



EAI
Energy Alternatives India

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Preview Copy

Off Grid Solar Industry

A Market Intelligence Report

Preface

Energy is the genesis of all things. It plays a significant part in the economic development of a country and is the main driver of wealth creation. Currently, there is an emphasis on the use of renewable/ clean sources of energy primarily due to climate changes and constraints on the use of fossil fuel. A new form of generating system using these sources of energy is fast emerging as a popular means of creating electricity. Currently, India country faces average energy and peak shortages to the extent of 12 percent and 11 percent respectively. In fact, deficit in power supply has emerged as the biggest infrastructure constraint in the country.

Although, the government has impressive plans for generation and transmission capacity augmentation; it would still not be able to accomplish 100% village electrification or total household electrification by 2012. Successful (though small scale) business models such as solar-based home electricity systems and lanterns, energy-efficient cook stoves, are increasingly finding a market among rural and semi urban India.

The Ministry of New & Renewable Energy (MNRE) seeks to achieve its solar mission targets in part through the installation of rooftop photovoltaic systems. It also has set goals for providing 20 million solar lighting systems in place of kerosene lamps to rural communities within the next few years. Such measures serve the government's dual objectives of providing electricity to rural areas and reducing the trajectory of India's greenhouse gas emissions.

The solar industry has immense potential for a tropical country like India where around 45% of households, mainly rural ones, do not have access to electricity. The industry has witnessed rapid growth over the past few years and is projected to grow further in future. However, for the solar industry to penetrate into the off-grid market, there is a need for a clear understanding of the market dynamics, market needs and successful business models that can help in reaching the target segment.

The report has been developed to give a holistic view of the possible business models to promote clean energy in off grid markets in India. It covers the technological aspects, opportunities, investment procedures, government policies, regulations, and challenges in the business environment. The report provides an extensive research and rational analysis of the solar industry in India. It thoroughly examines current industry trends, with focus on recent changes in the state and country level regulatory environment. The report will assist investors to understand the market dynamics and get an insight into the future outlook of the off grid solar sector in India.

This is a preview for the report prepared by EAI, India's leading renewable energy advisory research and consulting firm. The report was last updated in the December 2011.

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Section 1

Section I – What are the off-grid solar applications and products

1. Off-Grid Renewable Energy in India
2. Introduction to Solar Off-grid Applications and Products

India's unique proposition to benefit from solar energy technology and the various solar off grid products and solutions have been described in detail in this section. Inputs on the market status and future outlook for various off grid solar products and solutions are covered in this section.

Section 2

Industry & Market Information

3. Off-grid Products Business Value Chain Analysis
4. Solar Products Manufacturing
5. Government initiatives/ programs to support off-grid renewable energy deployment

This section will provide detailed analysis of the business opportunities in off grid solar value chain. The major companies in the off grid solar value chain and the most successful business models in this sector have been comprehensively covered. There are also vital inputs available on the government support that is available for deployment of solar energy in off grid pockets in India.

Section 3

Understanding the Industry Dynamics

6. Case Studies and Key Learnings
7. Next Steps for Entering the Off-grid Solar Market
8. Frequently Asked Questions

This section is offers actionable intelligence and critical insights about the off grid solar sector. Real time case studies that would help you understand the dynamics of the off grid solar industry is available in this section. The next steps to be taken by investors willing to venture into this sector has been elaborated clearly in this section.

Why you should buy this report

- It provides in depth analysis of the various off grid products and solutions with emphasis on the three key market segments –domestic, commercial and industrial.
- It helps you with concise inferences on market attractiveness and opportunities in the solar off-grid solar value chain.
- It includes a number of real life case studies to assist you in gaining a more practical perspective of the industry dynamics
- It has been developed with inputs from authoritative primary research.
- Special emphasis is on inputs that will facilitate businesses to quickly take further steps.
- Developed by Energy Alternatives India, the leading renewable energy advisory research and consulting firm of the country.

Highlights of the Report

- It answers the most important questions that entrepreneurs, investors and businesses have regarding the off grid solar industry.
- The report focuses on the various business opportunities available in the off grid solar value chain and offers recommendations on the various business models that are essential to market the off grid solar products and services for various market segments.
- It helps you understand key drivers, challenges and bottlenecks for the off-grid solar industry in Indian scenario.
- It contains profiles of the key players in the off grid solar value chain and the successful business models that are practiced by them.
- It showcases case studies on off grid solar industry that would help you to learn from the experiences of others.
- It provides precise inputs on the niche off grid applications where solar energy could play a critical role.

1

Off-Grid Renewable Energy in India

The chapter summarizes the potential of renewable energy technologies in replacing conventional sources for distributed power applications. The current status of the renewable energy sector in the off-grid pockets of India has been concisely dealt in this chapter.

Key Sections

1. Off-grid Renewable Energy in India
 - 1.1 Introduction to Off-grid Renewable Energy Sector

Sample Content: Transition to renewable energy in rural off-grid areas

Energy Service	Existing off-grid Energy Sources	Examples of new and renewable energy Technologies
Lighting and other small electric needs (homes, schools, street lighting, phone charging, hand tools, vaccine storage, refrigeration)	Candles, kerosene, batteries, small diesel generators, central battery recharging by carting batteries to grid	<ul style="list-style-type: none"> • Hydropower (pico, micro, small-scales) • Biogas from household-scale digester • small-scale biomass gasifier with gas engine • village-scale mini grids and solar/hydro/wind hybrid systems • Solar home systems • Pico scale PV System, including solar lamps
Communications (televisions, radios, mobile phones)	Dry cell batteries, small diesel generator, central battery recharging by carting batteries to grid	<ul style="list-style-type: none"> • Hydropower (pico, micro, small-scales) • Biogas from household-scale digester • small-scale biomass gasifier with gas engine • village-scale mini grids and solar/hydro/wind hybrid systems • Solar home systems • Pico scale PV System
Cooking (Domestic, Commercial stoves and Ovens)	Burning wood, dung or straw in open fire at about 15 percent efficiency	<ul style="list-style-type: none"> • Improved cooking stoves (fuel wood, crop wastes) with efficiency above 25% • Biogas from household scale digester and Biogas stove • Solar cookers
Heating and Cooling (Crop drying and other agricultural processing)	Mostly open fire from wood, dung and straw	<ul style="list-style-type: none"> • Improved heating stoves • Biogas from small and medium scale digesters • solar crop dryers • Solar thermal for heating and cooling • fans from small grid renewable systems
Process Motive Power (Small Industry)	Diesel generator and engine	<ul style="list-style-type: none"> • Small and Large solar home systems • Small wind turbines • Mini-grid with hybrid system (combination of microhydro, gasifiers, direct combustion, Large biodigesters and other renewables)
Water Pumping (Agricultural and Drinking Water)	Diesel pumps and generators	<ul style="list-style-type: none"> • Mechanical Wind Pumps • Solar PV pumps • Mini-Grid with hybrid system

