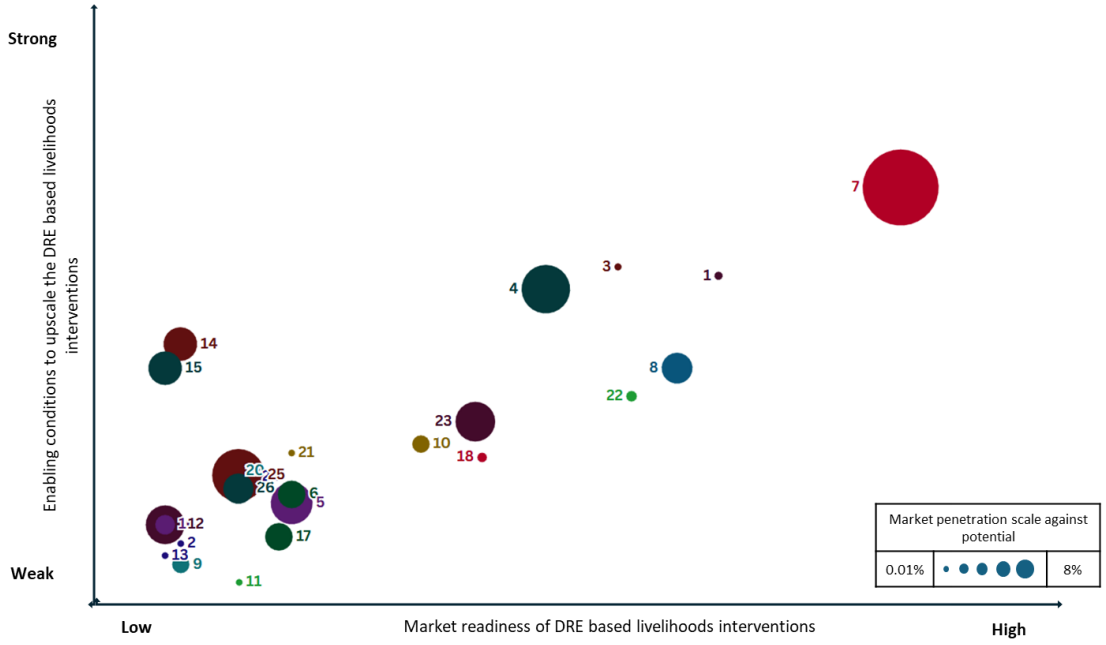
Several DRE-based livelihood interventions in Madhya Pradesh present substantial untapped potential- an assessment of the serviceable/addressable market over the next 5-6 years estimates a cumulative opportunity of approximately USD 860 mn. However, in the context of Madhya Pradesh, there remains limited clarity on which specific livelihood segments are most conducive to accelerated DRE adoption over the next 3- 4 years, and what tailored business models, enabling policies, and ecosystem-level interventions are required to effectively convert this potential into scalable and sustainable market outcomes

The agriculture sector represents the largest share, with over USD 540 mn in DRE opportunities- driven primarily by RE-powered post-harvest management, food processing, and agri-waste to biofuel applications. Post-Harvest Management (USD 276 mn) presents the single largest opportunity; this segment includes DRE-powered micro cold storages followed by Food Processing value chain with solar dryers (USD 197 mn) particularly in horticulture and spice value chain. These solutions can significantly reduce post-harvest losses, improve value realization, and strengthen supply chains for perishable commodities. Simultaneously, the non-farm enterprise segment- valued at USD 155 mn- reflects the rising diversification of rural livelihoods beyond agriculture, signaling a growing role for DRE in powering

microenterprises such as rural shops, eateries, and textile units.

9.2 Interventions with evolving enabling conditions and fructifying demand

The framework below presents a synthesis of technologies of priorities based on their market readiness vs. the enabling conditions required for scale-up; and helps gauge the policy and market development interventions needed to ensure scale-up.



1	Micro-Cold Storage	**6**	Pellet Maker	**11**	Ice Flake Plant	**16**	Solar juicer	**21**	Solar powered Rice mills
2	Animal Deterrent	**7**	Solar Pumps	**12**	Solar Egg Incubator	**17**	Solar Water Purifier	**22**	Solar powered Flour mills
3	Solar Dryer	**8**	Bulk Milk Chiller	**13**	Solar Aerator	**18**	Solar Refrigerator/ Deep freezer	**23**	Solar powered looms
4	Bio-digester	**9**	Solar milking machine	**14**	Biomass Cookstoves	**19**	Solar powered rice huller	**24**	Solar Reeling Machine
5	Torrefaction Unit	**10**	Solar hydroponic fodder machine	**15**	Solar Cooker	**20**	Solar powered rice polisher	**25**	Solar Charkhas
								26	Solar Sewing Machines

