SELCO FOUNDATION

FINANCING FOR DECENTRALIZED RENEWABLE ENERGY

A GUIDE ON END-USER FINANCING FOR BANKERS

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FOREWORD

Uninterrupted power supply, even today, is a major issue in most parts of the country. We still find people in rural and remote areas dependent on kerosene and other fuels for lighting and cooking. Ensuring affordable, adequate and uninterrupted power supply to domestic and other consumers, remains one of the major challenges before the country. This underlines the importance of renewable sources of energy. With over 300 clear sunny days available annually, there is a huge potential to tap, store and retrieve solar power. Actual exploitation of solar power is insignificant when compared to other energy resources. NABARD, our parent body, is associated with the implementation of Jawaharlal Nehru National Solar Mission (JNNSM) of Government of India to promote this sector in a big way.

I am glad to note that SELCO Foundation has come out with this Practioner's guide to bankers on lending for Renewable energy, mainly solar. Let me congratulate the entire team, who made this possible.

This guide presents a detailed account of Decentralized Renewable Energy; clarifies various myths which are hampering the percolation of technology and answers many Frequently Asked Questions. In addition to highlighting the initiatives of the Foundation in lending through banks, the booklet lists out the possible schemes for effective convergence. The technical specifications given are very informative and will serve as a ready reckoner.

I am confident that this guide will be very useful for all stake holders for better understanding of the subject and will thereby result in effective contribution by all concerned, to the overall development of the renewable energy sector with special focus on Solar energy in our Country.

Let us all unite for the social cause of cleaner and greener environment.

Kamakshi S Pai
Joint Director
Bankers Institute of Rural Development
Mangaluru

CLIMATE CHANGE AND ENERGY POVERTY

Energy and Climate Change

Today, over 1.6 billion people in the world and 240 million in India do not have access to reliable energy.[1] And it is estimated that four out of five people without electricity live in rural areas of the developing world. But this pattern in the deprivation is rapidly changing with the growing urban and semi-urban population. In the absence of clean energy sources, dependence of biomass and fossil fuels is high.

In addition indiscriminate usage of fossil fuels has negatively affected the environment which has been reflected by the climate change. Increased use of fossil fuels and burning of biomass in factories, from vehicles etc have all led to the release of greenhouse gasses such as nitrous oxide and carbon dioxide. This has resulted in the rise in the global temperature in turn causing the melting of the ice-caps, droughts, hurricanes, heat waves, flooding etc. The Figure below captures the global rising temperature and the consequent natural calamities.

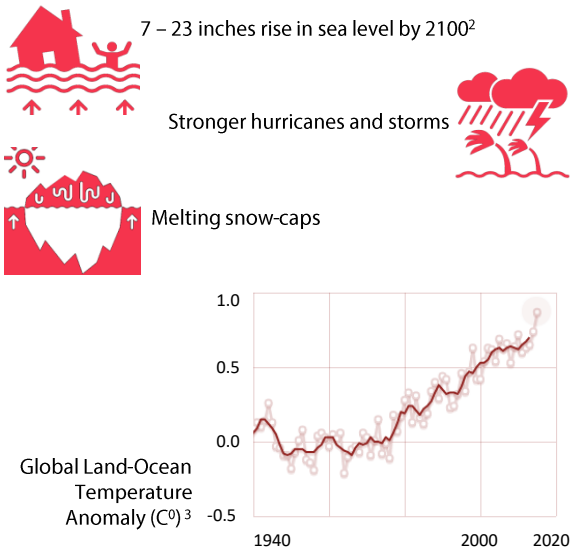


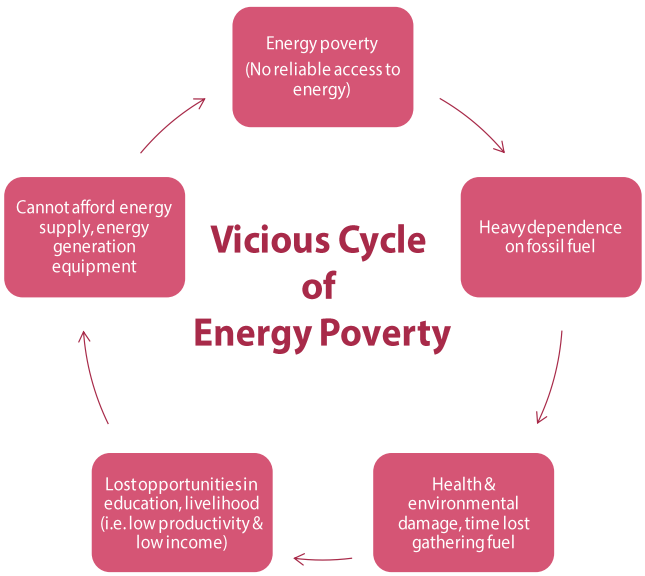
Figure 1: Negative Impact of Climate Change

The impacts of climate change adversely impact the poor resulting in exacerbated devastation of property and life. To combat energy poverty and ensuing economic poverty renewable energy can be the critical source that provides energy while also addressing partially the concerns of climate change from increased usage of fossil fuels.

Energy and Poverty

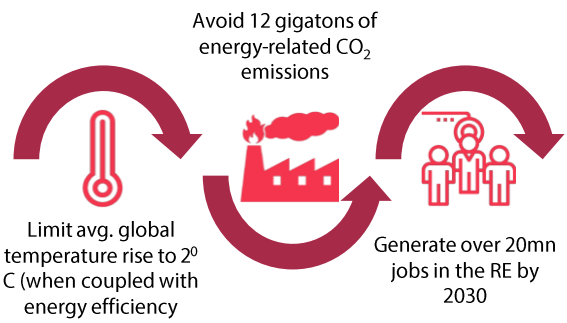
Absence of clean energy then translates into low incomes and traps the household in the vicious cycle of energy and income poverty. Figure 2, below, captures how this vicious cycle perpetuates vulnerability and pushes poor households further down the poverty ladder in the face of increasing cost and decreased availability of fossil fuels & biomass and poor access to health, education, finance etc.

Figure2: Vicious cycle of Energy and Income Poverty



Renewable Energy (RE) can be defined as energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. It has been noted that apart from being a alternative to some of the harmful energy sources, doubling of the present generation of RE can have a positive impact on global growth and development.

Figure 3: Benefits of doubling share of Renewable Energy[4]

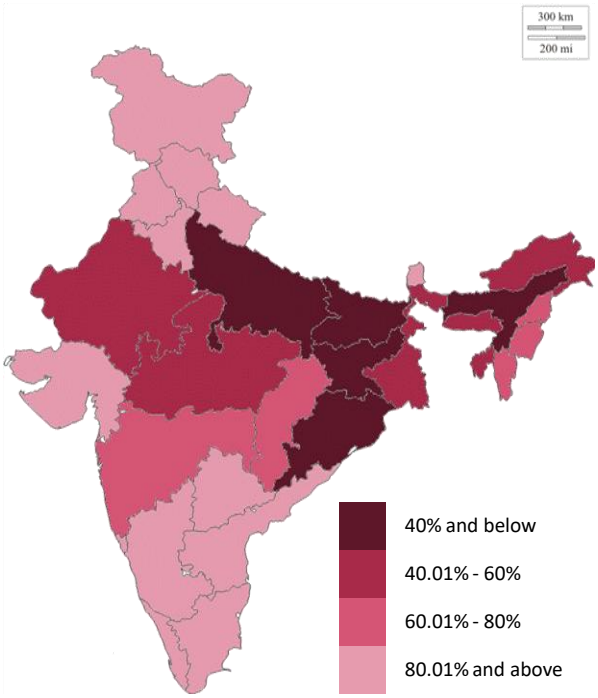


1. International Energy Agency (2015), *"India Energy Outlook"*, Link: http://www.worldenergyoutlook.org/media/weowebsite/2015/IndiaEnergyOutlook_WEO2015.pdf
2.National Geographic (2007), *"Effects of Global Warming"*, Link: http://environment.nationalgeographic.com/environment/global-warming/gw-effects/
3.NASA (2016), *"Global Climate Change"*, Link: http://climate.nasa.gov/vital-signs/global-temperature/
4.IRENA (2016), *"A roadmap for a Renewable Energy Future"*, Link: http://www.irena.org/DocumentDownloads/Publications/IRENA_REmap_2016_edition_report.pdf

Overview of Decentralized Renewable Energy (DRE)

Decentralized Renewable Energy is the electricity produced at or near the point of use for households or institutions. This is gaining wider acceptance in India as its applications increase and costs fall. There are over 16,000 unelectrified villages in the country and millions of households that are yet to be electrified[1]. As a complement to grid extension, renewable energy (RE) solution through tailor made interventions can benefit un-electrified households, communities as well as institutions that suffer from acute power outages. Remoteness of villages combined with deficiencies in power generation and transmission have also stifled the growth of Micro, Small and Medium Enterprises (MSMEs) in these rural and semi-urban areas. Figure 4, below, captures census data on the household level rural electrification in the country. However, this data fails to account for the availability and reliability of power. Power cuts in some areas can be as high as 16-18 hours a day.

Figure 4: Percentage of Rural households using electricity as main source of lighting to Total number of Rural households



Source: Census of India, 2011

During the period April to January 2016 the deficit in supply stood at 2.20%, with the deficit as high as 12.70% in Uttar Pradesh and 5.70% in the North Eastern region[2].

The government taking cognizance of these facts has started promoting renewable energy at the national level and has assigned targets to be achieved by 2022.

Figure 5: Renewable Energy Targets

Market-based decentralized renewable energy (electricity) has the potential to be a viable alternative or can complement grid extension programs, if implemented with the right business model and ecosystem setup. Decentralized Renewable Energy is also a viable solution for rural electrification. It has the potential to (Brookings , 2015)[3]:

1) Reduce demand on fossil fuels and of centralized power generation and distribution.

2) Reduce transmission and distribution losses. And overcome power theft issues.

3)Provide customized system designs, technology selections, business models based on present community needs and the community's domestic and economic growth aspirations.

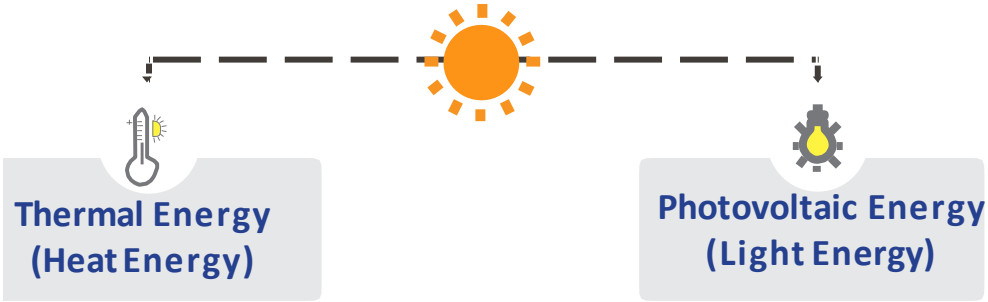
4)Decentralize tariff collections, operations, maintenance and management

5) Once grid connected, they can potentially shave peak power demand with intelligent use of storage technology and reduce requirement of short term power purchase.

6) Create entrepreneurs in the field of DRE and generate employment

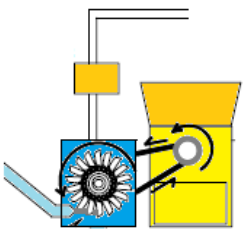
1.Central Electricity authority (2016), *"Progress Report on Village Electrification"* Link: http://www.cea.nic.in/reports/monthly/electrification/2015/village_electrification-10.pdf
2.Central Electrification authority (2016), Power Supply Position, http://www.cea.nic.in/monthlypowersupply.html, Data as on 31st October 2015,
3. "Blowing Hard or Shining Bright?: Making Renewable Power Sustainable in India" (2015). Rahul Tongia (Ed.), Brookings India, New Delhi

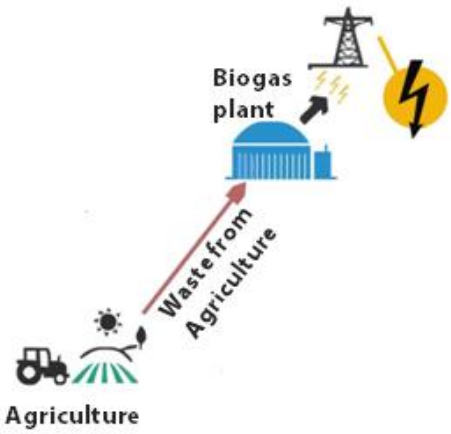
Solar Energy: This form of energy relies on the nuclear fusion power from the core of the Sun. This energy can be collected and converted as thermal energy for solar water heating or the sunlight can be converted to electrical energy using photovoltaic cells. Decentralized solar energy systems are photovoltaic based systems that are installed at the household level where the point of generation and consumption are the same.