Sample Content: Off-grid / distributed renewable power installations in India

SOURCE	CUMULATIVE CAPACITY (MW)
Biomass Power/Cogen. (Non-Bagasse)	267.08
Biomass Gasifiers	128.16
Urban Waste-to-Energy	60.78
Rural Waste-to-Energy	0.45
Captive Solar PV Power Plants	2.39
Aero-generators/Hybrid systems	1.07
Total	459.93

Sample Content: Decentralized Energy Systems installations in India

SOURCE	CUMULATIVE CAPACITY
Rural / Semi Urban Biogas Plants	42,77,000
SPV Street Lighting System	1,21,634
SPV Home Lighting System	6,19,428
SPV Lanterns	8,13,380
SPV Pumps	7,495
Solar Cookers	6,64,000
Wind Pumps	1,352

2

Introduction to Solar Off-grid Applications and Products

India's unique proposition to benefit from solar energy technology has been described in detail in this chapter. This chapter involves in-depth analysis of products (solar lanterns, home lighting systems, solar water heaters, solar concentrators for industrial process heating, solar cookers and solar pv for small consumer electronics) and market segments (domestic, commercial, industrial etc.) Inputs on the market status and future outlook for various off grid solar products and solutions are covered in this chapter.

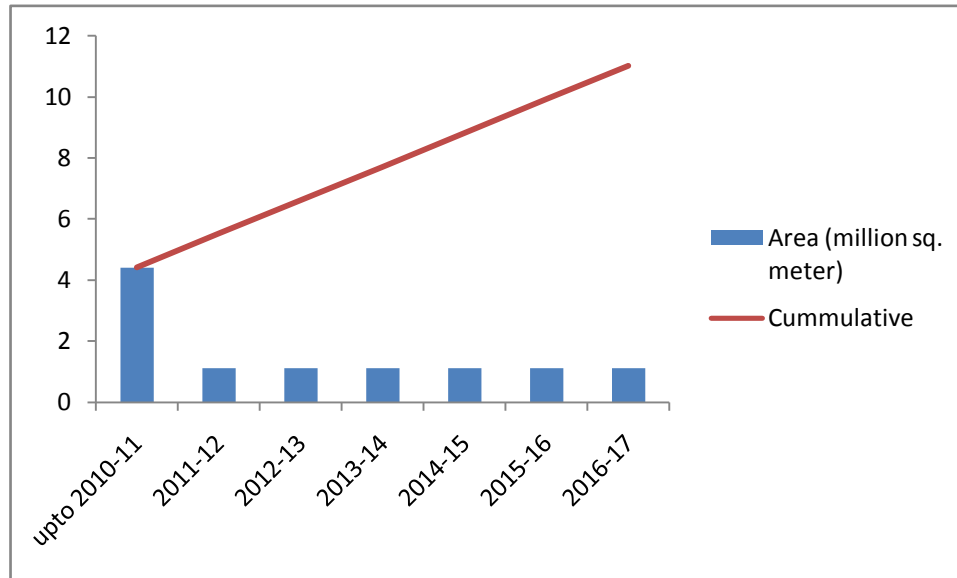
Key Sections

1. Introduction to Solar Off-grid Applications and Products
 - a. Introduction
 - b. India's Unique Proposition
 - c. Off-grid solar power
 - i. Residential roof tops
 - ii. Commercial roof tops
 - iii. Captive industrial solar power
 - d. Solar PV products
 - i. Solar street lights
 - ii. Solar home lights
 - iii. Solar lanterns
 - iv. Solar PV pumps
 - v. Solar water heaters
 - vi. Residential solar power packs for rural electrification
 - vii. Other innovative solar products

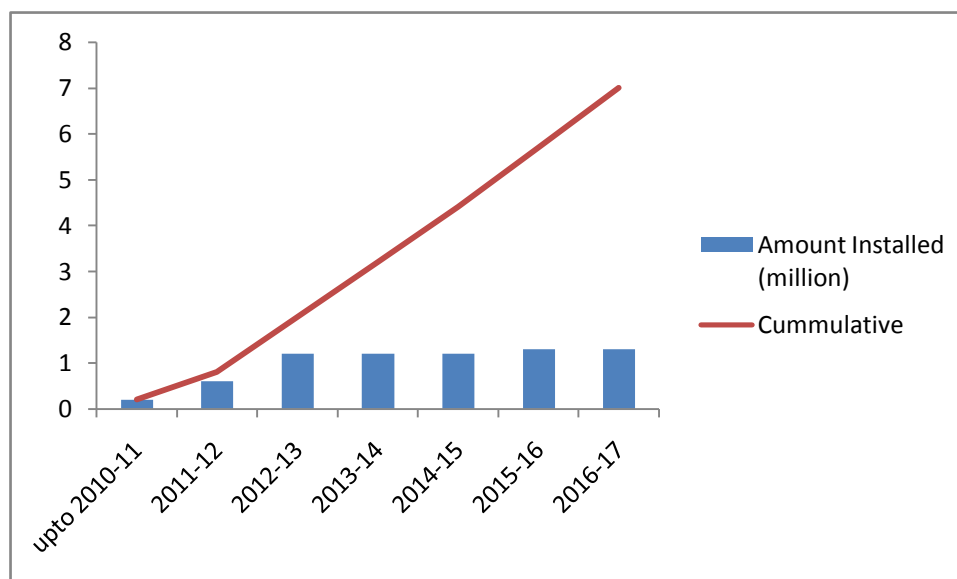
e. Market Status

- i. Installed capacity of solar PV products and systems
- ii. Future outlook

Sample Content: **Projected Installations for Solar Thermal Water Heating Systems**