Figure 23: Market readiness and Enabling conditions evaluation framework

		Enabling Conditions		
	Scale	Strong	Moderate	Weak
Market Readiness	High	Solar Pumps		
	Moderate		RE powered Micro-Cold Storage, Solar Dryers, Solar powered flour mills, RE powered Bulk Milk Chiller, Solar Refrigerator/Deep freezer, Bio-digester, Solar powered looms Solar powered rice huller, polisher, Rice mills	Solar Vertical hydroponic fodder machine, Solar Charkhas, Solar Egg Incubator, Biomass Cookstoves, Torrefaction Unit, Pellet Maker, Solar Cooker, Solar Water Purifier
	Limited			Solar Reeling Machine, Solar Sewing Machines, Animal Deterrent, Solar milking machine, Ice Flake Plant, Solar Aerator, Solar juicer,

9.3 Potential geographies of opportunities for priority interventions

Madhya Pradesh ranks among the leading states with significant DRE potential to support livelihood enhancement across agriculture, livestock, and non-farm sectors. The overleaf highlights the list of prioritized DRE based livelihoods interventions with high potential in the state.

Livelihood Intervention	DRE Interventions	Market (Mn USD)	High potential clusters for deployment
Post harvest management	RE powered Micro-Cold Storage	276+	Burhanpur, Chhindwara, Agar Malwa, Shajapur, Rewa
Food processing	Solar Dryer	197+	Burhanpur, Chhindwara, Agar Malwa, Shajapur, Rewa
Diary	RE powered Bulk milk chiller	41+	Ujjain, Morena, Indore, Shivpuri, Sehore
Agri based non-farm enterprise	Solar powered Rice huller, polisher, mills	38+	
	Solar powered Flour mills	55+	Narmadapuram, Sehore, Ujjain, Dewas, Shajapur

Table 15: Serviceable/ Addressable potential of prioritized interventions in Madhya Pradesh

In post-harvest management, districts such as Burhanpur, Chhindwara, Agar Malwa, Shajapur, and Rewa exhibit significant potential for RE-powered micro-cold storage solutions. These districts can benefit from improved storage infrastructure to reduce post-harvest losses and extend the shelf life of horticultural produce, especially in high-production belts. For food processing applications, particularly solar dryers, deployment opportunities are promising in the same districts- Burhanpur, Chhindwara, Agar Malwa, Shajapur, and Rewa. These technologies can enhance local processing value addition, reduce moisture-related spoilage, and support the development of processing units for fruits and vegetables. In the livestock sector, districts like Ujjain, Morena, Indore, Shivpuri, and Sehore offer strong potential for solar-powered dairy applications. These include solar-powered milk chillers that can ensure quality preservation, especially in remote dairy clusters with irregular grid access. For agri-based non-farm enterprises, adoption of solar-powered equipment such as solar flour mills inc. oil extractors are particularly viable in districts like Narmadapuram, Sehore, Ujjain, Dewas, and Shajapur. These areas have emerging rural enterprise ecosystems and can benefit from energy solutions to reduce operational costs and increase productivity, especially in wheat processing value chain.

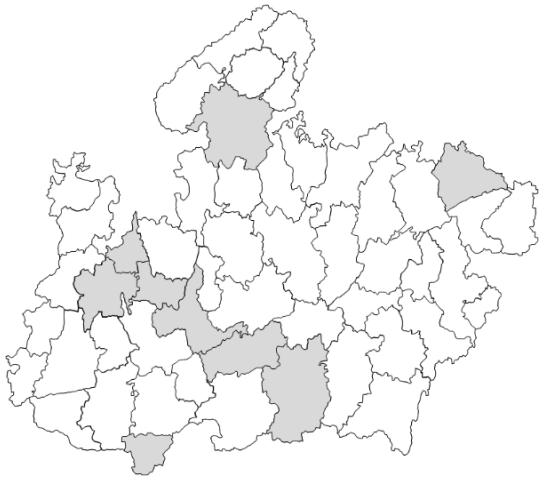


Figure 24: High potential districts for prioritized DRE interventions in Madhya Pradesh

9.4 Analysis of key policies/ schemes influencing the DRE livelihoods solutions in Madhya Pradesh

MP's policy environment presents a growing opportunity for promoting Solar water pumps but lacks enabling programs for other DRE solutions across different livelihoods segments. A range of central schemes

currently provide financial incentives, capital subsidies, and other ecosystem development support. However, dedicated states policies/ schemes are not present to scale the solutions, and opportunities for convergence and scale are yet to be fully realized. The overleaf presents the analysis of schemes/ policies for key DRE segments.

