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THE GOLD STANDARD:
Project Design Document for Gold Standard Voluntary Offset projects

(GS-VER-PDD)

For more information, please contact The Gold Standard:

http://www.cdmgoldstandard.org
info@cdmgoldstandard.org

phone +41 61 283 09 16
fax +41 61 271 10 10

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Explanatory information on how to complete the PDD and how to obtain Gold Standard registration can be found in the project developer's manual available on the Gold Standard website.

This template of the PDD is applicable for micro-, small- and large-scale projects. Note that the shaded boxes present information on the Gold Standard VER project development procedures. Project developers should delete these shaded boxes when preparing their PDD.

PROJECT DESIGN DOCUMENT FORM (GSv2-VER-PDD)
Version 01 - in effect as of: 1 August 2008)

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scaleproject activity

A.1 Title of the small-scale project activity:

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Title: Orb Energy Solar Project, India
Version: 08.1
Date: 19/02/2013

A.2. Description of the small-scale project activity:

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Orb Energy ('Orb') has proposed a VER project to increase the penetration of solar PV and solar thermal systems in rural and semi-urban India. This is to be achieved through the establishment of a network of Orb Energy branches which push deeper into rural and semi-urban markets through targeted door-to-door selling, installation, and after-sales service by highly trained sales and technical personnel.

The rural households in India meet their energy needs from grid electricity, kerosene, LPG, diesel and wood which are used as energy sources for lighting and water heating[1]. The same has been established by the baseline survey conducted by Orb.

The energy baseline is the fuel consumption of the technology in use or that would have been used in the absence of the project activity to generate the equivalent quantity of energy needed for electric and thermal applications per household. The baseline technology applicable for PV systems is grid electricity connection, LPG (Gas), kerosene and diesel generators, while solar water heating baseline is the grid electricity, LPG (Gas) and kerosene.

The proposed project through dissemination of solar heater and photovoltaic will utilise the energy from the sun and convert it into electrical and thermal energy to replace the above fuel types currently used in meeting household energy demands.

Thus, the project shall achieve emission reductions through substitution of fossil fuel based electric energy, and also through the substitution kerosene, diesel and LPG that would be directly combusted in the absence of power, either as a result of power blackouts or electricity supply.

By the end of 2008, just 2 years after launching, the company had established 60 branches, and employed more than 300 personnel in the state of Karnataka. Orb already covers more territory and penetrates more deeply into rural and semi-urban markets than any other solar company in India. Orb intends to use VERs to continue its branch expansion. By the end of 2013, the company aims to establish 150 branches in state of Karnataka in India, and employ more than 500 personnel in this state alone.

Today, some of Orb Energy's branches are run by dealers, and the rest are run directly. But, whether run by a dealer or directly-run, a branch is run according to a common set of standard operating procedures set by Orb, and has the same trained staff: an administrator known as an 'operations executive', door-to-door sales personnel who must visit a minimum number of prospective customers weekly and inform them of the benefits of solar as an alternative (and close sales), and door to door technicians who carry out installation, and after-sales service.

[1] See also the Baseline Survey Report

The objective of an Orb Energy branch, no matter where it is located, is the same: to reach deeper into local rural and semi-urban markets, liaise with key banking partners to facilitate customer loans, and ensure that customers receive a high quality product, installed on their premises, with reliable after-sales service.

Orb sells both Sunstream-branded solar thermal hot water systems and Solectric and Solite-branded solar photovoltaic (PV) systems for lighting and other appliances.

Solar PV systems start at 5 watts and scale to whatever size suits the customers demand. The aim is to ensure that the product is closely tailored to customer needs.

PV systems are sold mainly in rural areas where power cuts are severe (in many of Orb's markets, rural power cuts are 8-12 hours on average per day). PV systems are bought by residential and commercial customers not just for lighting, but also for a broad range of electricity needs (fans, TV, refrigerators, etc).