Sample Content: **Projected Installations for Solar Home Lighting Systems**



Sample Content: Solar Water Pumps

A solar PV water pumping system - commonly known as a solar pump - draws power from solar cell / modules to operate a motor pump set. Solar power pumps use specially developed and energy efficient motor pump sets to achieve higher discharge which off sets the high initial cost. A solar PV water pumping system consists of a number of solar PV modules connected in series - parallel combination to generate sufficient power to operate a motor pump. The solar PV modules are mounted on a metal frame in a manner that the mounting frame can be turned / tilted to ensure that the modules keep facing the sun throughout the day. The system does not have any storage battery since power generated is used directly then and there. The SPV array converts the solar energy into electricity which is used for running the motor pump set. The pumping system can draw water from the open well / bore well or stream / pond or canal.

The solar water pumping system is a stand-alone system operating on power generated using solar PV (photovoltaic) system. The power generated by solar cells is used for operating DC surface centrifugal mono-block pumpset for lifting water from bore / open well or water reservoir for minor irrigation and drinking water purpose. The system schematic is shown in the figure below. The system requires a shadow-free area for installation of the Solar Panel.

Types of solar power pumps:

SPV water pumping system uses the SPV array mounted on a stand and includes one of the following motor pump sets compatible with the PV array.

- i. DC surface pump (centrifugal) or floating pump set
- ii. AC surface or submersible pump set

Centrifugal pumps are suitable for areas where water is available at shallow depths such as open wells / stream / ponds / canals etc. They are driven by a DC motor. The total head is 14 m and maximum suction head is 7m. Better performance in the form of higher water output can be achieved when the suction head is kept at the minimum.

Submersible pumps are recommended where water table is available at higher depth (more than 14 m). It is highly efficient and rugged multistage pump. Pumps can be conveniently placed under water so as to lift water from up to 50 m depth.

Advantages:

- SPV water pumping systems can be installed at a site completely eliminating loss of energy in transmission.
- Can be installed to the required load of pumps up to 3000 Watts (2 HP)
- SPV modules need only minimum maintenance and no battery is required.

Potential for use:

SPV pumps are more suitable for remote areas with *no* or unreliable grid or as an alternative to diesel pumps. Some of the most popular applications are :

- i. Drinking water supply for small habitations
- ii. Horticulture farms, orchards, vineyards, gardens and nurseries
- iii. Agro forestry and plantations
- iv. Dairy, poultry and sheep farm
- v. Aqua culture, fish farming

Cost & subsidy:

Tentative cost of solar water pumps range from Rs.2.10 lakhs to Rs.5.10 lakhs depending on type and capacity of pumps.

MNRE subsidy was available at the rate of Rs.30 per Watt peak subject to a maximum of Rs.50, 000/- per system for community applications such as drinking water are to be given priority over individuals. IREDA will provide loans to eligible users and the interest arise at the rate of 5% per annum respectively for the remaining price subject to a maximum of 90 % repayable in 10 years (subject to changes).

CFA pattern for solar pumps

CFA for General Category States	Rs. 30/Wp, subject to a maximum of Rs. 50,000/- per system
CFA for Special Category States	Rs. 30/Wp, subject to a maximum of Rs. 50,000/- per system
Administrative Charge	Rs. 2,000

Source : MNRE

3

Off-grid Products Business Value Chain Analysis

In this section, we make a comprehensive analysis of the off grid solar industry value chain to identify the business opportunities available at the manufacturing, service and trading levels. Profiles of the prominent companies in the off grid solar industry value chain and analysis of the most successful business models in the off grid solar is provided in this chapter. Also, inputs on the most suitable business model for different market segments are available.

Key Sections

3. Off-grid Products Business Value Chain Analysis
 - a. Solar off-grid products value chain
 - b. Business opportunities in off-grid solar products
 - i. Manufacturing opportunities
 - ii. Service opportunities
 - iii. Trading opportunities
 - c. Off-grid solar PV power production – alternative business models
 - i. Distributor-Dealer Channels
 - ii. Proprietary Distribution Channels
 - iii. Institutional Partnerships
 - iv. Franchise Model

- v. Rental /Leasing System
 - vi. Electric Cooperatives
 - vii. Pay As You Save (PAYS)
 - viii. Choosing the Right Model for the Right Segment
- d. Prominent companies in the various stages of off-grid solar products value chain
- i. Kotak Urja Pvt Ltd.
 - ii. TATA BP Solar India Ltd
 - iii. SELCO Solar Pvt Ltd
 - iv. KCP Solar
 - v. Central Electronics Limited (CEL)
 - vi. D.Light Design Inc
 - vii. HHV Solar Technologies Pvt Ltd
 - viii. Solkar Solar Industry Ltd
 - ix. Aspiration Energy

Sample Content: Off-grid Solar Sector – Alternative Business Models

Rental /Leasing System

In this model, a company contracts or franchises to micro-entrepreneurs who set up solar charging kiosks. The micro-entrepreneurs either

- (1) rent products out to consumers on a hourly/daily basis or
- (2) sell the products without a power source and offer a fixed fee for charging. Charging can be provided via on-grid power or alternative power generation (solar, diesel, etc).

The Energy Services Company (ESCO) is a company that owns, installs and operates electricity systems (eg solar home systems, solar water heaters etc) and provides energy services to consumers. The company is also responsible for repair and maintenance of the systems and providing replacement parts over the life of the service contract. The ESCO charges the users/beneficiaries a fixed monthly fee or leases the equipment to the consumers for a fixed rental fee, which is why the model is also known as fee-for-service model.

LaBL-TERI – A business model with the strongest impact on rural community

TERI's Lighting a Billion Lives model is probably the best known business model in the off grid solar sector and follows a fee-for-service delivery approach where a solar charging station is set up by TERI and operated by a village entrepreneur. This not only provides employment opportunities for the local communities but also claims to make the overall process sustainable.