Wind Power: The movement of the atmosphere is driven by differences of temperature at the Earth's surface due to varying temperatures of the Earth's surface when lit by sunlight. Wind energy can be used to pump water or generate electricity and a small wind turbine can be used for micro-generation.

Hydroelectric energy : Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height between the source and the water's outflow. Pico hydro is a term used for hydroelectric power generation of under 5 kW. It is useful in small, remote communities that require only a small amount of electricity.





Energy from Biomass: Biomass is the term that refers to organic materials such as plants, animals, animal and human waste etc . Among other uses biomass can be used to generate gas through the process of gasification or anaerobic digestion, produce ethanol through fermentation and through densification produce pellets that can be used as a fuel.

1. Alternative Energy (2015), Link: http://www.altenergy.org/renewables/renewables.html; http://inderen-renovables.blogspot.in/2013_08_01_archive.html
2.Hydroelectricity (2016), Link: https://en.wikipedia.org/wiki/Hydroelectricity
3.Pico-Hydro (2016), Link: https://en.wikipedia.org/wiki/Pico_hydro
4.Practical Action (2014), Link: http://www.british-hydro.org/uploads/5162008111442AM.pdf

PART A OVERVIEW OF SOLAR ENERGY

Thermal Energy (Heat Energy)

Thermal energy or heat energy is used in applications such as water heating, cooking, drying and power generation.

Solar Thermal Water Heating System

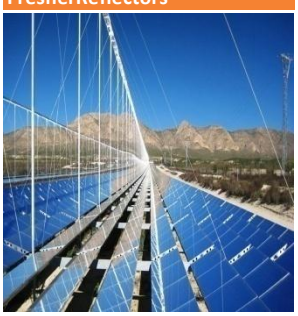
Heat energy from the sun is used for water heating using a solar thermal collector.

Concentrated Solar Power

ConcentratedSolarPower(alsocalledasConcentratedSolar Thermal and CSP) systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electricity is generated when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator or powers a thermo-chemical reaction.

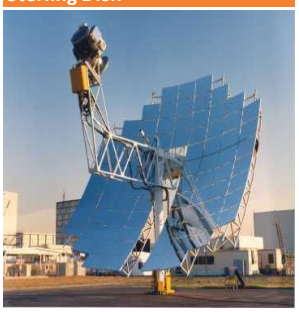
Parabolic Trough

Fresnel Reflectors



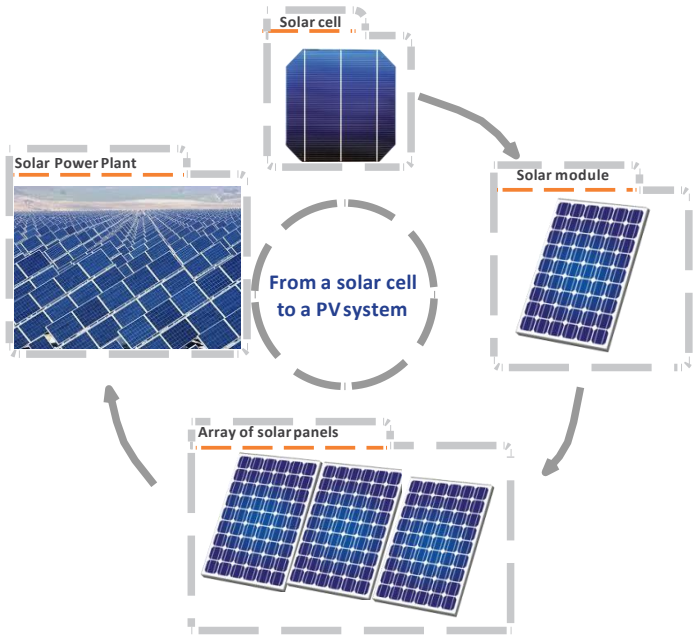
Solar PowerTower

Sterling Dish

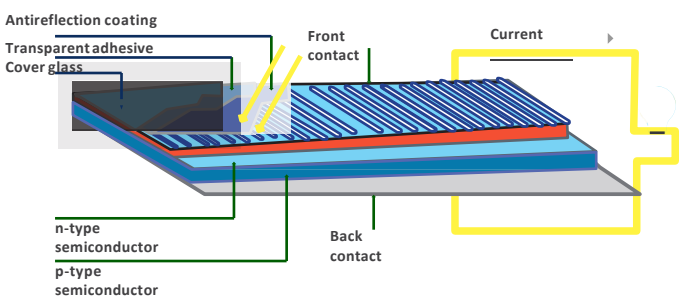


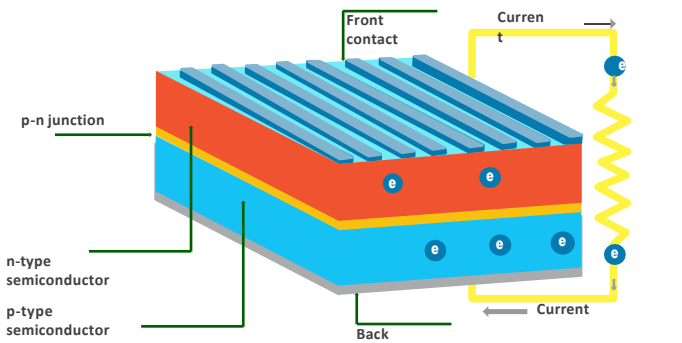
Photovoltaic Energy (Light Energy)

Light energy from the sun is converted to electrical energy using solar cells. Solar cells are the basic components in a photovoltaic power plant. Solar cells are composed of two layers of semiconductor material with opposite charges. Sunlight hitting the surface of a cell knocks electrons loose, which then travel through a circuit from one layer to the other, providing a flow of electricity. This phenomena is called photovoltaic effect.



How Solar cell works





source: www.solarcellcentral.com Accessed on: 03.08.2016

The advantages of PV Systems

• **Cost-effective:** In many instances, life-cycle costs of PV systems are comparable to or lower than for non-renewable alternatives, including power grid extensions. The below tables provide the lifetime (25 years) cost comparison of a kerosene lantern and solar home lighting system.

Kerosene Lantern	Cost (Rs.)
System cost	Rs.100
Cost of spares in the lifetime	Rs.170
Cost of kerosene (per ltr)	Rs.20
Monthly kerosene consumption	5 liters
Lifetime cost (25 years)	Rs.21,170

1 light Solar Home System	Cost (Rs.)
System cost	Rs.8,000
Cost for servicing and spares in the lifetime	Rs.6,000
Total Lifetime cost (25 years)	Rs.14,000

It can be evidenced from the table that solar home system is more cost effective and also by nature is a more cleaner fuel.

•**Environmentally Benign**: PV produces no gaseous or other emissions during operation.

•**Free, abundant and Reliable Fuel:** Sunlight, the fuel source for PV systems, is a widely available, inexhaustible, reliable, and free energy source. Hence, PV systems have no monthly fuel bills, though there may be costs associated with maintenance or fee-for-service installations.

•**Locally Generated Power:** PV makes use of a local resource – sunlight. This provides greater energy security and control of access to energy. It also reduces the dangers associated with transporting acid-filled batteries to recharging stations.

•**Flexible Size and Transportability:** PV can produce enough power for just about any application you can envision. Existing systems range in size from pocket calculators to multi-megawatt power plants. Their modular construction facilitates easy expansion of systems as finances allow and needs demand.

The Limitations of PV Systems

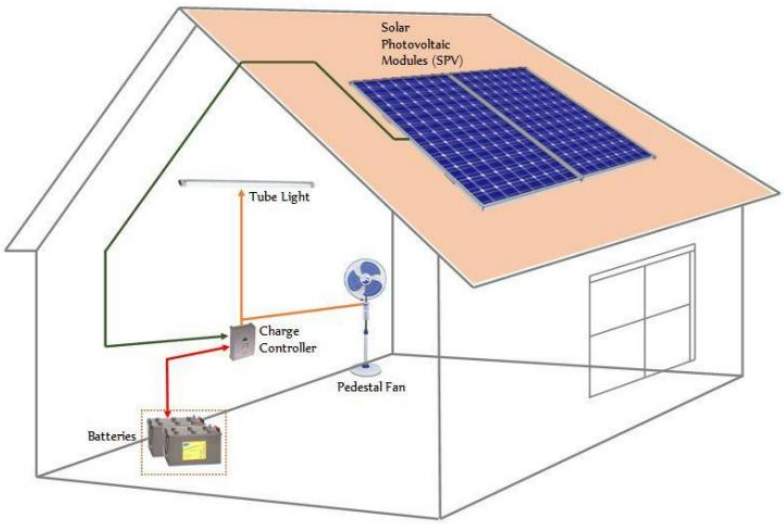
• **Considerable Initial Cost**: Although many rural dwellers already pay dearly for energy, this cost is spread over time. The high initial cost of PV systems acts as a barrier for their dissemination in rural areas. Financing is needed to spread the high initial cost of PV systems out over the life of the system, thereby making them accessible to cash-poor rural dwellers.

•**System Maintenance**: Although PV modules require relatively little upkeep, batteries need regular maintenance and eventual replacement. End-user training in aspects such as usage and battery maintenance is essential to ensure effective operation of a complete PV system.

•**Sun Dependent:** Sunlight is a diffused fuel source. Therefore, PV systems are energy limited, and are probably not the best choice for applications with high power requirements such as air conditioning or resistance heating – especially if they are needed at night. Applications that use power at night require batteries, increasing the system cost and complexity. In addition, clouds blocking the sun or shadows cast by vegetation and structures will diminish the system's output.

The small scale renewable (solar) energy sector offers a range of business models, across technologies and scales of operation, be they sales, leasing or rental models of individual home energy systems, portable products, community-based products or mini-grids with productive anchor base loads. There is a variety in the way organizations deliver services and the technologies depending on conditions related to the geography, socio-economic conditions, supportive infrastructure in a particular region. This sector includes technology solutions that are electricity (such as solar, pico-hydro, biomass, micro-wind) and non-electricity based (thermal technology- biogas, solar thermal) including those that use sustainable energy sources such as improved biomass cooking solutions. [4]

DC Solar System



Components:

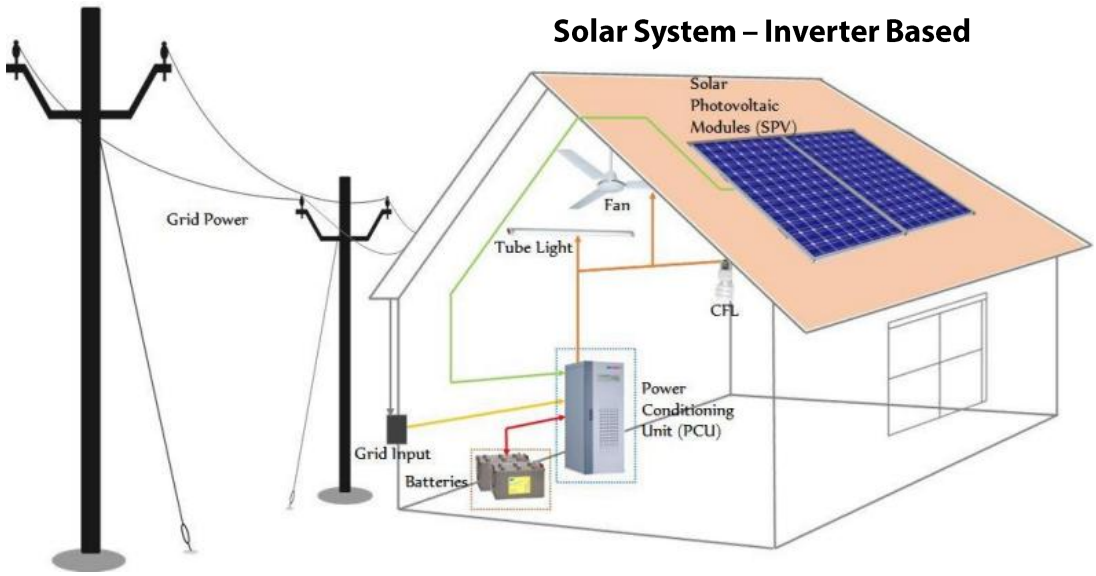
•Solar Module: Captures Solar Energy and converts it into DC-Electrical Energy.