Solar thermal systems are bought by rural and semi-urban customers to save money on heating water. Like solar PV they come in a variety of sizes, tailored to suit the customer's precise hot water needs. The smallest standard solar hot water heater starts at 100 litres (system sizes are measured in litres of hot water delivered per day), and can scale to whatever size the customer requires.[2] Orb sells solar hot water heaters to both residential as well as commercial clients.

To ensure customer satisfaction, Orb gives a total system warranty of 5 years for solar water heaters and solar home lighting systems (SHS) and 3 free preventative maintenance visits in the first year. Preventative maintenance visits in the first year are essential to improve customer understanding of the operation and necessary maintenance of the system. This preventative measure by Orb Energy is required to ensure that systems work properly over time. After one year from the date of installation, Orb then offers customers an annual maintenance contract for regular preventative maintenance and overall up-keep of the system.

All systems are installed by Orb-trained technicians, most of which are recruited from rural areas. Upon joining, technicians receive extensive training at Orb Energy's head office in Bangalore, and regular refresher training on an on-going basis (every 1-2 months). They are trained to the highest standards by Orb's in-house technical team. These technicians ensure optimal installation of the solar system and provide essential after-sales service to the customer in the form or preventative maintenance or complaint handling. Today Orb Energy has approximately 80 technicians in Karnataka on its payroll.

In order to ensure that customer complaints are addressed and preventative service visits are done as scheduled, Orb Energy's marketing and customer care division in head office, in Bangalore track and process service visits centrally. They allocate all required service calls to the Operations Executive (administrator) in each branch, and then follow up to ensure the relevant technician has completed the required visit and service. Senior management in Orb Energy head office receive daily reporting on complaint visits attended and those still outstanding.

In addition to providing the highest quality installed solar systems, and essential after-sales service, Orb also helps customers arrange a loan. Orb has agreements with more than 7 banks in Karnataka that offer customers up to 5 year loans for solar systems. This enables less affluent customers to also enjoy the benefits of solar. As is discussed later in the

[2] Typically, with an ambient temperature of 25^0C, a Sunstream will deliver hot water at 65^0C and above.

document, key to encouraging bank finance for solar in rural areas is coordination between the head of sales for the local Orb Energy branch, and the local branch manager of participating banks. Without this essential local coordination, it is difficult to reach deeper into rural India to sell solar, as the up-front costs of solar are higher than conventional technologies such as kerosene, electric geyzers, or diesel generator sets.

The use of both solar PV and solar thermal systems by rural and urban households leads to a switch from any of the following for energy provision:

- grid electricity,
- LPG,
- Diesel,
- kerosene

The proposed project therefore will realise emission reductions from reduced consumption of grid electricity, LPG, diesel and kerosene. The project not only helps in the reduction of emissions associated with energy consumption, it also has a sustainable contribution to the households and the community as a whole as outlined in the sustainability matrix table.[3]

Sustainable Development

The proposed project helps provide households and small enterprises with a renewable source of energy that is affordable. In addition to affordability, the source of energy provided by the project is reliable, enabling users to plan and execute critical activities in their homes or commercial establishments.

The project also helps in environmental conservation through conservation of vital resources associated with fossil fuel use and biomass utilisation.

A.3. Project participants:

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Orb Energy Pvt. Limited	No
United Kingdom of Great Britain and Northern Ireland	JP Morgan Ventures Energy Corporation	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

>>

Project Site: India
District: N/A
State: Karnatak

A.4.1.1.Host Party(ies):

>>

[3] See sustainability matrix in the Project Passport Document

India

A.4.1.2.Region/State/Province etc.:

>>
Karnataka State

A.4.1.3. City/Town/Community etc:

>>
Karnataka State

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scaleproject activity :

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Orb Energy has been active in the states of Karnataka since the start of 2007.By the end of 2008, Orb Energy had established 60 branches and by 2013 Orb Energy plans to expand and establish 150 branches which will cover the whole state. The proposed branch expansion plan is shown in Table 1 below.