Central Policies	State policies	Adequate Targets	Market Building	Incentives	Budgetary allocations	Perspective
Post Harvest Management (RE powered Micro-Cold Storage)						
						Although the serviceable opportunity for the solution is high, there are limited schemes/ policies to scale the solutions, Central schemes are applicable, but uptake is low.
Agri Waste to biofuels (Biodigesters)						
						Bioenergy scheme launched by MNRE and Gobardhan scheme launched by Ministry of Jal Shakti are key policy enablers
Dairy (RE powered milk chillers, Solar powered vertical hydroponic fodder machine)						
						There is no specific scheme or policy promoting renewable energy-powered appliances within the dairy sector.
RE powered appliances for shops/ commercial (Solar Refrigerator/ Deep freezer)						
						Although the serviceable opportunity for the solution is high, there are no schemes/ policies to scale the solutions.
Food processing (Solar Dryers)						
						Along with micro cold storage solutions, this has been incorporated into major schemes and policies related to the horticulture value chain and is supported under central schemes such as MIDH and SMAM, but lacks implementation
RE powered Agri based enterprises (Solar powered rice huller, polisher and mills, Solar powered Flour mills)						
						Even as some schemes like SMAM have included the solutions for support, no concrete policies have been formulated to support the RE powered Agri-based enterprises directly in the state

High		Low

9.5 Key challenges and barriers to the opportunity for the uptake of DRE based livelihoods intervention in Madhya Pradesh

Based on the analysis of the operating landscape, key enabling conditions and market challenges have been identified for targeted interventions. The table overleaf outlines intervention-specific gaps - both on the supply and demand sides- highlighting barriers that currently hinder large-scale adoption and impact.

DRE applications	RE powered micro cold storage	Solar powered mills	Solar dryers
Barriers for market ecosystem			
Lack of confidence in technology and awareness on the use cases among the beneficiaries	✓		✓
Lack of awareness about the business models and return on investment	✓	✓	✓
Underdeveloped distribution and service networks	✓	✓	
Significant upfront costs, along with longer payback	✓	✓	✓
Lack of training and usage support for end users on product usage	✓	✓	✓
Lack of standardized products and verification process	✓	✓	✓
Barriers for enabling conditions			
Lack of dedicated scheme/ policy at state level	✓	✓	✓
Lack of dedicated incentives in policies/ schemes	✓	✓	✓
Limited technical knowledge among the implementing agencies	✓		
Limited access to affordable financing	✓	✓	✓
Current schemes/ policies creating an initial benchmark but not enough demand aggregation			✓
Limited technical capacity among the implementation agencies	✓	✓	✓
Limited incubation and capacity building support for technology providers		✓	

9.6 Policy elements and programmatic framing for upscaling the prioritized DRE livelihoods interventions in Madhya Pradesh

The identified DRE livelihoods applications can only achieve their potential uptake if policies and business models are set into place. An overview of the areas in which actions are deemed necessary for the uptake and prioritization of these technologies in Madhya Pradesh is summarized below:

Policy elements	Programmatic components to drive adoptions	Key Institutions
RE powered Micro cold storage at on farm/ near farm within the horticulture value chain		
Demand Assessment & Project Development	• MPUVN to lead demand assessment and identification of right beneficiaries across SHGs and FPOs with MPSRLM. This can be strengthened through institutional convergence with the Department of Horticulture and Food Processing, and MP Panchayat Raj institutions • Undertake district-wise demand assessments in high horticulture-surplus districts like Burhanpur, Chhindwara, Agar Malwa, Shajapur, Rewa. Use block-level MPSRLM networks and KVKs to identify clusters with post-harvest losses and weak cold storage infrastructure • Identify existing CLFs/ SHGs and producer companies led income generating activities in fruit and vegetable clusters and assess the extent of post-harvest losses in those clusters. This can be undertaken in collaboration with MPSRLM, which has active CLFs/ VOs engaged in horticulture-related livelihoods and Department of Horticulture and Food Processing • Include micro cold storage needs into District Agriculture Contingency Plans (DACPs) and State Agriculture Plan (SAP) • Set up block level working group with members from MPSRLM, MPUVN, Horticulture Department, and KVKs. These committees should meet quarterly to align plans, track deployments, and course-correct measures • Department of Horticulture and Food processing to identify crop cycles, region-wise surplus, and post-harvest losses. This will also include a review of existing cold storage infrastructure to prevent redundant investments and prioritize areas where cold storage can most effectively reduce losses and improve market integration	MPSRLM, MP Directorate of Horticulture, MPUVN, KVKs,
Supplier Innovation & Standardization	• Mandate integration of MNRE and NCCD cold storage specifications in future tenders for product performance assurance • Prioritize empanelment of vendors in tenders that maintain a local service presence and can ensure a defined turnaround time of no more than 36 hours, given the limited shelf life of perishable produce. This will help minimize downtime and prevent post-harvest losses • Mandate a comprehensive AMC for a minimum duration of 3 years, with a preference for extending it to 5 years, to ensure sustained performance and timely servicing of deployed assets • Mandate integration of IoT-based remote monitoring systems to enable real-time tracking of asset functioning and utilization, thereby supporting proactive maintenance and optimizing performance	MPUVN