TERI's Lighting a Billion Lives operates on fee-for-service or rental model where Centralised Solar Lantern Charging Stations (SCS) are set-up in villages for charging the lanterns and providing the lanterns daily on rent to households and enterprises. A typical solar lantern charging station consists of 50 solar lanterns with five numbers of solar panels and junction boxes. The charging stations are operated and managed by entrepreneurs (Self Help Groups/individual youths) who qualify the selection criteria set as part of the LaBL campaign. These entrepreneurs are selected and provided the handholding support by local LaBL implementation partners called LaBL Partner Organization. The rent is collected by the entrepreneur, a part of which is used for O&M of the charging station and for replacement of battery as may be required after 18-24 months of operation. Till date, TERI has successfully extended the Campaign in around 600 villages spread across 15 states in India impacting more than 150 000 lives.

The LaBL initiative has successfully demonstrated in India how solar lanterns could impact the community; be it for lighting or for livelihood generation at the household and village level. The impact is not simply the provision of lighting purely in a physical sense, but is actually an

instrument by which lives can be transformed and hopes and aspirations generated on a plane that clearly enhances human welfare substantially. There is direct livelihood benefit in the form of green jobs' for the entrepreneurs managing the SCS and earning through renting. The operators more than 15% of whom are women—earn approximately Rs 1500–3500 per month by renting out lanterns.

Sample Content: Off-grid Solar Sector – Alternative Business Models

Pay As You Save (PAYS)

The PAYS is one of the most favorable model for solar thermal and rooftop requirements. This avails customers with very low tariff plans. The pay per unit and pay per month plans are favorable for residential rooftop owners and commercial rooftops like telecom towers. Pay per Unit model has also been developed which provides electricity at as low as Rs 5/kWh for rooftop solar PV installations. Balance is paid over 10 years as energy cost at Rs 5/kWh and free 10 years after sales service is also provided.

Aspiration Energy

It has a pay as you save (PAYS) model which caters to the process heat requirement of industries like metal working, oil and cement. They give solutions in the 80 degree to 150 degree centigrade range on a pay as you save model. Its pay per unit (PPU) offering is a solar PV based electricity generation at rooftops of customer premises, targeted at urban commercial offices owned by profitable corporates, where they pay only Rs. 5 per unit (KWHr) solar energy to Aspirations Energy. Aspiration Energy provides free 5 years after-sales service.

A very recent offering is a pay per month model for telecom towers. They have an agreement with one of the top three telecom operators in India to put up solar infrastructure for telecom towers. It will erect 220 telecom towers in the first phase and scale it to 1,000 towers in the second phase with this telecom operator. This will be invested through a joint venture with another Rs. 500 crore public limited company, with 1,800 employees, that is responsible for the operations and maintenance of the telecom server. These offerings help its users save anywhere between 15 to 45 per cent of the operational cost. While PAYS and telecom towers are direct cost savings even without government subsidies, PPU depends on government subsidies. The company intends to focus on its three offerings. It has a couple of products - solar airconditioners, non-tracking type concentrated thermal collectors and water sewage handling systems - in the research and development pipeline. However, it plans to take these up once it has settled down with its current portfolio.

4

Solar Products Manufacturing

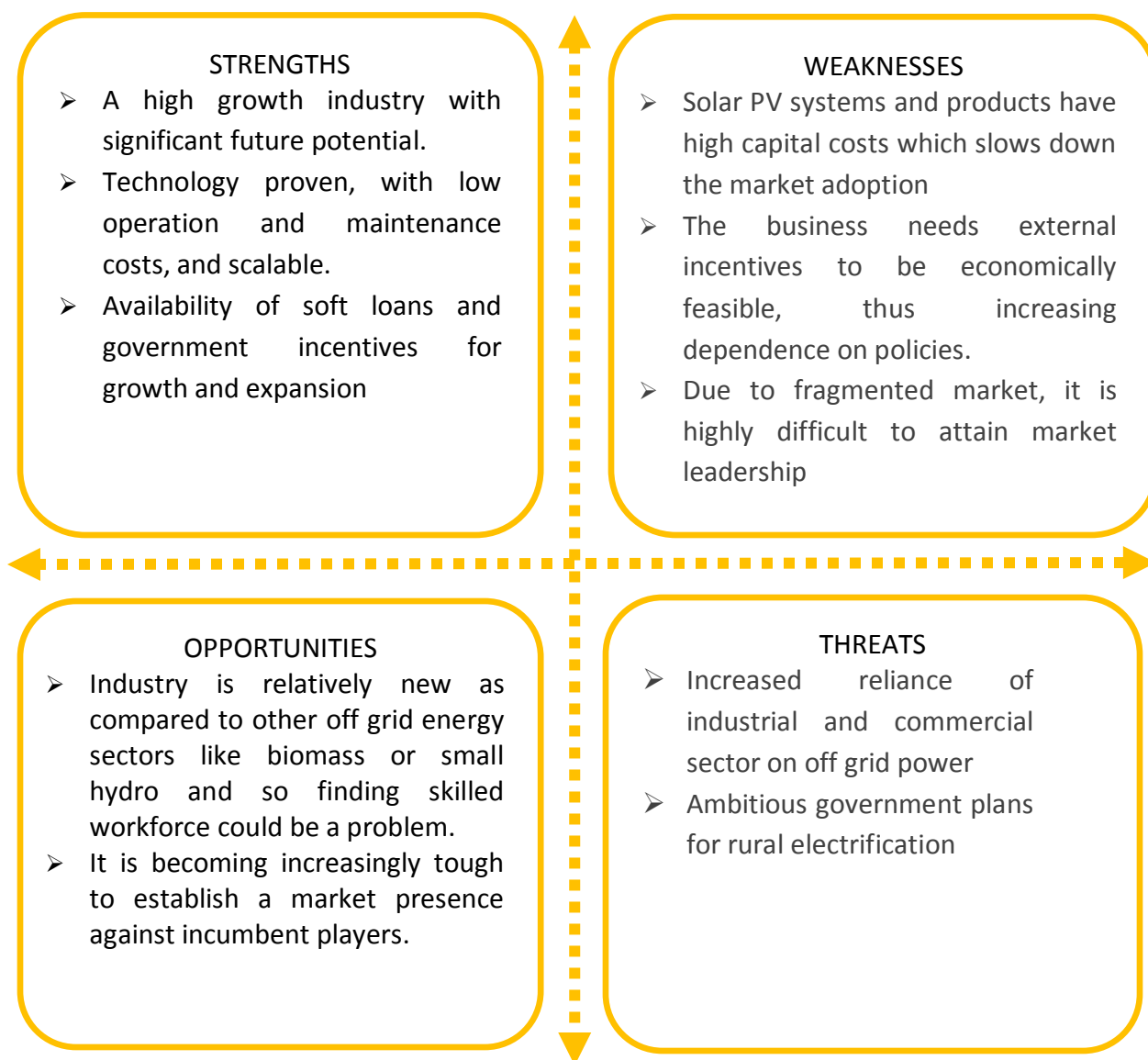
This chapter deals with manufacturing opportunities in the off grid solar value chain. The drivers and barriers, bottlenecks and challenges etc. have been analyzed in depth. The attractiveness of the manufacturing sector and the key aspects to consider before venturing into solar products manufacturing, has been clearly explained. The major risks associated with this sector have been clearly explained along with the mitigation strategies.