Table 1: Scheduled for Orb Energy Expansion In Karnataka State

Year	2009	2010	2011	2012	2013
No of Branches	60	70	75	100	150

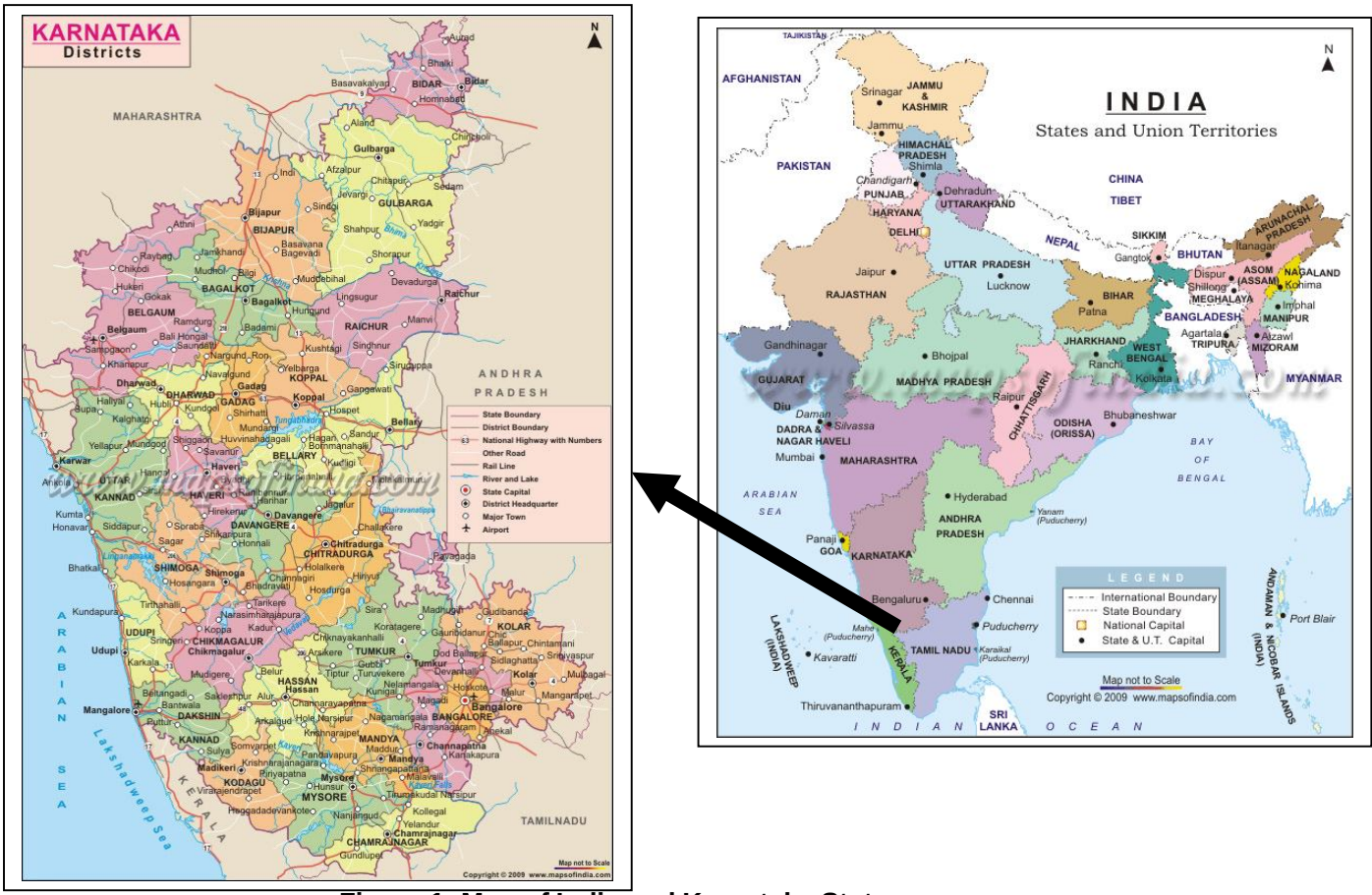

Figure 1: Map of India and Karnataka State

Figure 2: Orb Energy's Branch Presence in Karnataka as of end 2008

A.4.2. Type and category(ies) and technology/measure of the small-scaleproject activity:

>>

The project falls under sectoral scope 1: Energy industries (renewable - / non-renewable sources).

The project falls under Type I: Renewable Energy category and applies the following approved small scale methodologies:

AMS – I.A. Electricity generation by the user, ver 14 and,
AMS – I.C. Thermal energy production with or without electricity, ver 19

The proposed project is to install solar thermal and solar PV systems through Orb Energy branches in Karnataka state in India. The solar systems to be installed come in varying sizes depending on the user needs.

The parameters and detailed description of the solar systems to be installed by the proposed project are listed and discussed below:

Evacuated Glass Tube Thermal Systems

orb Sunstream

System Description	Sunstream 100G	Sunstream 200G	Sunstream 500G	Sunstream 150GP	Sunstream 200GP	Sunstream 250GP
Water output per day (litres)	100	200	500	150	200	250
Shadow free area required (East West x North-South)	1.4 mtrs x 1.6 mtrs	2.2 mtrs x 2.5 mtrs	3.2 mtrs x 4 mtrs	1.8 mtrs x 2.2 mtrs	2.3mtrsx2.5mtrs	2.3mtrsx2.5mtrs
Water temperature	60°C - 65°C *	60°C - 65°C *	60°C - 65°C *	60°C - 65°C *	60°C - 65°C *	60°C - 65°C *
Tube size	47mm outer dia 37mm inner dia	47mm outer dia 37mm inner dia	47mm outer dia 37mm inner dia	58mm outer dia 48mm inner dia	58mm outer dia 48mm inner dia	58mm outer dia 48mm inner dia
Tube length	1500mm	1500mm	1500mm	1800mm	1800mm	2000mm
No. of tubes	16	30	60	18	24	24
Abosrber	Borosilicade glass tube					
Hail impact resistance	< 25mm diameter					
Collector frame	GI Powder Coated			GI with Painting		
Glass beeding & sealing	Silicon rubber ring					
Grommets	EPDM with inside and outside locking collar					
Tilt angle	Fixed					
Hot water tank material	SS - 316 (food grade)	SS - 316 (food grade)	SS316(Food grade)	Porcelain coated	Porcelain coated	Porcelain coated
Thermal insulation	Polyuerethene foam (PUF)					
Insulation thickness	50-60 mm					
Tank cladng	SS430	SS430	SS430	Precoated sheet	Precoated sheet	Precoated sheet
Overnight heat loss	5°C - 7°C					
Tank design	Suitable for withstanding 1 kgf/Cm (Atmospheric)					
Electrical heater (Optional)	1.5kW	1.5kW	4kW	1.5kW	1.5kW	1.5kW
System design for hard water	400 PPM (800 TDS)	400 PPM (800 TDS)	400 PPM (800 TDS)	600 PPM (1200 TDS)	600 PPM (1200 TDS)	600 PPM (1200 TDS)