Policy elements	Programmatic components to drive adoptions	Key Institutions
Skill Development & Capacity Building	• The SCGJ under NSDC could collaborate for capacity building among employment-related training institutes such as RSETIs and NIRD to leverage their existing focus on rural entrepreneurship in the cold storage sector • Enhance and integrate training modules for on-ground technicians by incorporating cold storage systems into existing skilling programs, such as the Surya Mitra Skill Development Program under the NISE, to ensure technical readiness and field-level service capacity • NISE's Surya Mitra program to be expanded in MP, specifically targeting cold storage installations, solar panel maintenance, and troubleshooting. MPUVN can anchor implementation. • JNKVV and RVSKVV to develop crop-specific handling and post-harvest operation modules for ICAR institutes and KVKs, to deliver location-wise, commodity-specific cold storage training for SHGs, FPOs and create district-level training program to scale outreach • Provide crop-specific post-harvest handling and cold storage training for CLFs/ SHGs and FPOs ensuring that stakeholders understand how to operate and maintain cold storage systems • Strengthen beneficiary capacity by enabling structured market linkages via MP Mandi Board and APEDA to ensure off-take	JNKVV, RVSKVV, ICAR Institute, KVK, MP Mandi Board
Access to Finance	• Convergence of schemes such as MIDH/ PMFME can be leveraged for credit-linked subsidies, while AIF can be utilized to avail interest subvention benefits • NABARD can play a key role in facilitating capacity-building programs for financial institutions, focusing on business models and financing for MCS • Financing for working capital costs to be facilitated by MP Rajya Sahkarita Bank for timely access to short-term loans or credit facilities to cover recurring operational expenses • MPSRLM can facilitate working capital loans to CLFs, SHGs, VOs, and producer groups under CIF • To mitigate concerns on high upfront capital burden as also access for the same, promote lease-to-own or pay-as-you-go models to enhance economic viability end beneficiary for the and improve asset utilization • Vendors may partner with financing entities to offer a lease-to-own model for FPOs and SHGs. Vendors can secure financing from these institutions to deploy the model • The model can be supported by offering partial risk guarantees to financiers or viability gap funding for the installer during the initial years of operations • Credit guarantee fund managed by Nabsanrakshan can further enhance the access to finance by providing credit guarantees for loans extended to FPOs thereby reducing the perceived risk	MPSRLM, MP Rajya Sahkarita Bank, NABARD

Policy elements	Programmatic components to drive adoptions	Key Institutions
	for lenders and encouraging credit flow for the first time borrowers	
Solar powered mills in rural areas		
Demand Assessment & Project Development	• Madhya Pradesh has significant wheat-producing regions such as Narmadapuram, Sehore, Ujjain, Dewas, Shajapur regions where small-scale milling is crucial. MPSRLM to identify high-demand grain-processing areas for solar-powered mill adoption. • Identify the existing rice/ wheat flour mills in the existing agro processing clusters, especially in rural areas where there is an over-reliance on inefficient, diesel-powered mills. Focus on districts where the electricity supply is inconsistent and manual labor dependence is high	MPUVN, MPSRLM
Supplier Innovation & Standardization	• Standardize the design and performance parameters for solar-powered wheat flour mills, ensuring compatibility with solar array systems and Variable Frequency Drives (VFDs). Focus on designs that can operate optimally even during periods of low sunlight or cloudy weather	MPUVN
Skill Development & Capacity Building	• Work with the Skill Council for Green Jobs (SCGJ) and MoFPI to develop and deliver capacity-building programs specifically focused on solar-powered mills. This could include partnerships with RSETIs and the NIRD which already focus on rural entrepreneurship- can be facilitated by MPSRLM • State level training institutes of RSETI and NIRD to impart training to district level resource institutions which shall further train the beneficiaries at district level on operations, maintenance procedures and also the technical specifications of Solar array system and mechanical milling operations • Integrate solar-powered wheat flour mills with eNAM platform to streamline the post-processing and marketing of milled wheat, connecting small rural mills to both local and national markets for better price discovery and profitability	RSETI, MPSRLM
Access to Finance	• Partner with local banks, including MP State Cooperative Bank, RRBs, and MFIs to design financial products that integrate pre-approved financing for solar-powered wheat flour mills. Special financing schemes can be designed to accommodate the cash flow dependency of small-scale mills • Facilitate the access of subsidies under PMFME and loans for the installation of solar mills, thereby easing the initial capital burden	MPSCB, RRB
Solar Dryers		
Demand Assessment & Project Development	• MPSRLM to lead the demand assessment for solar dryers, focusing on spice-growing regions like Chhindwara, Sehore, Shivpuri, Jabalpur, and Indore, where chili, coriander, and turmeric are produced in bulk • Identify key areas where post-harvest losses of spices and vegetables are high, particularly in tribal districts like Jhabua, Alirajpur, Dindori, and Balaghat. These regions can benefit from	MPRLM, TDCCOL, MP-AIDC, Van Dhan Yojana, MPUVN, Spice Mission, KVKs