Key Sections

Solar Products Manufacturing

1. Overview of off-grid solar manufacturing sector in India
2. Key drivers, challenges and bottlenecks for the off-grid solar industry in Indian
3. Key aspects to consider before entering the off-grid solar industry
4. Analysis of the attractiveness of off-grid sector
 - a. SWOT analysis
 - b. Risk analysis
5. Investor's FAQs

Sample Content : Analysis of the attractiveness of off-grid sector – SWOT



Key Aspects to Consider

While the off grid solar PV sector is an exciting business, success in this industry requires efforts similar to those for other businesses. It is important that investors and developers analyze the key aspects of the industry well enough while making this investment decision.

- Costs
- Technology Differentiation
- Central & Regional Policy & Mandates
- Value Chain and Key Industry Segments
- Business Model and marketing strategy

5

Government initiatives/ programs to support off-grid renewable energy deployment

In this chapter, we have discussed all the government support schemes and programs for off grid solar energy. Information on all the incentives, subsidies, tax benefits and the criteria to avail the same has been clearly explained.

Key Sections

Government initiatives/ programs to support off-grid renewable energy deployment

- a. RGGVY program from Ministry Of Power
- b. RVE and VESP program of MNRE
- c. Renewable Energy Supply for Rural Areas (RESRA)
- d. Renewable energy for urban, industrial & commercial applications
- e. Special area demonstration project programme
- f. Other programs/ incentives/ subsidies
- g. Key takeaways for success/failure of the programme

Sample Content: Solar City Programme

Under “Development of Solar Cities Programme” the Ministry had proposed to support 60 cities/towns for Development as “Solar/ Green Cities” during the 11th Plan period with the aim to promote the use of renewable energy in urban areas by providing support to the Municipal Corporations for preparation and implementation of a Road Map to develop their cities as Solar Cities. At least one city in each State to a maximum of five cities in a State was to be supported. Systems mainly for electricity conservation

(Target 750 kW during rest of 11th Plan)

- Solar street lights
- Solar traffic signals
- Solar blinkers
- Solar power packs/inverters
- Solar illuminating hoardings/ Bill boards
- Other systems of community use as felt necessary by Implementing Agencies

@ Rs. 150 per watt of SPV panels upto a capacity of 1 kW each with required storage batteries (preferably 6 hours) to a maximum of 50% of cost of system to urban local bodies/ SNAs/ Institutions not availing depreciation benefits and

@ Rs. 100 per watt to a maximum of 33% of the cost of systems with similar conditions to commercial establishments/ industry availing depreciation benefit.

In specific cases, where battery storage is not required, the support will be @ Rs. 115 per watt and Rs. 75 per watt respectively:

Maximum capacity of the systems to be supported in a State will not be more than 1/5th of the target for a particular year, out of which not more than 1/5th capacity will be supported in a single Urban Local Body. Support for solar street lights will be limited to 50% of total capacity of SPV Systems / devices in an Urban Local Body supported under the scheme. Implementing Agencies will be free to decide about the capacity and other specifications of systems to be installed in their area. Roof Top Systems for diesel abatement (Target : 4.25 MW during rest of 11th Plan) (for diesel abatement in Institutions, Govt. Buildings, Commercial establishments e.g. Malls, Hotels, Hospitals, Nursing homes, Industry & Housing complexes facing huge power shortage during daytime)

@ Rs. 75 per watt of SPV panels to a maximum of 30% of the cost of systems to profit making bodies who can also avail accelerated depreciation benefits and

@ Rs. 100 per watt to a maximum of 40% of the cost of systems to nonprofit making bodies.

Systems could be with or without grid interactive. Support will be available for systems capacity varying between 25 to 100kW. No restriction of targets to States. Proposals in prescribed format to will be considered on first-cum-first basis through SNAS.

Benefits

- Will pay back the cost in 5 to 6 years
- Life : 25 to 30 years
- No air and noise pollution
- No moving parts and zero maintenance except cleaning of SPV panel once in a while
- Beneficiary to decide supplier on cost and quality competitive basis. List of suppliers available at Ministry's website
- A 100 kW capacity Roof Top system could save around 50,000 liters of diesel per year

The scheme has been revised in January 2011, which provides the following support:

Solar City Programme- Revised 2011

- Up to of 50 lakh for each city is provided for preparation of the Master Plan (up to 10 lakh), setting up of Solar City Cell in the City (up to 10 lakh) oversight of its implementation (up to Rs 10 lakh) and organizing other promotional activities (up to 20 lakh).
- Ten Cities to be developed as 'Pilot Solar Cities'. The financial support upto 2.50 crore will be provided for each Pilot Solar City provided the equal amount of 2.50 crore is given by the Municipal Corporation/City Administration/State or any other resources including public private partnership for installation of renewable energy projects/systems.
- Four Cities will be developed as 'Model Solar Cities'. The financial support upto 9.50 crore will be provided for each Model Solar City provided the equal amount of 9.50 crore is given by the Municipal Corporation/City Administration/State or any other resources including public private partnership for installation of renewable energy projects/systems.
- Apart from 60 Solar Cities, 50 new Small townships/Campuses duly notified/permitted by the concerned Authorities being developed by the promoters/builders, SEZs/ industrial towns, Institutional campus etc. will be developed as Solar Township/Solar Campus. The

financial support upto 10.00 lakh will be provided for each new small townships/campuses for preparation of Master Plan/DPR including the action plan for renewable energy installations, green campus development, awareness generation and trainings etc.