Evacuated Glass Tube Thermal Systems

System	Sunstream 1000G	Sunstream 5000G	Sunstream 10000G	Sunstream 15000G	Sunstream 20000G
Litres per day	1000	5000	10000	15000	20000
System configaration	1000 / 500 x 2	2500 x 2	2500 x 4	2500 x 6	2500 x 8
Water temperature	60°C - 65°C on normal sunny condition				
Tube size	47mm outer dia, 37mm inner dia, 1500mm length				
Number of tubes	120	600	1200	1800	2400
Tubes made of	Borosilicade glass				
Impact resistance / hail resistant	<25mm dia				
Collector frame	MS with powder coated				
Glass beeding & sealing	Silicone Rubber Ring				
Tilt angle	Fixed				
Hot water tank material	Stainless steel SS-304				
Thermal Insulation	Rockwool -Installation at site				
Insulation thickness	50 mm - 60 mm				
Tank cladng	Aluminum				
Overnight heat loss	5ºC - 7ºC				
Tank design	Suitable for withstanding 1 kg / cm² (atmospheric)				
Electrical heater	4Nos of 2kW immersion type with thermostat	4 nos of 2kW immersion type with thermostat for each tank			
System designed for hard water	400 PPM (800TDS)				
Shadow free area require for Installation(East-We	8Mtrs(East-West) X 5.8mtrs(North-South)	20Mtrs (East-West) X 6.8Mtrs (North-South)			

The Solar thermal units being installed by the project consists of both glass tubes evacuated technologies for eg (Sunstream G for 'glass') and copper flat plate (Sunstream C for 'copper'). However, due to demand and efficiency, more evacuated glass tube systems will be installed compared with copper flat plate[4].

Thermal solar system uses the thermo-siphoning principle whereby water circulates from the hot water storage tank to the glass tubes by gravity. Since hot water is lighter than cold water, the lighter hot water in the glass tubes rises into the hot water storage tank while the

[4] It is estimated that sales of evacuated glass tube solar thermal systems will constitute about 98% of all installations under the project.

cold water flows in to fill the space left by hot water in the glass tubes. The rate of water movement is determined by how bright and strong the sunshine is.

The thermal glass tube or flat plate is placed facing south position for maximum sunlight. Once the system is fully configured, the user can achieve a water temperature of up to 65^0C.

Solar PV Systems

orb Solectric

System	Solectric 120	Solectric 180	Solectric 240	Solectric 330	Solectric 440	Solectric 660
Applications	DC Lights DC Fan	DC Lights DC Fan	DC Lights DC Fan	Lights 21" colour TV Ceiling fan	Lights 21" colour TV Ceiling fan Mixer	Lights 21" colour TV Ceiling fan Mixer
Examples of Use	4 nos of 7w lights for 4 hours per day	2Nos 11W CFL for 3 hours, 3 nos 7W CFL for 3 hours and 1 no 18W Pedestal Fan for 2 hours daily	1 no. 16W TL for 3 hours, 2 Nos 11W CFL for 3 hours, 3 nos 7W CFL for 3 hours and 1 no 18W Pedestal Fan for 3 hours daily	3 nos of 14W lights for 3 hours, 1 no of 21" TV for 2 hours and 1 no of ceiling fan for 1 hour daily	1no. 28W Tube light for 3 hours, 2 nos 14W light for 3 hours, 1no. 21" TV for 1 hour and a mixi for 20 minutes daily	1 no. of 28W tube light for 3 hours, 3 nos of 11w CFL for 3 hours, 1 no of 21" TV for 2 hours, 1 no. ceiling fan for 2 hours and a mixer for 20 minutes daily
Technical Description						
Available energy per day (Whrs)	120	180	240	330	440	660
System Voltage(Volts)	12	12	12	24	24	24
PV Module Capacity(Wp)	40	60	80	120	160	240
Charge Controller(A)	5	10	10	10	10	10
Inverter Capacity (VA)				350	600	600
Maximum Load (Watts)	60	100	100	150	400	400

Solar PV systems sold either come as direct current (DC) units or alternating current (AC) units. For DC units, the solar unit come with the photovoltaic module, battery and charge controller while the AC units, come with a solar photovoltaic module, console battery and inverter. All these units come in different sizes based on user needs.