•Solar Charge Controller – Used for regulating the charging of the batteries.

•Battery for storage of solar power

•DC Loads: Works on DC power

Solar System – Inverter Based



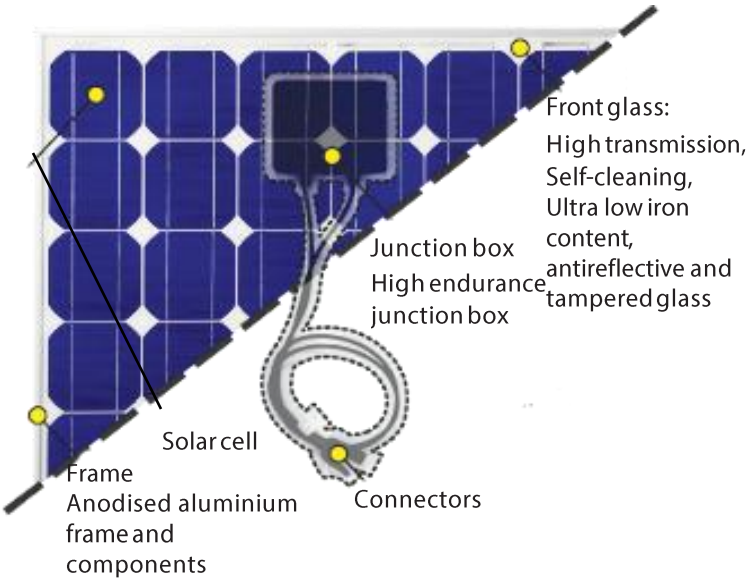
Components:

•Solar Module, Battery, AC Loads: Works on DC power

•Solar Power Conditioning Unit: Consists of Inverter, Solar charge controller, solar charging logic etc.

4. "Blowing Hard or Shining Bright?: Making Renewable Power Sustainable in India" (2015). Rahul Tongia (Ed.), Brookings India, New Delhi

Components of Solar Home Systems



Photovoltaic Solar Panel: The Solar PV system uses solar panels made up of Photovoltaic material that absorbs photons of light and release electrons. When a thin layer of silicon doped with some Phosphorous comes in contact with a thick layer of silicon doped with Boron, a voltage is produced. A single silicon cell produces nearly 1.1 Volts irrespective of its size. As soon a ray of sunlight with sufficient energy falls on the cell, electrons start moving under the influence of the voltage that has already been produced and a DC current is generated. Since 1.1 Volt is very less, multiple such cells are connected together to create a solar panel of 12Volts or 24Volts. Usually solar panels are available in 12Volts or 24Volts. Wattages range from 10 Watts to 300 Watts. If more wattage is required, similar panels can be connected together.

Solar Battery: Tubular wet lead acid batteries of low maintenance type are often used in solar applications. They are deep cycle batteries and can discharge power slowly over few hours and have the ability to receive slow charging from solar panel.

If properly designed and maintained, give a life of 7 to 8 years. Batteries used in automobiles are not designed for deep cycle operation. During the day, electricity from the module charges the storage battery. During the evening, the battery is discharged to power lights and other applications. Batteries are typically 12-volt lead-acid batteries, ranging in capacity from 20-100 Amp.-Hours (Ah). Batteries are typically sized to provide several days of electricity or "autonomy", in the event that overcast weather prevents recharging.

A Solar charge regulator/ controller is utilized to control the flow of electricity between the module, battery, and the power outlets or loads. It prevents battery damage by ensuring that the battery operates within its normal charge levels. If the charge level in the battery falls below a certain level, a "low voltage disconnect" (LVD) will cut the current to the loads, to prevent further discharge. Likewise, it will also cut the current from the module in cases of overcharging. Indicator lights on the controller display the relative state of charge of the battery.

Luminaries

The table on the right provides the comparison of different luminaries such as the incandescent bulb, CFL, LED and tubelights. Presently MNRE regulations and industry standards are leaned towards the LED bulbs.

Particulars	Incandescent	CFL	LED	Tubelights
Bulb				
Watt	60w	15w	9w	18w
Lumens	800	800	840	1700
Cost per bulb	Rs12	Rs 200	Rs 250-350 Rs 100* (subsidy)	Rs 350
Bulb lifetime	1,200 hrs	8,000 hrs	50,000 hrs	50, 000 hrs
Rated life	1-2 years year	6 -10 years	15 - 25 years	15 - 25 years
Number of bulbs needed for 50,000 hrs	42	5	1	1
Units (kWh) consumed in a year (6 hrs/day)	131.40	32.80	21.90	8.74

Wiring & Mounting Structure:
Metal frames are included to attach the PV Modules to a pole or roof. The various components are connected by wires and contain switches for the lights. In some cases, wiring is housed inside conduit attached to interior walls.

An Inverter is used to run AC appliances from a DC source like a battery or a solar panel. A converter is used when DC appliances are run from a DC source like a battery/solar panel, but have different voltages.

* The efficiencies mentioned are indicative and can vary from manufacturer to manufacturer

Solar Home System – Troubleshooting and Maintenance

System performance

low performance

system not working

Clean the panels

Check if panels are displaced

Remove shadow creating objects near panel if any

Check for any loose connections/ wires are broken

Check water level in battery. Top up with distilled water

Use hydrometer to check the specific gravity of the cells in the battery

Not OK

OK

If one or few of the cells show less specific gravity than the others

If battery level is still low

Battery has to be replaced

Allow the battery to charge completely without using loads for 2 to 3 days and check again

Batteries and panels perform well and the system is still not performing

If the battery is still not charging

Make sure there is no short circuit in the panel /battery

Avoid children from touching panels, batteries, inverters

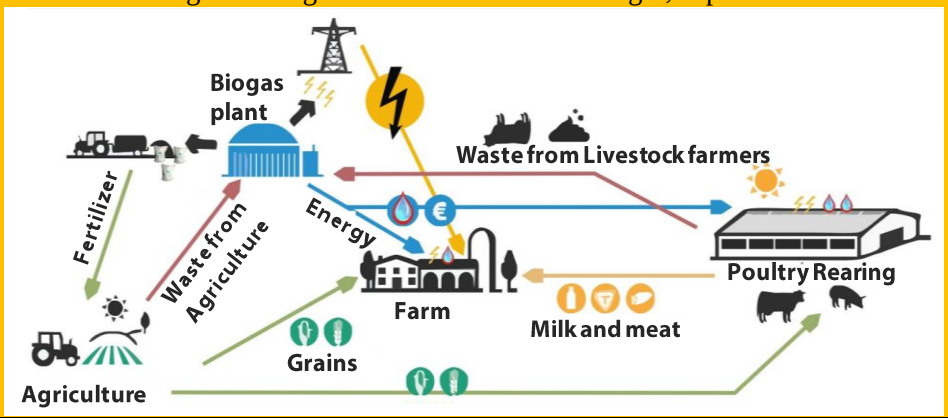
Keep the batteries with free air circulation

The problem could be with inverter or charge regulator

Biomass - Overview

Biomass is a renewable source of energy as its application does not lead to any net CO2 emissions as the CO2 released during the conversion of biomass is equal to the CO2 absorbed by the biomass from the atmosphere during the process of photosynthesis (it is a CO2 neutral energy source). There are different biomass technology models that are popular are presented in the below table.

Table: Biomass conversion techniques

Gasification: Conversion of a solid fuel to a combustible gas by supplying a restricted amount of oxygen.
Anaerobic Digestion: The process of bacterial breakdown of biomass in the absence of air during which a gaseous fuel often called biogas, is produced. 
Fermentation: Biomass fermentation involves breaking down glucose inside organic material to produce ethanol. The end goal is the production of ethanol with sufficient alcohol concentration to fuel automobiles, while also finding uses for the solid byproducts.
Pellet Manufacturing: The process of compaction of biomass residues into a product of higher bulk density than the original raw material

Bio-energy in India

About 32% of the total primary energy use in the country is derived from biomass and more than 70% of the country's population depends upon it for their energy needs. The Ministry of New and Renewable Energy (MNRE), Government of India has realized the potential and role of biomass energy in the Indian context and has initiated a number of programs for the promotion of efficient biomass conversion technologies to be used in various sectors of the economy.

Table : State wise Status of Biomass/Co-generation projects in India

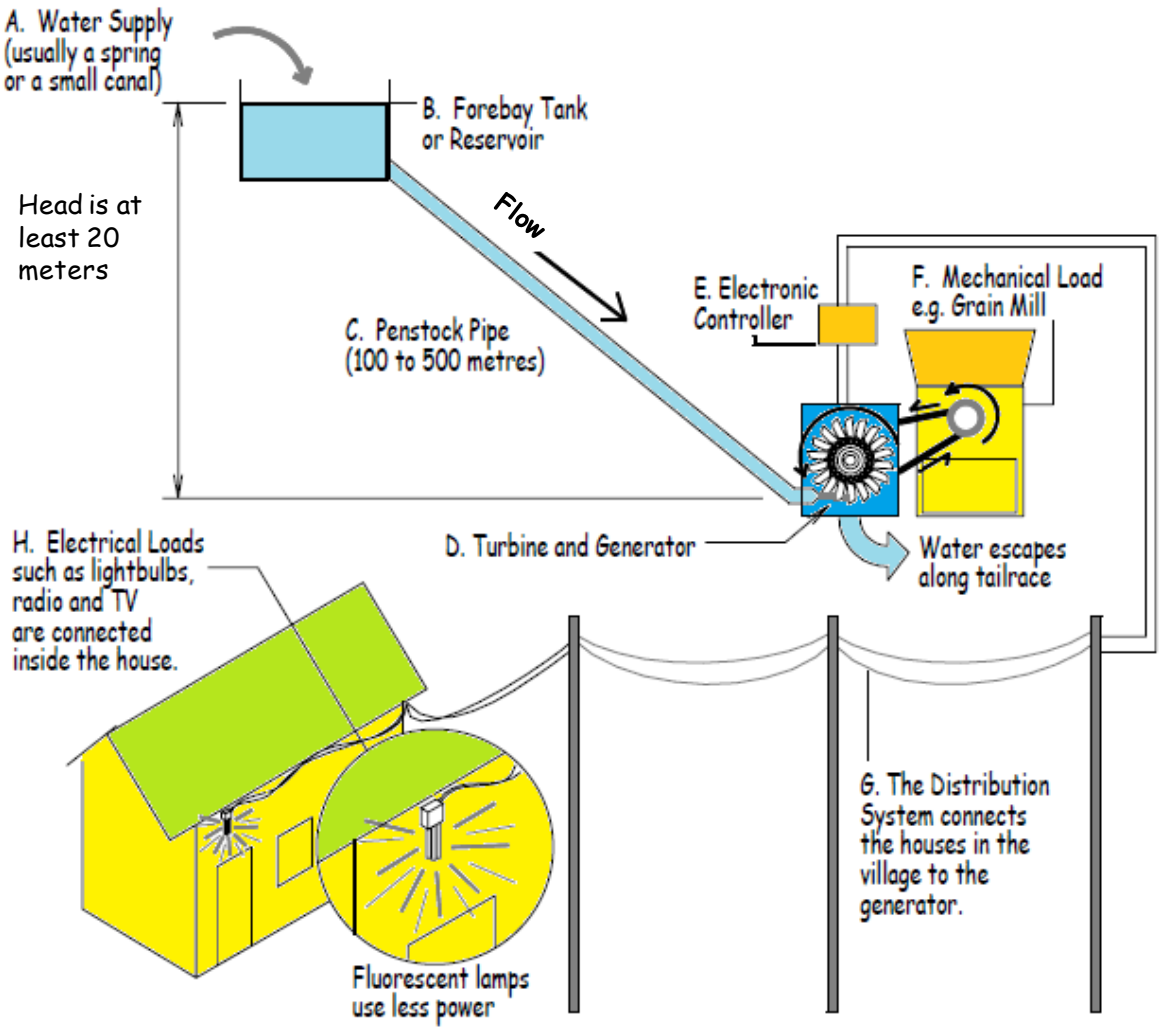
Sl No.	State	Total (MW)	Sl No.	State	Total (MW)
1	Andhra Pradesh	380.75	9	Maharashtra	1220.78
2	Bihar	43.42	10	Odisha	20
3	Chhattisgarh	279.9	11	Punjab	155.5
4	Gujarat	56.3	12	Rajasthan	108.3
5	Haryana	45.3	13	Tamil Nadu	626.9
6	Karnataka	872.18	14	Uttarakhand	50
7	Madhya Pradesh	35	15	Uttar Pradesh	842
8	West Bengal	26		TOTAL	4831.33

PART C OVERVIEW OF SMALL HYDRO

Small hydro Overview:

Hydropower or water power is power derived from falling or running water, which may be harnessed as useful energy through devices like Turbines. Since ancient times, hydropower from many kinds of watermills has been used as a renewable energy source for irrigation and the operation of various mechanical devices, such as gristmills, saw mills, textile mills, trip hammers, dock cranes, domestic lifts and ore mills.