Policy elements	Programmatic components to drive adoptions	Key Institutions
	solar drying technology to enhance shelf life and reduce wastage. Promote installations under Van Dhan Yojana already enabling entrepreneurship among tribal communities and identify horticulture and spice dominant VDVK clusters with Madhya Pradesh Rajya Laghu Vanopaj	

Supplier Innovation & Standardization	• Develop and roll out technical standards and quality benchmarks for various types of solar dryers to be led by NISE and BIS and MPUVN to adopt these standards in local context
	  ○ Define output parameters like moisture content targets, drying time ranges, temperature consistency, load capacity and drying time
	  ○ To maintain compliance with food-grade material standards and post-harvest hygiene requirements
		MPUVN

Skill Development & Capacity Building	• JNKVV and RVSKVV to develop post-harvest processing modules for capacity building of implementing agencies to deliver training to the district level resource institutions/ partners • RSETIs, NIRD, and state-level training institutes to conduct hands-on training for SHG members and FPO members on spice-specific drying techniques, post-harvest handling, and hygiene practices • Integrate solar dryers with spice production value chains, leveraging MP Spice park and organized retail for better market access • Collaborate with eNAM platform and local spice markets to establish direct procurement channels for dried spices. These linkages will ensure that farmers and spice processors have consistent access to markets and get better prices • Facilitate structured training support through MPSRLM for SHGs and farmers on the operational protocols, hygiene maintenance practices, and commodity-specific techniques for cutting, chopping and slicing to optimize the drying time • Training should include pre-treatment methods (e.g., slicing, chopping), temperature control, and moisture management to ensure the drying process optimizes the quality of produce • Strengthen market linkages through MPSRLM by facilitating structured market access for farmers, enhancing produce offtake through organized retail channels, and integrating farmer networks with established food processing value chains • Linkage to District Export Plans (for identified clusters) to strengthen market linkages by facilitating structured market access for farmers, enhancing produce offtake through organized retail channels, and integrating farmer networks with established food processing value chains	RVSKVV, JNKVV, RSETIs
Access to Finance	• Establish financial linkages for solar dryers through national schemes like MUDRA and AIF, targeting underbanked and unbanked tribal communities and smallholder farmers.	MPSRLM, MPSCB

Policy elements	Programmatic components to drive adoptions	Key Institutions
	• Use the existing network of MPRLM's Business Correspondence Agents (BCAs) to conduct financial literacy programs and facilitate loan applications for solar dryer installations at the Gram Panchayat level. • MPSRLM and MPSCB may establish financial linkages for farmers, enabling them to access MUDRA Loans, Kisan Credit Cards (KCC). • Integrate financial products with central government schemes, such as PMFME, to provide subsidized loans for solar dryer systems • Establish financial literacy programs via MPSCB for the district level cooperative bank branches and gram panchayat level PACS and also the end user beneficiary to educate on loan options, loan eligibility, and the long-term financial benefits of investing in solar dryers	