- Based on the proposals received and the cities identified by 23 States/UTs, 'In-Principle' approval has been given to 14 Cities during the year making a total of 48 Cities namely, Agra, Moradabad, Rajkot, Gandhinagar, Surat, Nagpur, Kalyan-Dombiwali, Thane, Nanded, Aurangabad, Indore, Gwalior, Bhopal, Imphal, Kohima, Dimapur, Dehradun, Haridwar-Rishikesh, Chamoli-Gopeshwar, Chandigarh, Gurgaon, Faridabad, Coimbatore, Vijaywada, Bilaspur, Raipur, Agartala, Guwahati, Jorhat, Hubli, Mysore, Thiruvananthapuram, Amritsar, Ludhiana, Ajmer, Jaipur, Jodhpur, Bhubaneswar, Aizawl, Panaji City & Environs, Itanagar, Hamirpur, Shimla, Howrah, Kochi, Rewa, SAS Nagar Mohali and Shirdi for developing them as Solar Cities.
- Sanctions have been issued for 17 Cities during the year making a total of 31 Cities namely Agra, Moradabad, Rajkot, Gandhinagar, Nagpur, Kalyan-Dombiwali, Kohima, Aizawl, Dimapur Dehradun, Chandigarh, Gurgaon, Faridabad, Thane, Panaji City & Environs, Bilaspur, Raipur, Imphal, Itanagar, Jodhpur, Jorhat, Guwahati, Agartala, Ludhiana, Amritsar, Shimla, Hamirpur, Haridwar & Rishikesh, Vijaywada, Aizawl, Mysore, Hubli and Gwalior. Funds for preparation of their Master Plans have been released which is under progress.
- The draft Master Plans have been prepared for 11 cities namely Kalyan-Dombiwali, Kohima, Amritsar, Nagpur, Thane, Rajkot, Imphal, Moradabad, Indore, Chandigarh, and Agra which are under finalization.
- Nagpur and Chandigarh are being developed as Model Solar Cities. The proposal of Gandhinagar for developing as Model Solar City has been received and is under consideration.
- Over 30 Stakeholders Meetings/Consultations were held in different cities with Municipal Corporations, Consultants, Electricity Department and other City Representatives.etc. Their inputs were included in the Master Plans being prepared for the Solar Cities.

6

Case Studies and Key Learnings

The chapter that offers the most critical insights and actionable intelligence is the comprehensive case study analysis. Ten different case studies with key takeaways and inferences, is one of the vital chapters in this report.

Key Sections

Case Studies and Key Learnings

- a. Rural electrification – experiences of SELCO Solar Light Pvt. Ltd
- b. Solar water pumps - experiences of Aurore
- c. Community solar power plant - experiences of Development Alternatives Group
- d. Captive solar PV systems – experiences of L&T
- e. Captive solar PV systems – experiences of SSN Research Center
- f. Solar powered weave yarns - experiences of PRADAN
- g. Passive solar greenhouses – experiences of GERES
- h. Solar Lanterns– experiences of Winrock International India (WII)
- i. Solar Home Lighting– experiences of Aryavart Gramin Bank
- j. Solar Powered Computers– experiences of Gnanmata Sadan School
- k. Key Takeaways from the various Case Studies

Sample Content : Solar Powered Lanterns – Experiences of D.Light Design, Inc

D.Light Design, Inc is a multinational energy enterprise, registered in the US, aiming to bring light to homes in rural and far flung areas which are not connected to the electricity grid. Funded by Silicon Valley and Indian venture capitalists, the company sells its solar products in about 32 developing countries through local distributor networks.

Innovativeness in design is the backbone of D.Light's business model

D.Light puts extensive research efforts for each of their product line so that the product is tailor made of the end user who invariably is below poverty line community. Before finalizing a product model, D.Light carries an extensive research to find out the most efficient and sustainable design, then it develops a pilot product and field tests them with their end users in India, East Africa and worldwide. If these pilot models satisfy the requirements of the users, only then D.Light launches those models in the market.

Solar lanterns are designed by D.light to be low cost, high quality and durable. The company has three basic models are in production. The largest of the lanterns is the Nova (launched June 2008), which has a 1.0 or 1.3 Wp detachable photovoltaic (PV) module with an outdoor cable. It has four light settings, from task lighting to nightlight. The Solata (launched June 2008) has a 0.625 Wp detachable PV module with an outdoor cable. The smallest and least expensive model is the Kiran (launched October 2009), which has an integrated 0.3 Wp PV module. Each lantern includes a rechargeable battery and charge controller. The expected lifetime of the PV module is at least 10 years, and the battery needs to be changed approximately every one to two years. The LED light has an estimated lifetime of 50,000 hours.

Financing the upfront investment

Most of the customers buy these lanterns for down payment. However some rural entrepreneurs give lanterns to customers on credit, if they know their customers' credentials and those customers payback the loan on terms and conditions agreed upon mutually by the customer and his dealer. There are some efforts to give lanterns to customers through micro credit and financing schemes, however such initiatives are yet to be scaled up.

Most customers pay for the lanterns up front from a local dealer. Some dealers offer credit to customers they know well, but on an informal basis. There have been some pilot projects with micro finance institutions, including SKS, to provide loans for the solar lanterns, but they have not been taken up on a large scale. Some large employers have bought lanterns in bulk and sold them to their employees via monthly salary deductions.