In India, hydro power projects with capacities up to 25 MW have been classified as Small Hydro Power (SHP). While the Ministry of Power is responsible for large hydro projects, the mandate for SHP's have been given to the Ministry of New and Renewable Energy (MNRE). The figure presented below outlines the working of a pico hydro project where the water is used to generate power for a livelihood (e.g. flour mill) and power lights in the house.1



Source: Practical Action3

Status of Hydro Power in India:

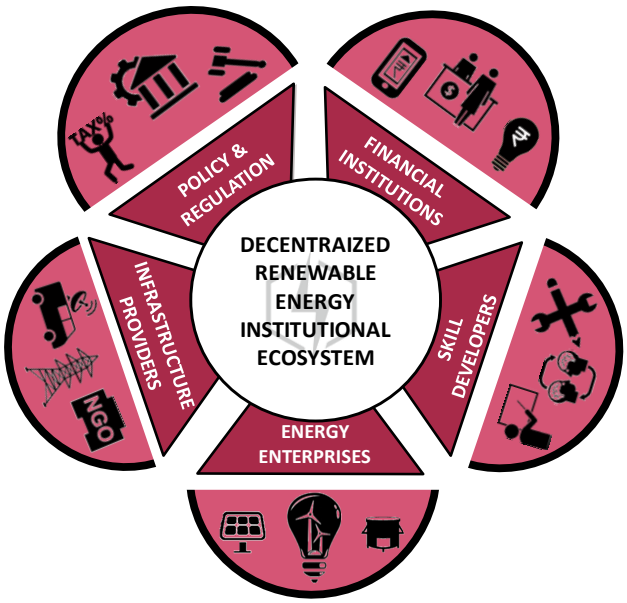
India is the 7th largest hydroelectric power producer in the world with a generation potential of 84,000 MW at a load factor of 60% and total installed capacity of 42, 783 MW which is 14.35% of the total utility electricity generation capacity in India. As of march 2016, 4,274 MW of small hydro power has been installed in India. 2

1.Hydroelectricity (2016), Link: https://en.wikipedia.org/wiki/Hydroelectricity
2.Pico-Hydro (2016), Link: https://en.wikipedia.org/wiki/Pico_hydro
3.Practical Action (2014), Link: http://www.british-hydro.org/uploads/5162008111442AM.pdf

Institutional Ecosystem of the DRE Sector

The DRE sector has been growing in the country with the support of both private and public sectors institutions, all of whom are striving to meet the energy demand of the burgeoning population. These institutions together form the ecosystem for energy access. The ecosystem is the framework comprising of actors and their solutions that defines the DRE sector. The critical ecosystem elements are finance, skill building, technology, infrastructure and policy and regulation. The institutions that represent these elements are presented in Figure 6.

Figure 6 : DRE Institutional Ecosystem



The important institutions that operate in the DRE sector are listed in the table below. Many of these institutions support the sector with tailor made interventions such as schemes and programs for financing, technical assistance and training.

Some of the important institutions and their role in the decentralized renewable energy sector are detailed below;

- **Ministry of New and Renewable Energy (MNRE):**

a. Under the National Solar Mission (off grid), MNRE creates an enabling environment for bankers, end-users, energy enterprises and technocrats to adopt DRE through financial support routed through the banking system.

b. Encourages energy enterprises through channel partnerships and creates networking platforms.

c. Enables technology development and adoption by developing standards and monitoring the functioning of the sector etc.

- **Clean Energy Access Network (CLEAN) :**

An all-India industry representative that brings together diverse stakeholders working to improve energy access for the rural and urban poor and supporting the growth of the Decentralized clean energy sector in India. CLEAN works across issues of Policy, Finance, Technology, Skills and Networking to support the needs of the sector and improve confidence in the market. Currently, CLEAN has a membership of over 91 organizations and energy enterprises.

- **RSETI's and ITI's :** RSETI's in select states of Orissa, Karnataka etc have actively facilitated and conducted courses on Renewable Energy targeted at rural youth. The focus is on development of technical capabilities to service renewable energy products and entrepreneurship skills. More RSETIs can actively take up similar initiatives. Through the recent launch of the Green Jobs Sector Skills Council and Suryamitra programme, the emphasis on skill training for the sector has received an impetus- beginning with solar PV technician training.

Table : Institutional Players in the DRE Sector

Finance	**Enterprise:** SIDBI, IREDA, Commercial Banks, Impact Investors, Bilateral and Multilateral agencies **End users:** NABARD, Regional Rural and Commercial banks, NBFC, , Crowd funding sources. Potential Fund sources: National Clean Energy Fund, Funds for Clean energy adoption, NABARD Innovation fund
Skill Development	Green Jobs Sector Skill Council, National Skill Development Council, National Institute for Solar Energy, Suryamitra Program and training partners, RSETI, RUDSETI, ITI, Polytechnics .
Technology & Energy Enterprises	Energy Enterprises (typically for-profit- MSME scale), Innovation and Incubation Centers (typically not-for-profit), National Institute for solar energy, Bureau of Energy Efficiency, Testing Centers for machinery, appliances etc.
Infrastructure	**Physical** : Govt. departments, energy corporations, utility companies, private infrastructure providers for energy water, roads, technology, communication etc. **Social** : Civil Society institutions, NGO's
Policy & Regulation	MNRE, IREDA, RBI, State Nodal Agencies of MNRE, Ministry of Power and State Energy Departments , BEE, Ministries of Rural Development, Housing and Poverty alleviation, Human Resource Development, Skills and Entrepreneurship, MSME, National Rural Livelihood Mission and state counterparts.

The main emphasis on bank lending has been popularizing new technologies in all walks of production including agriculture and enterprise. In the modern banking philosophy, particularly with the policy of liberalization, any activity of an entrepreneur or purchase of an asset becomes eligible for bank credit.

Several commercial banks, Regional Rural Banks, and Co-operative banks in the country already finance end-users and enterprises for renewable energy but the extent of the lending is not currently evaluated. The technical feasibility of DRE has been established beyond doubt.

For instance a solar home system can provide the user/ customer with net financial, health, and convenience value, if the up-front capital cost can be financed with reasonable and affordable terms.

The banking sector can emerge as the driving force enabling access to decentralized renewable energy solutions for the poor. A small step in this direction can be estimating and systematically lending towards RE and to achieve the same:

- Banks can adopt district level targets for lending towards based on the suggestion of the NABARD or State Level Bankers Committee (SLBC)
- The District Consultative Committee (DCC) can take up the responsibility of monitoring the achievement of these targets
- At the Block Level Banker Committee (BLBC), service providers may be invited to create technological awareness with a focus on the after sales service. The committee can also review the performance of banks and service providers.

Despite banks having participated in the subsidy programs of the Ministry of New and Renewable Energy and NABARD, they are yet to explore their full potential in lending to DRE. Some of the reasons why bankers are reluctant to lend are:

a. Small loan sizes: Often under-served households and small livelihoods require loans in the range of Rs.10,000 to Rs.1,00,000 which are perceived as small loans with higher administrative cost
b. Repayment collection in remote regions poses additional costs to lending banks

But to overcome the above, the below mitigation mechanisms can be adopted:

- In Karnataka, banks have lent to rural slum dwellers for home lighting and micro entrepreneurship through the **pigmy banking system**.
- Banks in **partnership with NGO's** have participated in private interest subsidy/collateral support programs to benefit micro entrepreneurs such as tailors, bakery owners etc and to energy enterprises.
- **Self Help Groups/Joint Liability Groups** have been funded for taking up renewable energy interventions.
- Banks in their **Corporate Social Responsibility** programs have actively funded RE solutions. The CSR funds can be used to leverage finance and act as risk mitigating fund for village development.

The development of the DRE sector has been hampered by the myths with regard to the provision of Decentralized Renewable Energy Solutions.

Myth 1: The poor cannot maintain DRE systems.

For DRE to reach the poor, there needs to be a strong contingent of energy enterprise who can provide servicing. This myth has been debunked by the penetration of solar and bio-gas plants at the village household level. The poor must be given the freedom of choice to procure these products and this leads us to the second myth.

Myth 2 : The poor cannot afford DRE technology

While poor households cannot purchase DRE solutions in one go, banks can play an important role in facilitating finance at convenient terms to these households. The cost of solar for example has drastically reduced and become affordable.

Myth 3 : Social Enterprises are not Sustainable

Enterprises face difficulties in accessing debt finance and working capital. Bankers need to take cognizance of the need and provide enterprise and end-user finance that will not only improve energy access but also lead to the socio-economic development of the country.

Part A: Financial Innovation with Banks

SELCO Foundation has experimented with banks, mechanisms to bring 'un-banked' customer segments into mainstream financing. The mechanisms captured in Figure 7 were piloted with bankers to encourage bank lending, de-risking the loan, building banker confidence and encourage end-user participation

Risk Guarantee	Collateral in the form of FD parked with bank for Enterprise and End-user Financing Ex. Slum Dwellers, SELCO Incubatee
Interest Subsidy	Interest on FD or upfront partial interest payment made to bank - to credit against loan account on a monthly basis - to ensure EMI's meet cash-flows of entrepreneur. Ex. Sewing Machine, Solar Fridge in Bakery
Gap Finance	Gap finance for projects that have a component of technical innovation that are considered high-risk. Ex. Entrepreneur model for light rental
Margin Money	For poor end-users unable to bring in margin money Ex. Lighting for unelectrified households
Grant	Provided as a last EMI waive i.e. back ended subsidy for encouraging end-users to engage with bankers. Ex. Tribal and nomadic communities
Revolving Risk Fund	To benefit multiple end-users where the fund provides risk-guarantee. Ex. End-users in remote region

The above mentioned innovations are mainly targeted at the rural poor and under-served.

In addition to implementing joint lending programs with bankers the SELCO Foundation also engages with bankers for:

1. Banker Workshops: Aimed at creating a platform for bankers, energy enterprises, policy makers and end-users to share their experiences, discuss viability of RE solutions, relevant challenges and design solutions.
2. Engage with bankers to institutionalize processes and financing mechanisms for RE both at end-user and enterprise level.
3. Engage with RSETI's to conduct training programs for solar technicians and micro entrepreneurs .
4. Conduct community based programs as part of Bank and NABARD awareness camps to increase confidence around clean energy for household and livelihood development, by discussing Technology, Costs, Dissemination and maintenance models and so on.