10 Annexure

10.1 State Assessment framework parameters

Geographic diversification parameters						Population diversification parameters						Rural Livelihood parameters			RE resource potential	
Location	State/ UT	Small/ medium/ large	Geographic location	Geographic Area (Sq.km)	Geoclimatic zones	Population	Population Density (Person per sq. km)	Rural population	Rural population density (per sq. kms)	No of Rural Habitations	Total rural marginalized community	No of rural households	Number of unemployed rural	% of rural unemployed youth	Unutilized Biomass Potential (tonnes)	Solar Irradiance
Andaman & Nicobar Island	UT	Small	Island	8,249	Warm and Humid Climate	383,989.1	46.5	224,313	27	266	24,539	58,525	25,343	11.30%		4.96
Andhra Pradesh	State	Large	South	162,970	Warm and Humid Climate, Composite Climate	53,156,000	326.2	37,878,092	232	48,330	9,849,808	9,545,307.00	2,861,592	8%	17.09	5.32
Arunachal Pradesh	State	Medium	East	83,743	Cold Climate, Warm and Humid Climate	1,388,358.6	16.6	1,035,432	12	8,213	1,113,294	228,566.00	54,146	5.23%	0.17	3.49
Assam	State	Medium	East	78,438	Warm and Humid Climate, Cold Climate	31,257,491.6	398.5	26,371,820	336	88,040	7,448,265	7,261,969.00	468,862	2%	2.54	4.26
Bihar	State	Medium	North	94,163	Composite Climate, Warm and Humid Climate	104,202,889.7	1106.6	91,302,876	970	1,05,021	17,953,171	16,458,803.00	3,751,304	4.11%	7.98	4.51
Chandigarh	UT	Small	North	114	Warm and Humid Climate	1,135,844.5	9963.5	5,914	52	-	-	-	189	3.20%		5.09
Chhattisgarh	State	Large	Central	135,192	Composite Climate, Warm and Humid Climate	25,755,315.4	190.5	18,684,137	138	75,192	11,420,101	4,995,567.00	386,330	2.07%	2.65	4.90
Dadra & Nagar Haveli & Daman and Diu	UT	Small	West	603	Hot-Dry	952,994.9	1580.4	137,262	228	98	185,800	85,166	20,289	14.78%		5.04
Delhi	UT	Small	North	1,483	Composite Climate	17,409,415.1	11739.3	125,674	85	-	-	-	12,819	10.20%		4.82
Goa	State	Small	West	3,702	Warm and Humid Climate	1,577,093.5	426.0	392,529	106	373	128,282	263,922.00	178,212	45%	0.23	5.21
Gujarat	State	Large	West	196,244	Hot-Dry, Warm and Humid Climate, Composite Climate	61,374,580.8	312.7	31,254,728	159	35,811	13,555,058	9,053,172.00	859,244	2.75%	21.74	-
Haryana	State	Medium	North	44,212	Composite Climate	25,924,410.6	586.4	14,887,108	337	7,300	4,005,338	3,045,259.00	1,503,616	10.10%	10.91	4.82
Himachal Pradesh	State	Small	North	55,673	Cold Climate, Composite Climate,	6,865,171.9	123.3	6,156,336	111	54,921	2,437,324	1,707,977.00	240,281	3.90%	0.57	4.66
Jammu & Kashmir	UT	Medium	North	55,538	Cold Climate	12,595,857.8	226.8	8,760,317	158	16,870	2,452,276	1,923,865	428,259	4.89%		4.68
Jharkhand	State	Medium	East	79,716	Composite Climate, Warm and Humid Climate,	33,070,863.3	414.9	24,356,871	306	1,24,169	14,026,796	6,208,782.00	297,638	1.22%	1.2	4.66
Karnataka	State	Large	South	191,791	Warm and Humid Climate, Composite Climate,	61,867,576.0	322.6	34,371,693	179	57,692	13,104,109	10,030,335.00	928,014	2.70%	14.05	5.25
Kerala	State	Medium	South	38,852	Warm and Humid Climate	44,591,581.5	1147.7	11,507,053	296	15,966	3,234,577	7,083,539.00	747,958	6.50%	6.04	5.30
Ladakh	UT	Medium	North	166,698	Cold Climate	300,000	1.8	247,601	1.49	1,383	242,224	40,671	14,113	5.70%		5.54
Lakshadweep	UT	Small	Island	32	Warm and Humid Climate	103,564.2	3236.4	4,634	145	10	70,604	13,370	3,521	75.98%		5.23
Madhya Pradesh	State	Large	Central	308,252	Composite Climate, Hot-Dry	72,694,566.1	235.8	51,555,600	167	1,26,813	25,921,107	11,123,735.00	581,557	1.13%	19.93	5.15
Maharashtra	State	Large	West	307,713	Hot-Dry, Warm and Humid Climate, Composite Climate	112,849,758.4	366.7	57,981,137	188	1,00,276	18,757,248	14,614,921.00	2,482,695	4.28%	21.49	4.99
Manipur	State	Small	East	22,327	Warm and Humid Climate	2,835,266.8	127.0	1,793,882	80	2,979	1,323,271	451,619.00	127,587	7.11%	0.48	4.49
Meghalaya	State	Small	East	22,429	Cold Climate	2,967,500.1	132.3	2,353,757	105	9,804	3,384,258	650,914.00	148,375	6.30%	0.56	4.17
Mizoram	State	Small	East	21,081	Warm and Humid Climate	1,099,849.4	52.2	501,990	24	728	662,091	133,060.00	13,198	2.63%	0.02	4.58
Nagaland	State	Small	East	16,579	Warm and Humid Climate, Cold Climate	2,236,638.2	134.9	1,171,500	71	1,548	1,793,459	363,769.00	64,863	5.54%	0.44	4.16
Odisha	State	Large	East	155,707	Warm and Humid Climate, Composite Climate	42,099,529.8	270.4	34,137,971	219	1,57,808	16,418,360	8,905,048.00	1,515,583	4.44%	2.23	4.77
Puducherry	UT	Small	South	490	Warm and Humid Climate	1,250,216.0	2551.5	370,647	756	292	131,079	114,969	70,012	5.54%		5.25
Punjab	State	Medium	North	50,362	Composite Climate	27,951,904.9	555.0	16,225,924	322	15,250	7,057,476	3,426,760.00	1,733,018	10.68%	22.25	4.73
Rajasthan	State	Large	West	342,239	Hot-Dry, Composite Climate	68,661,011.1	200.6	50,292,701	147	1,20,656	20,437,296	10,925,095.00	1,709,952	3.40%	10.21	5.42
Sikkim	State	Small	East	7,096	Cold Climate	780,301.4	110.0	372,683	53	2,267	249,639	132,827.00	17,167	4.61%	0.04	3.98
Tamil Nadu	State	Large	South	130,060	Warm and Humid Climate	72,891,411.6	560.4	33,737,229	259	79,339	12,845,076	12,528,874.00	2,769,874	8.21%	12.22	5.25
Telangana	State	Large	South	112,077	Warm and Humid Climate	35,004,000	312.3	21,395,000	191	24,194	6,860,302	5,443,255.00	980,112	4.58%	13.76	5.31
Tripura	State	Small	East	10,486	Warm and Humid Climate	3,965,982.7	378.2	2,358,609	225	8,708	1,927,840	750,583.00	43,626	1.85%	0.25	4.60
Uttar Pradesh	State	Large	North	240,928	Composite Climate	197,992,072.8	821.8	143,162,578	594	2,54,122	39,483,039	26,385,443.00	7,721,691	5.39%	21.6	4.80
Uttarakhand	State	Medium	North	53,483	Cold Climate, Composite Climate	10,192,716.0	190.6	6,877,368	129	38,622	1,783,183	1,443,724.00	163,083	2.37%	0.72	4.94
West Bengal	State	Medium	East	88,752	Warm and Humid Climate, Composite Climate	92,196,633.6	1038.8	58,144,604	655	1,05,595	27,247,774	17,595,248.00	1,382,950	2.38%	16.28	4.45