D.light is also looking at reducing the cost of the products with the help of carbon finance. D.Light solar lanterns have been approved by the UNFCCC for a carbon offset project in India, in which carbon reductions resulting from the use of lanterns will be accurately measured and

carbon credits paid for. Reduction in prices will in turn reduce the burden of financing the upfront investments needed by the end user to purchase the products.

Marketing the product in the low income pockets of the nation

D.Light markets the lanterns directly to rural customers, using road shows, sales vans, and go-to-market campaigns. It markets the products through distributors, dealers and rural entrepreneurs (REs). REs are local entrepreneurs who buy a few solar lanterns at a time from dealers and sell them at a profit in their own village. Local dealers and REs explain the benefits of the lights and stage demonstrations in markets and villages. Local dealers are free to adopt their own strategies to market and sell the lanterns. Some dealers even allow their prospective customers to use the lanterns on trial basis. If customers like the product they purchase it, otherwise they are can return the product back to the dealer.

Usually, the dealers and distributors educate the end user about the benefits of adopting a lantern over kerosene. On average INR.100 is spent on kerosene for lighting one lamp per month. In comparison to the expenses incurred on kerosene lamps, solar lanterns from D.Light make more economic sense. The low end Kiran, which costs about 549, can pay for itself with in five months of its purchase and the most expensive Nova in less than two years. The fact that each household is entitled to only three litres of subsidised kerosene per month, makes way for kerosene purchase in open market at higher prices of more than INR.25/liter. If this expense is also considered then the payback period for solar lanterns becomes much shorter. The dealers usually educate the end user about all these expenses and the tangible and intangible benefits for purchasing lantern.

7

Next Steps for Entering the Off-grid Solar Market

After having understood the market potential and industry dynamics, it is vital to have an understanding on the way forward and this chapter precisely deals with this. Actionable intelligence on how to enter the market and what are the niche market opportunities is available in this chapter.

Key Sections

Next Steps for Entering the Off-grid Solar Market

- a. Steps to be followed in order to avail government subsidies / incentives
- b. Collaborating with financial integrators
- c. Identification of attractive off-grid segments
- d. Opportunities in various off-grid applications
 - i. Telecom towers
 - ii. ATM's
 - iii. Irrigation pumps
 - iv. Rural energy hubs/solar multi utility
 - v. Common service centers
 - vi. Large commercial facilities
 - vii. Desalination
 - viii. Remote Monitoring Systems
 - ix. Onshore and Offshore oil and gas
 - x. Others
- e. Marketing of clean energy in off-grid markets
- f. Understanding the role of NGO's
- g. Preparing prefeasibility and detailed project reports

Sample Content: Opportunities in various off-grid applications

ATMs

In the last four years, many banks including PSUs and Private Banks have set up around 28,000 ATMs across the country. ATMs require uninterrupted power supply and connectivity to communicate with the ATM Network (Core Banking System) and avail transactions to its customers. In order to reach more and more customers, banks have been establishing ATMs on large scale. These ATMs have been established in all regions be it rural, remote or urban areas. As banks expand to rural India, there will be a need for more home grown solutions and most importantly, a rural solution (rugged) to reach out to the segment.

Normally ATMs use a complex Cash Dispensing Mechanism where the cassettes are horizontal and at bottom of the ATM and cash is moved from the cassette through a conveyor belt upwards to dispense cash in the cash presenter in ATM. Also they use CRT monitors in many models as well as full-fledged PC boards consuming power.

Solar ATMs have innovative Cash Dispensing Mechanism, that does not use any conveyor belt and the cassette is mounted vertically in the top half of the ATM. This makes the notes dispensed from cassette to travel only a short distance to the cash presenter in ATM. So, it uses much smaller and low-power consuming motors and hence able to operate under very less power. It also uses lower-power consuming processors and LCD displays that consume much less power and Linux as OS. Low power consumption ensures that the heat generated by the ATM is negligible. It uses hardened components that can operate under ambient temperatures of up to 50 deg C. This ensure that Solar ATMs can operate without any air-conditioners up to 50 deg C, which feature is not offered by any other ATM.

IndusInd Bank- a new generation private sector bank inaugurated Mumbai's first solar-powered automated teller machine (ATM) as part of its Green Office Project campaign "Hum aur Hariyali". It also unveiled a "Green Office Manual - A Guide to Sustainable Practices," prepared in association with the Centre for Environmental Research and Education (CARE). IndusInd Bank has a comprehensive plan to reduce its carbon footprint. Some of the initiatives being undertaken under this plan are solar powered ATMs, thin computing, e-archiving, e-learning, e-waste management, paperless fax, energy conservation, CNG cars and also supporting finance programs with incentives to go green.

Sample Content: Understanding the role of NGOs

Non Governmental Organizations have played a significant role in off-grid industry and have taken a leap further into business model of institutional partnerships. NGOs approach with non-profit making models and a strong customer base. NGOs based in rural areas and serving for rehabilitation and disaster relief come forward with least margins- availing end-users with a product at low cost. Other organizations like self-motivated and self-help groups contribute along-with governmental policies, as in case of Poverty Alleviation Programme, Power for All-2012, RGGVY etc.

NGOs always have been working on their sole aim of welfare of society and hence their contribution in hospitals, hotels and slums is well acknowledged. In recent past, a few NGOs have come up with green labels and have been contributing by working towards afforestation, poverty alleviation, enlightening non-grid connected areas, creating awareness for- renewable energy, water conservation, fuel consumption, wildlife protection and education. Many of such objectives have to be achieved through alternative and better solutions provided by renewable energy. NGOs demonstrate success/failure of a new technology by implementing proof-of-concept programmes in their area of operation.