Part B: Due Diligence and Project Appraisal

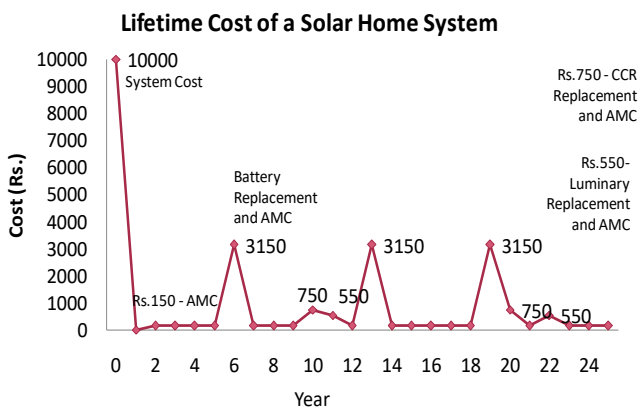
Bankers analyze several risk categories before funding a project proposal, but while lending for DRE especially for the rural populace, the following aspects must be considered to asses the project viability.

Technical Aspects: Some of the technical aspects are:

Product Specification: During appraisal of the project, it is important to ensure that the products & components and manufacturer/system integrator meet the standards specified by MNRE. These standards are revised periodically and presented in the MNRE website. For example, the PV modules more than 12 Wp capacity should be made up of crystalline silicon solar cells and conform to IEC 61215 Edition II / BIS 14286 testing standards from an NABL (National Accreditation Board for Testing & Calibration Laboratories) or IECQ (International Electro-technical Commission Quality Assessment System For Electronic Components) accredited Laboratory.

Life and Recurring Cost: The banker shall also ensure that the manufacturer/dealer of the systems offer Annual Maintenance Contracts (AMC) covering supply of spares (excluding batteries) and services after the five years mandatory warrantee period to ensure satisfactory operation of the system on a sustainable basis. The terms of the AMC are to be agreed upon by the system supplier and the end user.

The table below presents the lifetime cost of a two light solar home system having an initial cost of Rs.10,000. Over the life of 25 years, the system might cost between Rs.23,000 to Rs.25,000 depending on the ability of the end-user to maintain the system. While determining the tenure of the loan and EMI, the banker must keep in consideration these additional potential expenditures that the customer might incur.



Electricity Generation from Panel: The standard solar panel has an input rate of around 1000 Watts per square meter, however on the solar panels available at present you will only gain roughly 15-20% efficiency at best. Therefore if your solar panel is 1 square meter in size, then it would likely to produce around 150-200W in good sunlight.

Charge Regulator: During the day the sunlight received by the PV panels fluctuates leading to irregular power generation. The charge regulator will balance this fluctuation and lead to uniform uninterrupted power supply which will lead to long life of other components of the system. It also provides the information to the user about the current status of system, battery charging and discharging status etc.

Cost of components: Economies of scale in manufacturing process of solar components provide the price advantage to the customers. Higher the capacity of components lowers the price.

Below table shows the average per unit cost:

Capacity	Cost / Unit in ₹
Panel	
12-18 Wp	Rs. 80-85 per Wp
25-30 Wp	Rs. 70-75 per Wp
40-60 Wp	Rs. 65-60 per Wp
75-120 Wp	Rs. 50-55 per Wp
Battery	
15-30 Ah	Rs. 160-200 per Ah
40-60 Ah	Rs. 125-140 per Ah
100-135	Rs. 90-100 per Ah
Charge Regulator	
10-15Amps	Rs. 60-70 per Amps

Warranty: In addition the banker shall insist on a minimum warranty of five years for the complete system (except for the luminaries) including battery, and for a minimum of 5 years for the PV module. Warranties should commence from the date of installation.

Ensure technology and Servicing : The banker needs to ensure that the equipment for which the loan is being installed by eligible enterprises eligible from the NABARD list of vendors. Strong after-sales servicing and support network must be available in the region for technical sustainability. A technical consultant could be used for newer system designs and larger projects, if required.

Non-Technical Aspects: Some of the non-technical aspects are:

Socio- economic Aspects and Background and need of customer: The social and economic background of the customer and his need should one of the critical aspects to understand the importance of the loan.

Encourage Small Ticket Sizes: Most DRE solutions fall in the relatively smaller ticket size category: Between Rs. 9000 to Rs. 20000 for household systems and Rs. 50000 to Rs. 500000 for livelihood and community applications. Though financial needs of these borrowers are relatively small, the impact of the DRE intervention in their lives is considerably large. More importantly, on a per unit basis, the repayment is very strong since the EMI is typically equivalent to the amount earlier spent on kerosene/diesel etc .

Lower Collateral Requirement: Keeping in mind the economic status of the household/small business, the banker can use his/her discretion to waive the collateral requirements .

It is important to note that during the loan tenure, the technology/product is hypothecated to the bank. Therefore, in the event of default, the bank has the authority to repossess the system and enter into a re-purchase agreement with the enterprise in extreme cases. Banks are also encouraged to consider the asset financed i.e. the solar home system or the solar pump as the collateral.

Experience has show that willful default in this category of loans is extremely rare. This combined with the relatively small ticket size and asset hypothecation justifies lower collateral expectations.

Lend for DRE livelihood intervention: It is critical for banks to begin lending for livelihood interventions powered by DRE to bring about increases in productivity and income of rural households and small businesses. Annexure 2 covers some of these interventions. Relevant terms and conditions must be created and the social standing and business acumen of the business owner must be taken into account, rather than mere credit history. The borrower's connection with any civil society organization where he/she receives mentoring can also be ascertained and factored in during decision making.

Impact after implementation: With the need the post-implementation impact of the project also will have to be assessed.

Bank Loan Documents *

Below listed are the indicative bank documents that bankers collect before extending a loan for an individual for lending towards renewable energy:

- ❖ Record of right (ROR) or Village Accountant's certificate or Adangal or Chitta or Pahani or 10-1 extract or Patta book furnishing details of land holding in case of farmers and agriculturists.
- ❖ Copy of the Patta/Khatha or possession certificate issued by the Town Panchayat, Municipality or City Corporation in case of urban or metropolitan areas furnishing details of house property.
- ❖ Copy of the rent agreement or any other proof of residence like family ration card etc.
- ❖ Latest land revenue/Municipal Tax/House tax paid receipt.
- ❖ In case the applicant is the tenant occupant of the house, the proof of tenancy.
- ❖ Proforma invoice/quotation from the manufacturer/ supplier of the SHLS for the cost of the system including accessories and installation.
- ❖ Copy of the test report issued by the Solar Energy Center or Authorized Test Center.
- ❖ Income Tax assessment order or the copy of the return field with the ITO (wherever applicable).

Application and Forms:

- ❖ Standard Application form with details:
  - Personal and Employment Details
  - Proposed Loan Details
  - Financial Details
  - Reference Details
  - Purpose of Loan
  - Income proof
- ❖ Know Your Customer Documents: Proof of Identity, address and DOB
  - Proof of Residence: Utility Bill (not more than 3 months old) / Passport (any one).
  - Latest 6 months Bank statement.
  - Signature verification proof
- ❖ Post Sanction / Pre Disbursement Documentation
  - Loan Agreement duly signed
  - Quotation wherever required
  - Property document along with Loan Statement in case of property being collateral security
  - Pre /Post Sanction Reports
  - Specimen signature card

Documents:

- ❖ Undertaking/ Authorization Letter (Unstamped for loans up to Rs.15,000) wherever applicable
- ❖ Agreement-cum-hypothecation for loans over Rs.15,000 wherever applicable
- ❖ Deed of hypothecation re-durable articles wherever applicable
- ❖ Waiver of obtention of stamped receipts/bills – Declaration
- ❖ Authorization letter to pay the proceeds to the vendor, wherever applicable
- ❖ Stamped receipts/invoices wherever required for loans over Rs.25,000
- ❖ Acknowledgement from borrower for having received the goods in good condition
- ❖ Simple Mortgage (Non-Agri) Deed where insisted and appropriate document incase of equitable mortgage
- ❖ Pledge letter in case of collateral securities of deposit obtained
- ❖ Certificate of loan papers obtained
- ❖ Letter for loan/advance against approved security obtained as collateral security
- ❖ Photo(s)

*The list is indicative and might vary across banks.

S. No.	Name of Scheme	Eligibility conditions	Scheme Highlights
A	**Enterprise Financing Schemes**		
1	MUDRA Yojana (Micro unit Development & Refinancing Agency)Yojana	1.Both in Commercial banks & RRBs. 2.Available for Micro, Sma-ll & medium entrepreneurs Artisans and others for taking up income genera-ting activities. 3.providing employment to unemployed youths.	1.Three types of loans a)Shishu- Loans up to Rs. 50,000/- b) Kishore-Loans above Rs 50,000/- up to Rs. 5 Lakh. c) Tarun- Loans of above Rs. 5 Lakh. 2.Term loan or working capital loan can be provided. 3.Margin 15-20% of project cost. 4.Other guidelines as applicable for Priority sector advances.
2	MSME scheme (Micro, Small and Medium Enterprise) Scheme.	1.For Micro, Small and Medium enterprises in the Manufacturing, Business and Service sector. 2.Solar loans can be under all the three sectors. 3.providing employment to unemployed youths.	1. Under service sector- Micro enterprises- up to Rs. 10 lakh. Small enterprises- loans from above Rs 10 Lakh and up to 2 Crore. 2.Not collateral shall be obtained if the loans are covered under CGTMSE(Credit Guarantee Fund Trust for MSME loans)
3	PMEGP Scheme (Prime Minister's Employment Generation Programme).	1.Providing employment to unemployed youths. 2.Shold be an 8th pass. 3.Age 18-45 years. 4. Commercial banks, RRBs 5.Application through DIC (District Industry Centre) and KVIC(Khadi & Village Industries Commission) or KVIB(Khadi & Village Industries Board) & Banks. 6.Selection through a Task Force committee. 7.Applicable for Both rural & urban	1.For general category- Margin 10% , loan 90% of the cost of project and subsidy from Govt. is 15%.. For SC/ST and women-margin is 5%, Loan -95% of cost of project and Govt. subsidy is 25%. 2. Repayment period 3 to 7 years 3.No Collateral security for loans up to Rs. 10 lakh. Asset created out of loan shall be the security. 4.beneficiaries have to undergo Skill training provided by Govt. for 2-3 weeks before financing by banks. 5.Free Training is provided by Govt.
B	**End-user Financing Schemes**		
4	DRI (Differential Rate of Interest) Scheme.	1. Available only in Commercial Banks. 2. To poor sections of the society- both in rural & urban areas. 3. Family income is not more than Rs 18,000/- in rural area and Rs.24,000/- in Urban areas.	1. Interest rate is 4% Per annum. 2. Loan limit is Rs. 15,000/- 3. Loan is granted for income generating activities- Lights for livelihood activities, entrepreneurs for generating income by hiring etc. 4. Income proof if available can be produced. Otherwise Bank Manager can make assessment of income by visiting the household.
5	General Credit card (GCC) Scheme	1.Both Commercial &RRBs 2.Poor section of society . 3.No specific activity. Any non farm activity. 4.Micro Entrepreneur can take the benefit.	1.Loans up to Rs.25,000/- 2.No collateral to be provided. 3.No guarantor is required. 4.Hypothecation of asset from loan 5.Margin 5-15%.