10.2 List of Investors and Financiers engaged in the DRE sector

S.No.	Name of Entity	Solutions invested in	Illustrative Portfolio
VC/PE (Including Impact VCs and Corporate Funding Arms			
1	Acumen Fund	Solar pumps, RE Powered Micro Cold Storage, Biomass Cookstove, Solar Dryer, Solar Flour Mill	Greenway Appliances, S4S Technologies
2	Artha India Ventures	Biomass Cookstove	Ecosense appliances
3	AXA Investment Partners	Biodigester, Biomass Cookstove	Sistema Bio
4	Blue Ashva Capital	RE Powered Micro Cold Storage	Tan90
5	Caspian Impact Investment	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
6	Engie	Biodigester, Biomass Cookstove	Sistema Bio
7	Good Ventures	RE Powered Micro Cold Storage	New Leaf Dynamic
8	Hivos Triodos fund	RE Powered Micro Cold Storage, Solar Pumps, Biodigester	Ecozen
9	Impact India Investment Partners	RE Powered Micro Cold Storage	Tan90
10	Infuse Ventures	RE Powered Micro Cold Storage	TESSOL
11	Invested Development	RE Powered Micro Cold Storage, RE Powered Milk Chiller	Promethean power systems
12	KawiSafi Ventures	Biomass Cookstove, Biodigester	Sistema Bio
13	Mela ventures	RE Powered Micro Cold Storage	TESSOL
14	TotalEnergies Ventures	RE Powered Micro Cold Storage, RE Powered Milk Chiller	Promethean power systems
15	Omnivore	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
16	Rajasthan Venture Capital Fund	RE Powered Micro Cold Storage, RE Powered Milk Chiller	Inficold
17	Artha Impact (impact investing arm of Rianta Capital)	Solar Pumps, Biomass Cookstove	Onergy Solar
18	Samridhi Fund	Solar Pumps	Claro energy
19	Sathguru Catalyzer Advisors	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
20	Schneider Electric Energy Access Asia	RE Powered Micro Cold Storage, Solar Pumps, Solar Flour Mills	Oorja Development Solutions
21	SIDBI Venture Capital	Solar Pumps	Claro Energy
22	Accel	Solar Dryer	S4S Technologies
23	Chiratae Ventures	Solar Dryer	S4S Technologies
24	DBS	RE Powered Micro Cold Storage, Solar Pumps	Ecozen