- During Tsunami Period, NGOs came forward with institutional partnership and 15-20% margin demand on lighting products. NGOs purchased many lanterns when there was no capital subsidy scheme implemented by the government. NGOs followed Institutional partnership models at company end, and rental model at the customer end. The lanterns were rented at Rs 50/day. Later during rehabilitation, NGOs partnered with many local companies like KCP Solar, Jaiso Lighting and MNRE's Aditya Solar shops for distribution of solar lanterns and installation of Street Lighting Systems. KCP Solar alone helped NGOs to erect 350 street lights in Nagapattinam and lighting solutions worth 20 crores in Karur. Initially these were maintained by NGOs on voluntary basis, but later their ownership was handed over to the local Panchayats and Community/Society based organizations.
- In hilly areas of Darjeeling and Shimla, NGOs have come up with attractive business models and a tailor-made menu of products dedicated to their local customers. In Kodaikkanal and Ooty the NGOs have convinced some private hotels, resorts and villas to put up solar-water heaters. Panchayats also show interest for the welfare of local tribes and people.
- In forest areas of Assam and Karnataka and other National Parks and Bio-reserves, the NGOs prevent poaching of animals by putting up solar fencing. The solar fencing is done

to prevent animals straying off into human inhabited places. The fences give small electric current impulses which keep the animals away from the fence. Also the poachers can be easily sighted and arrested in fenced areas.

- Creating awareness among people is demand of off-grid industry for earning wide-spread customer base. NGOs volunteering for Green Energy and Pollution Control opt to utilize various renewable energy technologies to demonstrate how easily available and non polluting renewable sources can contribute to a greener earth.
- Many schools/colleges, libraries and buildings have started approaching NGOs for partnering and availing installations at low cost. Once Schools and Colleges succeed and get approval through subsidy mechanisms of government, it opens a very huge potential for off-grid solar industry.
- NGOs and self help groups get financial assistance with banks easily. NGOs highlight the non-quantifiable benefits of solar products in support of government schemes towards education, electrification, poverty alleviation and agricultural assistance. Under the guidelines provided by the government, the Nationalized banks assess the borrowers and provide loans (mostly soft loans @5% interest). It is responsibility of the loan sanctioning bank to assure loan repayment capability of the borrower and other involved risks (more detailed in section 7.2).
- NGOs get financial support from donations and contributions given by individuals. Many may not be ready to donate in name of promoting renewable energy, but they may contribute for the sake of poverty alleviation, literacy, slums upliftment etc. This encapsulation of renewable energy objectives is done by NGOs.

Solkar Solar Industry Limited with ExNoRa International

Solkar Solar, a manufacturer of solar-powered products and photovoltaic modules, has tied up with the NGO Exnora International to launch the project for Exnora volunteers to sponsor donation of one lakh solar-powered lamps: WonderLite, to the poor in Tamil Nadu. The beneficiaries, to be identified by Exnora, would be those who use oil-powered lanterns. However, following the huge response to the project from potential donors, including the corporate sector, it has been scaled up to provide a million solar-powered lamps countrywide. Companies have evinced interest in participating in the project as a part of their own corporate social responsibility initiative.

The multiple benefits include the poor getting energy efficient and useful product, which would also be environmentally beneficial, as said by Mr Ragunaathan Managing Director, Solkar Solar. Each solar lamp that substitutes a kerosene-powered lantern would help save 45 litres of oil a

year. That translates into a saving of 45 million litres of oil. The solar powered lamp costing Rs 1,500 can light up a 200 sq ft area and work 6-12 hours continuously after a day of sunlight charging. It is user-friendly and safe and will benefit slum dwellers, tribals and the other poor. In addition, the project has a potential to drive growth of energy entrepreneurs in rural areas. Solkar Solar will train local representatives to service and maintain the products.

Aditya Urja Udyog- Helping hand during Tsunami

Just after Tsunami, the supply of electricity could not be restored immediately in the affected area. Aditya Urja Udyog from Bakrol, Gujarat, volunteered for help in lighting solutions in the disaster struck areas. Aditya Urja's primary activity is in manufacturing of solar photovoltaic operated systems. They are experienced for domestic (for house and offices) inverters, PLC based automation systems, and microcontroller based systems since last 12 years.

All their products are solar operated and they store energy in battery during daytime and at night they give light for sufficient required time period. Having range of products which do not require utility electric supply at all-was the best solution at those times. So it proved equally useful for rehabilitated people even after restoration of electricity.

Their SPV (solar photo voltaic) systems are characterized by totally unique and different technology. The important factor of the system is-the control action done by 8-bit microcontroller with inbuilt 10 bit analog to digital converter (for solar home lighting systems, solar street light systems and solar power packs) .By using a microcontroller the system becomes more accurate and efficient with compare to any conventional analog systems.

Benefits of microcontroller

- Battery charging compensation against temperature (for all terrain) by help of software techniques.
- Overload and short circuit protection by software techniques.
- Very compact and very less passive components so self consumption of power is reduced.

Under their special offer for tsunami disaster relief work, they supplied products on a no-profit basis to government bodies, NGOs and relief committee. The products were delivered within 2-4weeks:

8

Frequently Asked Questions

The most common questions and doubts from investors point of view has been answered in this chapter.

Q&A

Specific questions to which answers are provided in chapter are

- Do we need to have accreditation from standards bureau for our clients to qualify for MNRE subsidy?
- How should the subsidy be availed? Are there any bureaucratic bottlenecks in this process?
- Are the targets set by the government of India for the off grid solar industry realistic?
- In which states would it be most beneficial to set up solar projects-investment wise? How do various states fare in creating a suitable business environment to promote off grid solar energy sector?
- How is the willingness of financial institutions to fund off grid solar energy projects and solar products in rural India?
- What are the major attributes based on which off grid projects shall be financed?

- How will the fiscal incentives and subsidies offered by government impact the viability of solar energy based distributed power projects?
- What are the exciting business models and their success factors?
- What are the emerging business models in the off grid solar energy sector?
- In which part of the value chain should one enter?
- What are the new opportunities in manufacturing of equipment?
- What is the level of competitiveness in the market for off-grid solar PV systems and solar products?
- Who are the key players and what is the extent of their market penetration? Is there room for a new competitor?
- What are the key challenges for market penetration?
- Is there scope for growth without government subsidy?
- Is there any domestic content requirement for domestic solar products?
- Does the Indian govt. under JNNSM provide the proposed 30% capital subsidy to commercial/industrial entities in urban areas?
- In case the PV components are imported and they conform to international standards, would the components still need to be tested and certified in India?
- Are system integrators required to get any accreditation?

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