Schemes Banks can leverage while lending for DRE

S. No.	Name of Scheme	Eligibility conditions	Scheme Highlights
6	Solar Loans scheme under JNNSM(Jawaharlal Nehru National Solar Mission)	1.For water heaters, lighting systems, Inverters, entrepreneurs under solar, roof top solar. 2.Six models are approved by MNRE and test report has to be obtained for each Model. 3.Only billing from solar companies not from their dealers. 4.Supplier should be approved by MNRE 5. Individuals/SHGs/JLGs	1.Implemented through NABARD. 2.Capital subsidy for LED lights only up to 300 Wp-panel capacity. 3.up to 40 WP subsidy is Rs 160/Wp & for above 40 to 300 Wp subsidy is Rs.100 per Wp. 4.Subsidy only for systems where bank loan is availed. 5.Banks to claim subsidy from NABARD. 6.Subsidy is Back-ended with 3 years lock-in period. 7.No subsidy for water heaters. 8. Banks can submit request for advance deposit of subsidy from NABARD
7	Agricultural loans in banks- For solar Pump set loans	1.All banks-for all those who own agril. Land. 2.Solar pump sets can be under Agri. Loans. 3. Both DC &AC pump set-submercible/surface mounted 4. Individuals/SHGs/JLGs 5.Undertaking has to be provided by the supplier –enclosing MNRE approval and test certificate . 6.Other than pump sets, smaller solar loans can be covered under KCC(Kisan Credit card) scheme.	1.AC pumps 2 to 5 HP 2. Total head Max. 70 metres. 3.Water output-91,000 litres/day 4.Subsidy Rs.43,200/-per HP for 5HP it is Rs. 2,16,000/- 5. PV array 4800 Wp. 6. Subsidy back-ended with lock-in period of 3 years. 7. Rate of interest-As per bank norms 8.Security-MNRE has advised banks to waive mortgage of loans to solar pumping sets up to Rs. 5 Lakh. 9.Margin 20% of the cost 10.Repayment period 10 years. 11. Insurance of Pumpset is compulsory Cost of insurance, installation, transportation can be included in the project cost. 12. Financing bank to claim subsidy from NABARD. Request for advance subsidy deposit may be made by Banks from NABARD.
8	Housing loans	Solar lighting, water Heating, inverter loans can be included as a component of housing loans being sanctioned by banks to customers.	Same guidelines as applicable to solar lighting , water heating systems and inverter systems.
9	NRLM- under National Rural Livelihood Mission (and Karnataka Rural Livelihood Mission)Rajeev Gandhi Chaitanya Yojana	1.Unemployed youths to take up employment activity. 2.Panchayats select beneficiaries in Gramasabha. 3.Individuals/JLGs 4.Age18-35 years & 8th pass. 5.New investments-solar 6. All banks/co-operatives	1.Term loan/OD or composite loan 2.Subsidy-for individuals 1/3rd of cost or max. Rs. 10,000/-. For JLGs Rs.50,000/-. 3.Margin- Nil up to loan of Rs.50,000/ to individuals & Rs 2,50,000/for JLGs. 4.Repayment- 3 to 7 years

Schemes Banks can leverage while lending for DRE

S. No.	Name of Scheme	Eligibility conditions	Scheme Highlights
10	SHG/JLG schemes	All weaker section loans including solar loans	1.Instead of financing Individuals group financing is made by Banks . 2.Banks prefer SHG/JLG lending
11(i)	**State Govt. Sponsored Schemes** i)Udyogini Scheme	1.For women empowerment through income generating activities. 2.Women of 18-45 years 3.Family Income limit of Rs.40,000/-Pa. 4.Implemented by Women & Child Welfare Dept. (CDPO)	1.Loan amount up to Rs. 1 lakh depending on the type of project. 2.Subsidy-for General category women-20% of cost or maximum of Rs 7500/-. For SC/ST/Disabled/ and Widows it is 30% of cost or maximum of Rs 10,000/-. 3. Banks usual guidelines for loans under PSA.
11(ii)	**State Govt. Sponsored Schemes** ii) SC/ST Development scheme	1.Implemented by SC/ST Corporation. 2.Loans for income generating activities under Non-farm sector. Solar based activities can be included.	1.The department will provide Margin money support to beneficiaries and applications are routed through banks for sanction of loans. 2.Banks follow usual guidelines applicable for loans under PSA
11(iii)	**State Govt. Sponsored Schemes** iii)Backward class & Minority Devt. scheme	1.Implemented by Backward Class & Minority Development Corporation 2.Loans for income generating activities under Non-farm sector. Solar based activities can be included.	1.The department will provide Margin money support to beneficiaries and applications are routed through banks for sanction of loans. 2.Banks follow usual guidelines applicable for loans under PSA

In addition to the schemes promoted by the central or the state government, banks themselves have developed schemes for financing of decentralized renewable energy, the below table lists some of the schemes that reflect the pioneering efforts of the banks.

SPECIFIC BANK SCHEMES:

Sl No.	Name of Scheme	Scheme highlights
1	Bank of India - Solar Pump set	1. Target Segment : Farmers owning land with access to source of water Interest rate : linked to base rate 2. Repayment period : 5 to 7 years 3. Amount of loan : 75% of the cost of the equipment
2	Bank of Maharashtra - Mahadeep Solar Home Systems	1. Solar home systems for domestic use (max. loan Rs.25,000) and for entrepreneurs (max. loan Rs.2,00,000) to establish central battery charging stations and hire out solar lights to small businesses such as street hawkers and households on daily fee basis. 2. Before availing credit under this scheme entrepreneurs should undergo training at Mahabank Self Employment Training Institute (MSETI). 3. Repayment period : maximum 5 years 4. Interest rate : 9.70%

3	Canara Bank - Housing cum solar loan	1. Loan for the purchase of Solar Equipment can also be sanctioned to applicants who are having subsisting Housing Loans 2. Loan to individuals for installation of Grid connected Roof Top Solar Photovoltaic (PV) System along with the Housing Loan 3. Should be having free rooftop to install the Solar Equipment
4	Indian Overseas Bank - IOB Surya	1. 85% on the project cost which includes cost of the system, accessories, transportation & installation. 2. Minimum loan amount: Rs 30,000 3. Interest rate : 11.75% 4. Repayment period up to 5 years without holiday period
5	Punjab and Sind Bank Loans to Farmers for Purchase of Renewable Energy Equipments (Solar Pumpsets)	1. Target Segment : Individuals and institutions 2. The farmers' land should have adequate source of water. In case any Public/ Government source is being used, water right certificate from the concerned authority should be produced. In case of wells they should have sufficient recouping capacity to irrigate area proposed to be brought under irrigation. 3. The applicant should own an economic land holding with a minimum of 10 acres. However, loans may be considered even if the benefiting area is less than 10 acres provided the farmer is able to sell surplus water.
6	Punjab National Bank -PNB Saur Urja Yojana	1. Small Farmers/ Marginal Farmers/Share cropper/Tenant farmers/Other Farmers and Agri-entrepreneurs, will be eligible under the scheme. 2. Extent of Loan: Need based with a maximum limit of Rs.50,000 3. Repayment of Loan: 5 years in yearly/half yearly installments
7	UCO Bank Scheme for Solar Irrigation Pumpset	1. The farmers' land should have adequate source of water. In case any Public/Government source is being used, water right certificate from the concerned authority should be produced. 2. In case of wells they should have sufficient recouping capacity to irrigate area proposed to be brought under irrigation. 3. Farmer should have own an economic land holding with a minimum of 10 acres. However, loan can be considered even if the benefiting area is less than 10 acres provided the farmer is able to sell surplus water.
8	Vijaya Bank - V Solar	1. All individuals, Self Help Groups, Institutions, Associations, Small Business establishments, schools, hospitals, hostels etc.
9	Syndicate Bank – Synd Solar Jyothi Scheme for solar lighting system	1. Scheme with liberal lending norms on a case on case basis created with a view to assisting the public particularly in rural and semi-urban areas who face the problem of irregular supply of electricity
10	Syndicate Bank – Circular : Lending for Renewable Energy for Micro and Small Enterprises	1. Program for lending to micro and small enterprises to adopt renewable energy solutions (solar) for powering machinery such as sewing machine, fridge, laptop-printer, roti-rolling machine etc.

Some of the other schemes are the Kbl Ravi Kiran scheme from Karnataka Bank based on the priority sector guidelines, Sooryadeepa scheme from State Bank of Mysore, Union Bank of India scheme, Cent Solar Light Scheme, Cent Solar Water Heater Scheme and Cent Solar Pumpset schemes for solar home lighting and pumping and water heating. Andhra Bank, Bank of India, State Bank of Patiala has all designed schemes around the MNRE guidelines and the NABARD subsidy program.

FINANCIAL SCHEMES : BIOMASS

Financial Support for Biomass related technologies

•IREDA incentives for bio-energy

Under the supervision of IREDA there are fiscal incentives for Biomass Power Generation in the form of accelerated depreciation for some of the machinery used and tax holidays i.e Customs Duty, Central Excise Duty, Central Sales Tax, General Sales Tax exemptions subject to the state regulations.
Source: http://www.ireda.gov.in/forms/contentpage.aspx?lid=821

•MNRE Biomass Power and Bagasse Co-generation Program

The biomass power and Bagasse co-generation program is being promoted by the Ministry of New and Renewable Energy (MNRE), which aims at efficient utilization of biomass such as agro residue in the form of stalks, stems and straw; agro-industrial residues such as shells, husks, de-oiled cakes and wood from dedicated energy plantations for power generation.

•Household size Family Type Biogas Plants under NBMMP

Under the National Biogas and Manure Management Program Central Financial Assistance is provided to households to set up family type biogas plants. The below table details the subsidy provided by the government for this program:

S No.	Particulars of Central Financial Assistance (CFA)	Subsidy Amount (Rs.)	
	Central Subsidy Rates Applicable (In Rs.)	1 m^3	2- 6 m^3
1	NER States, Sikkim (except plain areas of Assam) and including SC and ST Categories of NE Region States.	15,000	17,000
2	Plain areas of Assam.	10,000	11,000
3	Jammu & Kashmir, Himachal Pradesh, Uttrakhand, Niligiri of Tamil Nadu, Sadar Kurseong & Kalimpong Sub-Divisions of Darjeeling, Sunderbans (W.B.) and Andaman & Nicobar Islands	7,000	11,000
4	Scheduled castes / Scheduled Tribes of other than NE Region States including Sikkim & other Hilly States / regions as given in Sl.no.3 above.	7,000	11,000
5	All Other States and Regions	5,500	9,000

Source: http://www.ireeed.gov.in/policyfiles/432-biogasscheme.pdf

Bank financing for bio-energy projects in India

•IDBI bank – Financing scheme for biogas plants

IDBI bank provides financing for expenses on construction of biogas chambers of steel gasholder and even construction of toilets, if attached, are recommended for financing. Many agencies such as Zilla Panchayat (Z.P.) / State Govt. / Central Govt. are providing subsidies, which are treated as margin money for the loan.

•UBI Loan scheme for Biogas plants

UBI has a loan scheme for biogas plant projects, the aim of which is to provide hassle-free and adequate credit, i.e., working capital and term loan for the construction of bio-gas plants and to acquire accessories like stoves, lamps, etc.

MNRE Small Hydro Power Program:

Central Financial Assistance for Watermills and Micro Hydro Power Projects
Watermills and Micro Hydro Power Projects have the potential to provide a decentralized solution to power requirements in remote areas of the country. To encourage the development and implementation of these projects, the MNRE has proposed incentives under the CFA program. The details are provided in the table below.

Product	Specification	Amount of CFA
Watermill	Mechanical Output Only	Rs. 50,000 per Watermill
	Mechanical and/or electrical output (up to 5 kW)	Rs. 1,50,000 per Watermill
Micro Hydro Power Projects	Micro Hydro Power Projects up to 100kW capacity	Rs. 1,25,000 per kW

Case Study : Micro Hydro Project in Gevali, Uttaranchal

A 25 kW micro hydro project was implemented at Gevali village in the Tehri Gadwall district of Uttaranchal. The village is located in a remote area of the Himalayan mountain range. The local tribal population lives below the poverty line. Gram Vikas Panchayat Samiti, an NGO in the village, took the initiative to supply electricity to this community, utilizing local available water resources from streams of water with technical and financial assistance from FORRAD, a German agency. The details of the project finances are given in table below.

Table: Financing the Gevali village project

Expense	Amount (INR)
Start up expenses (Funding Agency)	1,90,000
Machinery (Funding Agency)	328,000
Margin contribution by community	400,000
Margin contribution by local NGO	236,000
Total Cost	**900,000**

Under the project, 70 households in the village have been electrified and each household has been given electricity connection with a monthly tariff of Rs. 26. The two people trained by FORRAD look after the maintenance work and are paid Rs. 500 each per month. Self Help Groups (SHG's) were formed to monitor and supervise the maintenance, collection of tariff and prevent misuse of power by the consumers. Accordingly, the project is being managed by Urja Panchayat comprising of 4 men and 2 women taken from the consumers.

A. Financing and Policy

Q 1. Have banks provided loans for DRE ?

Ans 1. Several banks in India today are actively lending to decentralized renewable energy, with some banks also coming up with tailor made schemes. A number of nationalized and rural banks including Syndicate Bank, Aryavarth Grameen Bank, Prathama Grameen Bank, Canara Bank, Karnataka Vikas Grameen Bank, Pragathi Krishna Grameen bank, SBI, SBM, SBH, Bank of Baroda have been financing Decentralized renewable energy solutions, particularly solar PV and Thermal for more than 10 years.