S.No.	Name of Entity	Solutions invested in	Illustrative Portfolio
25	Ankur Capital	RE Powered Micro Cold Storage	
26	Factor[e] Ventures	Biodigester, Solar Dryer	
27	Cisco	RE Powered Micro Cold Storage	Tan90
28	SBI Foundation (CSR arm of SBI group)	Solar Dryer	Raheja Solar Food Processing
29	Elea (a family trust advised by Artha Impact)	RE Powered Micro Cold Storage, Solar Pumps, Solar Flour Mill	Oorja Development Solutions
30	Rainmatter	Solar Dryer	Raheja Solar Food Processing
31	Nuveen	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
32	Piramal Fund Management	RE Powered Micro Cold Storage	TESSOL
33	Sat Industries	RE Powered Micro Cold Storage	TESSOL
34	Dare Ventures (subsidiary of Coromandel International)	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
35	Asha Ventures	Biomass Cookstove	
36	SBI Ventures	Biodigester	
Accelerators / Incubators seed funds/ Crowd funding/ Donors (mix of convertible notes and grant)			
1	Upaya Social Ventures	Solar Dryer, Solar Powered Textile Machinery	Greenwear, Resham Sutra
2	Sangam Ventures	Solar Pumps, RE powered Micro Cold Storages, RE Powered Milk Chiller	Khethworks
3	Technology Development Board of the Government of India	Biodigester, Solar Powered Textile Machinery	Microspin
4	1crowd	RE Powered Micro Cold Storage	TESSOL
5	Social Alpha	Solar Pumps, RE powered Micro Cold Storages, RE Powered Refrigerator/ Deep Freezer, Biomass Cookstove	Khethworks
6	Rockefeller foundation	Biodigester	Grassroots Energy
7	Aurora Trust (formerly Ashden Trust)	Solar Powered Textile Machinery	Resham Sutra
8	Blink Foundation	Biodigester	Sistema Bio
9	DOEN Foundation	Biodigester, RE powered Micro Cold Storages, Solar Pumps	Grassroots Energy, Oorja Development Solutions
10	GROW Agrifoodtech accelerator	Solar Dryer	S4S Technologies
11	IIMCIP	Solar Powered Textile Machinery	Greenwear

S.No.	Name of Entity	Solutions invested in	Illustrative Portfolio
12	Indigram Labs	RE Powered Micro Cold Storage, Solar Dryer	New Leaf Dynamic
13	National Innovation Foundation	Solar Powered Juicing Machine	Dharambir Food Processing Technologies
14	RTBI	Solar Powered Textile Machinery, Solar pumps	Microspin
15	SELCO Foundation	Solar Dryer, Solar Powered Milking Machine, Solar Powered Sewing Machine	Envo Renewable
16	Shell Foundation	Diversified across several DRE segments	Khethworks, Inficold, Sistema Bio, Guna Organics, Pushan Renewable Energy, Taru Naturals
17	Villgro Foundation	Diversified across several DRE segments	CoolCrop, Ecozen, Hydrogreens
18	CIIE	Solar Pumps, RE Powered Refrigerator/ Deep Freezer	ONergy Solar
19	USAID (incl. Pacesetter Fund)	RE Powered Micro Cold Storage, RE Powered Milk Chiller,Solar Pumps, Biodigesters,	Promethean Power Systems, Claro Energy, Grassroots Energy
20	Pusa Krishi	Pellet Maker	A2P Energy Solutions
21	Echoing green signal fund	Solar Pumps, RE Powered Micro Cold Storage, Solar Powered Flour Mill	Oorja Development Solutions
22	Swiss Re Foundation	Solar Pumps, RE Powered Micro Cold Storage, Solar Powered Flour Mill	Oorja Development Solutions
23	1to4 Foundation	Solar Pumps, RE Powered Micro Cold Storage	Oorja Development Solutions
24	Credentia Trustee	RE Powered Micro Cold Storage	TESSOL
25	RangDe		
DFI/Bank/NBFC/Impact Debt- Enterprise financing			
1	cKers Finance	RE Powered Micro Cold Storage, Solar Pumps, RE Powered Milk Chiller	Ecozen, Claro, Tessol
2	Northern Arc	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
3	Maanaveeya	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
4	Samunnati	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
5	UC Inclusive Credit	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
6	Ashv Finance	Solar refrigerator, Solar Powered Freezer	Devidayal Solar

S.No.	Name of Entity	Solutions invested in	Illustrative Portfolio
7	S3IDF-US	RE Powered Micro Cold Storage	Coolcrop
8	InCred Capital	RE Powered Micro Cold Storage, Solar Pumps	Ecozen
9	IREDA	Biodigester, Torrefaction unit	
Retail Financing			
1	RBL Bank	Solar Pumps	
2	Samunnati	Micro cold storage	
3	IndusInd	Solar Pumps	
4	cKers Finance	Micro Cold Storages, Solar Pumps	
5	Karur Vysya Bank	Micro Cold Storages	
6	Bank of India	Milk Chiller, Milking Machine	
7	Andhra Pragathi Grameena Bank	Biodigester, Micro Cold Storages, Milk Chiller	