The National Solar Mission (off grid component) also used the bank financing channel to route subsidies to end users for Decentralized solar systems. Beyond basic solar home systems and rooftop systems, in recent times a few banks have also financed productive livelihoods- sewing machines, refrigerators and roti-rolling machines powered off solar energy, albeit in very small numbers.

The critical gap is the lack of data regarding the number of systems financed and the high rate of repayment that can provide assurance to bankers. To address this, bankers need to start classifying all renewable energy loans. This will provide data on repayments and project profiles which in turn will encourage new managers to lend.

Q 2. Can DRE be classified under Priority Sector Lending of the RBI?

Ans. The RBI in its notification on "Priority Sector Lending – Targets and Classification" has clearly stated that Renewable Energy is an eligible category under priority sector.

"Renewable Energy -Bank loans up to a limit of ₹ 15 crore to borrowers for purposes like solar based power generators, biomass based power generators, wind mills, micro-hydel plants and for non-conventional energy based public utilities viz. street lighting systems, and remote village electrification. For individual households, the loan limit will be ₹ 10 lakh per borrower."

-RBI notification on "Priority Sector Lending – Targets and Classification" (No.:RBI/2014-15/573 FIDD.CO.Plan.BC.5 4/04.09.01 /2014-15) dated 23rd April 2015

In addition banks can lend towards DRE and claim eligibility under the following categories:

a) Agriculture – Irrigation i.e. solar pumping, cold storage powered by Renewable Energy, Agro-processing i.e. dryers and diary processing using renewable energy etc.

b) Advances to Weaker Sections – SHG's, Artisans, village and cottage industries, Scheduled Castes and Scheduled Tribes, Self Help Groups, women beneficiaries and minority communities for adoption of renewable energy based livelihoods or renewable for their livelihoods for powering their appliances and machinery. Banks can also extend loans under the Differential Rate of Interest (DRI) scheme for DRE.

c) Micro, Small and Medium Enterprises – Banks can lend to energy enterprises during the start up phase of operation or for growth.

d) Social Infrastructure: Lending towards drinking water facilities such as water purification powered by renewable energy.

Q 3. Should bankers only lend when there is a subsidy scheme?

Ans. No, lending for Decentralized Renewable Energy systems is similar to lending for any other asset. The original MNRE-NABARD subsidy scheme was merely created to incentivize this lending and adoption amongst end users. As of 2016 March, the scheme has been reintroduced with certain system/product specifications. However, independent of whether or not there is a subsidy scheme, financing for Decentralized renewable energy needs to be institutionalized, similar to any other asset financing that banks undertake.

Q 4. How to categorize a loan given for solar intervention in livelihood?

Ans. An investment by an entrepreneur in energy for livelihood such as a solar powered refrigerator system or Sewing machine is essentially a capital investment and can be categorized as a lending towards MSME. However, ideally, banks should create a section for Renewable Energy lending (as it is part of the Priority sector) and such loans can be categorized accordingly.

B. Risk Mitigation

Q 4. What is critical when providing a loan for DRE?

Ans. Apart from the general business/product viability analysis that banks undertake focus must also be made on the quality of the vendor and his service.

MNRE provides details on the technical specifications of products eligible for bank financing. Despite these lists, there is hesitation amongst banks to lend for solar on account of the risk of non-functioning systems, lack of credibility of vendors and potential for loan default.

To overcome this issue, bankers can use this checklist of ideal criteria to determine the credibility of vendors and their ability to maintain systems while financing for SHS. This will allow the bank to use their discretion while financing systems of particular vendors and consequently reduce the risk of Non-performing assets (NPAs) under the SHS portfolio.

•Vendor details:

a) Vendors should have sold SHS in India for a period of at least 2 years. They should have installed at least 1,000 SHS in India.

b) They should operate in at least 2 districts in the state, and should have Sales Offices and Service Centres in both the designated districts.

c) They should have adequate experience in installing SHS in houses and small businesses in rural areas.

d) They should have provisions to ensure training of local technicians to service SHS installed by them.

•Specifics on after sales service:

There should be at least one Service Centre within a radius of 70 kms of the location of the SHS. Bank should be satisfied that the Service Centre is located at reasonably close distance from the customer's premises to provide high level of service, preferably within 48 hours of call. Vendor should provide information on Service Centers established by them, area covered by each and the facilities available in each.

- Vendor should have a pre-determined schedule for maintenance and after-sales service. Maintenance schedule should be disclosed in product literature. Both the customer and the Bank should be made fully aware of the schedule of maintenance that will be supported by the Vendor during the period of the warranty and the Bank Loan.

- Warranty and Guarantee of the product: Ensuring quality of the product will also assure repayments and loan recovery.

- In case of community based projects it is important to ascertain community cohesion and partner with NGOs/gram panchayat in the region to provide mentorship to the project.

Q 5. Often DRE loans are small and consume as much effort and time as bigger loans. How can bankers rationalize administrative costs?

Ans . Banks in general prefer loans with tenures less that 5 years as it allows for better asset and liability management. In this context small loans are a better option for banks especially to diversify their risks. If the loan is structured to meet the cash flows of the project, recovery will not pose a problem. In order to reduce the administrative costs banks can:

- Develop Pigmy banking facilities or Business correspondents to rationalize efforts towards all small loans and deposits, particularly in remote areas.

- Lend for DRE through JLGs/SHGs, wherever relevant.

- Build partnerships with energy enterprises to bundle small loans, where possible.

- Conduct Renewable Loan Melas similar to other credit melas where they can simultaneously address the demands of multiple borrowers. This can also be championed by the Lead District Manger in the state and involve multiple bankers.

Q 6. How to guard against Non-Performing Assets while lending for DRE ?

Ans . Banks can take up measures to ensure that loans do not fail.

a) List of Technical Experts and Specialists: Banks could avail the services of experts for performing due-diligence on the projects- particularly larger ones.

b) Restructuring and Rehabilitation: Bankers could provide prompt restructuring facilities that encourage repayments. Restructure loan if it is a matter of non-repayment owing to seasonal variations in income (more importantly, structure loans to meet cash flows at the very beginning)

c) Banker awareness programs where technology risks are addressed and mitigation mechanisms are discussed. Such workshops can be organized by NABARD, SLBC, Banker Institute of Rural Development etc. in partnership with NGOs, business development associations such as CLEAN and energy enterprises.

d) Ensure Vendor qualifications are kept in mind while lending- particularly service networks;

e) Ensure energy enterprise provides one individual as a representative in case of bulk issues with systems financed

f) In Extreme cases or where households are of very low income, undertake informal buy-back guarantees with enterprises or use other public funds for partial credit guarantee

g) Work with enterprises and industry representatives such as CLEAN to undertake an overview of the NPA assets for the bank branch/regional office that could provide insights into the real reasons for any minimal NPA in DRE loans

In addition;

a) CLEAN the industry body could be approached for its support in identifying technical experts and specialists.
b) Banker Awareness Programs can be encouraged by banks; there are several NGOs and practioners in the country who are capable of supporting the same.
c) During appraisal ensuring the quality and certification of the products.

C. Technical

Q 7.Will solar technology work under foggy conditions and during monsoons?

Ans . The solar Photovoltaic technology is well proven internationally in regions which have harsh winters and are cloudy / foggy and in many pockets of the country. Solar technology works effectively in cloudy weather as well since most established rural energy enterprises ensure a 2-3 day autonomy on their system, only the running time might reduce to 3-4 hours which during sunny days would be 5-6 hours. In case of any issues, the household is advised to switch off the system for a day and allow it to recharge before using it the next day.

Q 8. How do we know if a region is suitable for generating solar?

Ans . The National Institute of Wind Energy has created an Indian Solar Radiation Atlas that present the long term annual average radiation values for any 3km x 3km grid in the country. The atlas can be accessed at:
http://www.niwe.res.in/indian_solar_atlas.php

Q 9. Can an automotive lead-acid battery be used for solar?

Ans: Deep-Cycle Lead acid battery and Lithium-ion battery are only batteries suitable for storing the photovoltaic energy:
•For one or two light solar systems Lithium-ion battery can be used, it's higher cost makes it unviable for higher capacity systems. Lithium-ion batteries have shorter life span; generally these batteries will last for 2.5 to 3 years.
•Deep-Cycle Lead acid battery: Tubular battery, most suitable for larger systems because of slow charge and slow discharge. The automotive battery does not have this property.

Q 10. Where can I find data on the solar rooftop program and state policies?

Ans . The IREDA has published a compilation of all state policies sector wise (solar, wind, small hydro and biomass) that is available at:
http://www.ireda.gov.in/writereaddata/CompendiumStatePolicyRE/Program.htm

The MNRE has published a Technical Manual for Banks & FIs on Grid-Connected Rooftop Solar Power and it is available at: http://mnre.gov.in/file-manager/UserFiles/TERI-Technical-Manual-Banks-FIs.pdf , http://mnre.gov.in/file-manager/UserFiles/TERI-technical-manual-bank.pdf

Solar Powered Sewing Machine

The table 1 provides the system designs and details of the components and devices with specifications required for a solar powered sewing machine. The design below is suitable for a basic domestic machine that is not computerized. The design and in particular the capacity will change for a machine with higher capability (automatic embroidery) etc. The systems design in Table 1, will power the machine for 10 hours per day. The approximate cost of the below system including the sewing machine and installation could range between Rs.27,000 to Rs.30,000. An LED light can be added to the system with an increase in the cost in the range of Rs.3,000 to Rs.5,000.

Table 1: System Design - Solar Powered Sewing Machine

Particulars	Capacity	Quantity
Solar Module	75 Wp, 12 V	1 No.
Solar Battery	60 Ah, 12 V	1 No.
Module Mounting Structure	60 Wp, 1M	1 No.
Charge Regulator -Solid State Relay	10 A, 12 V	1 No.
Permanent Magnet DC motor	60 W	1 No.
Pulse Width Modulation (PWM) Pedal Controller, Pulley and belt	-	1 Set
Sewing Machine – Domestic Industrial	1500 spm*	1
Cables (red and black) and consumables	As required	

*SPM- stitches per minute

Table 2: Lending Terms - Solar Powered Sewing Machine

Particulars	Amount (Rs.)
Total Cost of the System	Rs.27,000
Margin Money	Rs.6,000
Amount taken as loan	Rs.21,000
Interest Rate	13 %
Loan Tenure	36 months
Equal Monthly Installments (EMI)	Rs.700
Total Amount to be repaid to bank (Approx.)	Rs.25,500
Total Amount spent on the system (including interest on loan)	Rs. 31,500

Source: Study of interventions by SELCO Foundation

Solar Powered Refrigerator

The table 3 provides the system designs and details of the components and devices with specifications required for a solar powered DC Refrigerator. The design below is for a capacity suitable for a bakery, small retail shop located in a small town/village. The design and in particular the capacity will change for a machine with higher capability etc. The systems design in Table 3, will power the machine for 24 hours each day and provide 3 day back-up in the case of cloudy weather. The approximate cost of the below system including the DC Refrigerator and installation could range between Rs.1,20,000 to Rs.2,50,000 depending on the extent of refrigeration from cooling to deep-freezer.

Table 3: System Design - Solar Powered Refrigerator

Particulars	Capacity	Quantity
Solar Module	300 Wp, 24 V	1 No.
Solar Battery	110 Ah, 12 V	2 No.
Module Mounting Structure	-	1 No.
Solar DC fridge Operating voltage: Dimensions (W x H x D):	240 liters, 12 – 24 V 684 x 849 x 1144 mm	1 No.
Cables (red and black) and consumables	As required	

The potential lending terms for a bank loan for the solar powered DC fridge are listed below.

Table 4: Lending Terms - Solar Powered Refrigerator

Particulars	Amount (Rs.)
Total Cost of the System	Rs.1,20,000
Margin Money	Rs.20,000
Amount taken as loan	Rs.1,00,000
Interest Rate	13 %
Loan Tenure	60 months
Equal Monthly Installments (EMI)	Rs.2,280
Total Amount to be repaid to bank (Approx.)	Rs.1,36,800
Total Amount spent on the system (including interest on loan)	Rs. 1,56,800

Source: Study of interventions by SELCO Foundation

Key Technical Aspects

- For solar powering of any appliance to be efficient the appliance should have a DC motor, this will also make the system cost most competitive.
- The life of a typical solar panel is 25 years, battery is 5-7 years, charge controller is 5 years and PM-DC motor is 3-5 years (without major repair).

Solar Powered Printing/Photocopying and Mobile Repair Center

The table 5 provides the system designs and details of the components and devices with specifications required for a Mobile Repair and Photocopying Center. The center will have a solar powered laptop , printer, basic lighting and soldering machine. The design below is for a capacity suitable for a single laptop-printer model, the design for an N-Computing center would be different. The approximate cost of solar powering a laptop-printer system consuming a maximum load of 98 W and requiring maximum units of energy (kWh) per day of 0.337 units could range between Rs. 35,000 to Rs. 40,000. This costing is with reference to the design in Table 5. This does not include the price of the printer , laptop or soldering unit.

Table 5: System Design - Solar Powered Printing/Photocopying and Mobile Repair Center

Particulars	Capacity	Quantity
Solar Module	75 Wp, 12 V	2
Solar Battery	135 Ah, 12 V	1
MMS	75 Wp, 1M	2
CR SSR	15 A, 12 V	1
DC-DC boost converter	150 W (12 V- 230 V DC)	1
DC LED Tubelight	9 W	1
Cables and consumables	As required	

The Table 6 provides suggestive lending terms for a bank loan which is inclusive of the cost of the laptop, printer and soldering machine.

Table 6: Lending Terms -Solar Powered Printing/Photocopying and Mobile Repair Center

Particulars	Amount (Rs.)
Total Cost of the System	Rs.75,000
Margin Money	Rs.10,000
Amount taken as loan	Rs.65,000
Interest Rate	13 %
Loan Tenure	40 months
Equal Monthly Installments (EMI)	Rs.2,000
Total Amount to be repaid to bank (Approx.)	Rs.80,500
Total Amount spent on the system (including interest on loan)	Rs. 90,500

Source: Study of interventions by SELCO Foundation

Solar Powered Lights for Hawkers

Lighting is critical for any small enterprise to operate, especially if they are street vendors and the customer flow increases in the evening. The hawker lighting model is an innovative project where the battery charging station that is powered by solar is in a centralized location, either in the entrepreneur's home or shop. The entrepreneur then delivers to the street vendors the battery that can be connected to their lights. This service not only benefits one, but spurs the growth of several entrepreneurs.

The design below is aimed to provide lighting for 20 street/mobile vendors. This is an indicative design and the panel and battery capacity can be altered based on the need. This system design will power the lights for 4-5 hours each day. The approximate cost of the below system including the lights and installation could range around Rs.1,00,000 to Rs.1,20,000.

Table 7: System Design – Solar Powered Lights for Hawkers

Particulars	Capacity	Quantity
Solar Module	60 Wp, 12 V	3 Nos.
Solar Battery	15 Ah, 12 V	20 Nos.
Module Mounting Structure	60 Wp, 1 M	3 Nos.
Diode Box	15 A	3 Nos.
LED Light	3.6 W	20 Nos.
Distribution box	-	3 Nos.
Cables and consumables	As required	

The potential lending terms for a bank loan for the above system is presented below.

Table 8: Lending Terms - Solar Powered Lights for Hawkers

Particulars	Amount (Rs.)
Total Cost of the System	Rs.1,00,000
Margin Money	Rs.20,000
Amount taken as loan	Rs.80,000
Interest Rate	13 %
Loan Tenure	48 months
Equal Monthly Installments (EMI)	Rs.2,100
Total Amount to be repaid to bank (Approx.)	Rs.1,00,800
Total Amount spent on the system (including interest on loan)	Rs. 1,20,800

Source: Study of interventions by SELCO Foundation

Solar Powered Roti Rolling Machine

The table 9 provides the system designs and details of the components and devices with specifications required for Roti Rolling Machine. The design presented below will power a rolling machine to make 500 roti's per day and also provide basic lighting. The approximate cost of solar powering a roti rolling machine and light requiring on an average 110 W per day could range between Rs. 65,000 to Rs. 75,000. This costing is with reference to the design in Table 9 and includes the price of the roti rolling machine.

Table 9: System Design - Solar Powered Roti Rolling Machine

Particulars	Capacity	Quantity
Solar Module	50 Wp, 12 V	2
Solar Battery	110 Ah, 12 V	2
MMS	50 Wp	2
Hybrid Charger	150 Wp, 12 V/24V	1
DC Motor	150 W , 24 V	1
DC LED Tubelight	9 W & 5W, 12 V	1 each
Pulley, Belt and Fittings		1 set
Switch	5 Amps, 10 Amps	1 each
Cables and consumables	As required	

The Table 10 provides suggestive lending terms for a bank loan which is inclusive of the cost of the roti rolling machine.

Table 10: Lending Terms -Solar Powered Roti Rolling Machine

Particulars	Amount (Rs.)
Total Cost of the System	Rs.75,000
Margin Money	Rs.10,000
Amount taken as loan	Rs.65,000
Interest Rate	13 %
Loan Tenure	40 months
Equal Monthly Installments (EMI)	Rs.2,000
Total Amount to be repaid to bank (Approx.)	Rs.80,500
Total Amount spent on the system (including interest on loan)	Rs. 90,500

Source: Study of interventions by SELCO Foundation

Solar Pumping Systems for Agriculture

Water is a critical input for agriculture and decrease in surface water availability in lakes, rivers etc , poor rainfalls is a huge burden on the farmer. Water pumping is a potential solution that can help irrigate agriculture and horticulture fields. But in the face of severe power outages, solar pumping can be a potential solution.

The table 11 provides the system designs and details of the components and devices with specifications required for solar powering of a AC (alternating current) pump. The design presented below will power a 5 HP motor to pull water from a depth of 220 meters. The cost of the system range between Rs.6 lakhs to Rs.6.50 lakhs depending on the cost of the AC motor used in the system, output required etc.

Table 11: System Design - Solar Powered Pump

Particulars	Capacity	Quantity
Solar Module	150 Wp, 24 V	32 Nos.
Single Axis Manual Tracking Module Mounting Structure	As required	
Submersible AC pump	5 HP	1 Nos.
Pump Controller /Drive	5 HP	
Cables and consumables	As required	

The potential lending terms for a bank loan for the above system is presented below.

Table 12: Lending Terms - Solar Powered Pump

Particulars	Amount (Rs.)
Total Cost of the System	Rs.6,00,000
Margin Money	Rs.1,20,000
NABARD Subsidy*	Rs.2,16,000
Amount taken as loan	Rs. 4,80,000
Interest Rate	13 %
Loan Tenure	60 months
Equal Monthly Installments (EMI)	Rs. 6,000
Total Amount to be repaid to bank (Approx.)	Rs.3,60,000
Total Amount spent on the system (including interest on loan)	Rs. 4,80,000

Source: Study of interventions by SELCO Foundation

Note: Under the Jawaharlal Nehru National Solar Mission presently subsidy is available for solar pumps. The amount is only indicative and will be provided as a back ended subsidy.

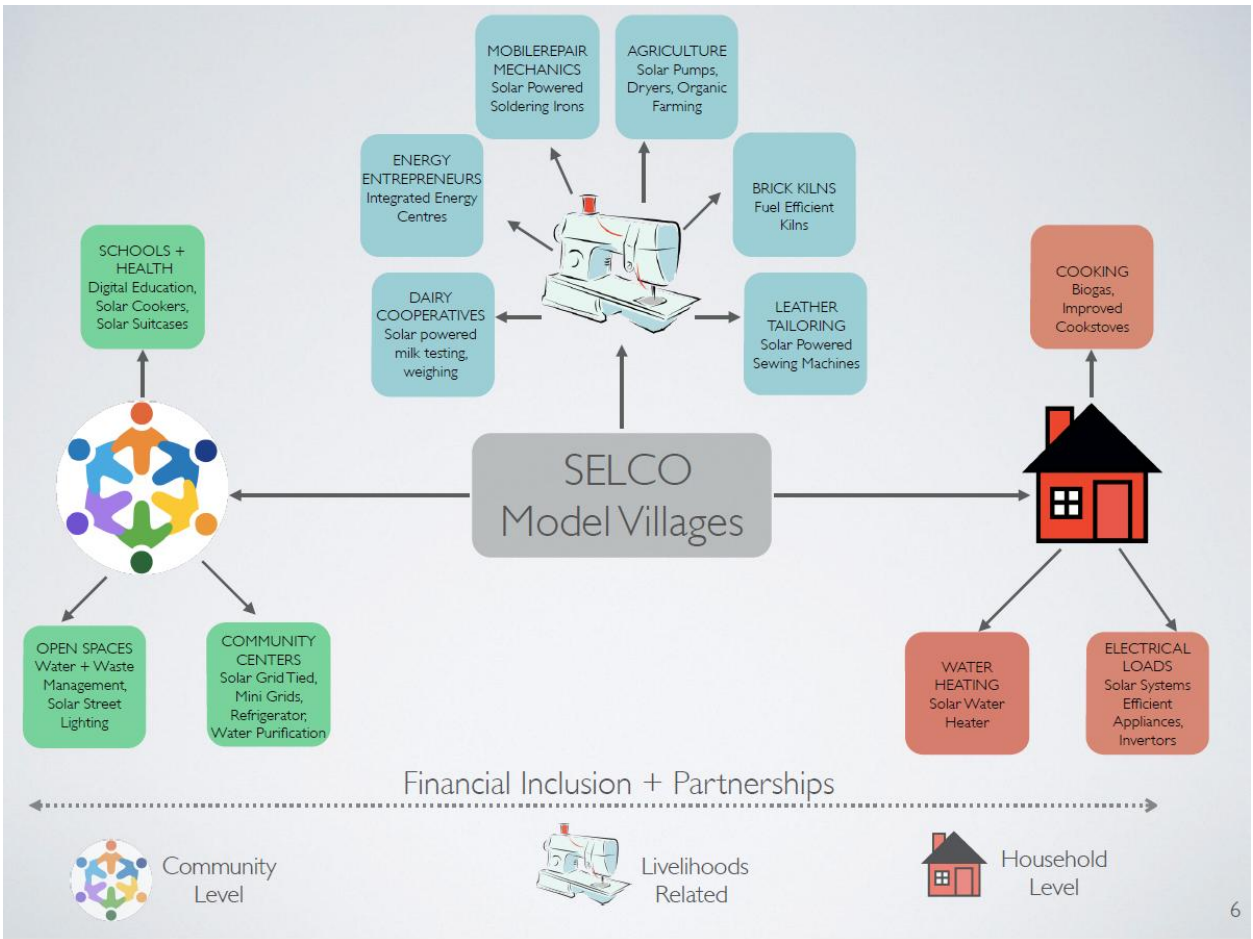
Low – Carbon Model Village

Model village is the concept of holistic village development and presently focus is on integrating low-carbon solutions through renewable energy, energy efficiency, waste and water management, efficient practices in agriculture and other livelihoods. Currently local parliamentarians, multi-national corporations and banks are interested in the creation and planning of model villages.

The process for creating a model village begins with need assessment and energy mapping, followed by customization of solutions, implementation and monitoring and evaluation. Using a cross-sectoral approach, current model village interventions are integrating energy related inputs in health, education, livelihoods and skill development, while also providing safe drinking water and low cost infrastructure facilities. Model Village development can be financed through CSR funding or government programs such as the Sansad Adharsh Gram Yojana (SAGY).

Model Village interventions should ensure environmental, social and financial sustainability by:

- Creating customer segment based financing, matching the existing or perceived cash flows of the poor.
- Reverse market linkages thus not only creating or improving livelihoods but also ensuring that the poor are a part of the formal economy
- Involving the poor in the process as partners and not as beneficiaries.



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FOUNDATION






Contact
SELCO Foundation
No.690, 15th Cross, J.P Nagar, 2nd Phase,
Bangalore- 560078, Karnataka.
Tel: 080-2649 3145
www.selcofoundation.org
http://thelastmileselco.in (Videos of Innovative project)