Although the systems sold include those for commercial, the carbon calculation for the project has been limited to domestic applications only.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

>>

Years	Annual estimation of emission reductions in tonnes of CO2 e
2010	6,032.8
2011	8,585.1
2012	11,386.3
2013	14,526.0
2014	14,526.0
2015	14,526.0
2016	14,526.0
Total emission reductions (tonnes of CO2e)	84,108.2
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	12,015

A.4.4. Public funding of the small-scaleproject activity:

>>

There is no public funding of the proposed project as explained in the annexed *Gold Standard Passport.*

A.4.5. Confirmation that the small-scale project activity is not a de-bundled component of a large scale project activity:

The proposed project is not a de-bundled component of a large-scale project because it meets the de-bundling rules set out by the EB 47, Annex 32 (version 02) as follows:

There is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and
(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

Since, all the above mentioned conditions are being met, it can be concluded that the proposed project is not a de-bundled component of a large scale project.

There is no similar registered small-scale CDM or VER project activity or an application to register another small-scale CDM or VER project activity applying a similar technology in the same state with the same project participants or in the same project category and technology/measure.

Since Orb Energy is not and has not been implementing a CDM or VER project within the state of Karnataka, the project is therefore not a de-bundled large-scale project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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- AMS-I.A. “Electricity generation by the user”; version 14 is applied to solar PV systems (See the justification below in Section B.2).
- AMS-I.C. “Thermal energy production with or without electricity”; version 19 is applied to solar thermal systems (See the justification below in Section B.2)

B.2 Justification of the choice of the project category:

>>

Both solar PV and thermal systems are based on renewable energy technologies that supply users with electrical and thermal energy.

The project activity involves the use of renewable energy (solar radiation) to supply electricity (solar PV systems) and thermal energy (solar water heating systems) to the user. Both systems will displace associated emissions of the baseline fossil fuel for the grid system, kerosene, LPG and diesel, as applicable. The thermal systems will replace electrical geysers which use grid electricity for water heating, LPG, wood and kerosene, where applicable.

The approved small scale methodology AMS-I.A. (Electricity generation by the user) is applicable to the solar PV because the solar PV systems supply individual households or users or groups of households or users with electricity. Although some of the households and users have a grid connection, the project qualifies for this approved methodology because the emissions reduction per renewable energy based lighting system is less than 5 tCO_2e a year (see section B.6.3 below), and it has been shown, through a baseline survey, that fossil fuel would have been used in the absence of the project activity. The result of the survey, which was based on a representative sample survey (90% confidence interval, ±10% error margin) of target households, is available as separate report.

Further, the project activity does not involve any hydro, combined heat and power component; neither it is a retrofit/replacement nor capacity addition.

The methodology AMS-I.C (Thermal energy production with or without electricity) is applicable for the solar thermal systems because the solar thermal systems supply individual households or users with thermal energy that displaces fossil fuels either directly or indirectly through the grid. The total thermal generation capacity of the installed systems, as specified by the project proponent, is less than 45 MW_{th}. Other conditions given in AMS I.C. are not applicable to the project activity being a solar energy based project.

B.3. Description of the project boundary:

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The boundary of the proposed project will be delineated by physical and geographical location where the solar PV and solar thermal systems will be distributed and installed within the state of Karnataka in India.

The boundary further is delineated by the actual users, such as the residential and commercial customers (e.g. households, shops, factories, etc) who have bought the solar units from Orb Energy branches. All customers are entered into Orb Energy's centralised data-base, which not only shows the number of systems sold, and to whom, but tracks the essential services that have been provided, and need to be provided. The database shows exactly where systems have been installed – e.g. the full address including household, village and district.

B.4. Description of baseline and its development:

>>

Since households using solar systems purchased from Orb Energy use different energy sources in meeting their energy needs, a survey was conducted to establish the baseline for this project within the project boundary. The survey established that grid electricity, kerosene, LPG, diesel and wood are used as energy sources for lighting and water heating[5].

The aggregated baseline household energy use showed that PV system users, on average, replace 0.153 Kg of kerosene, 0.617 Kg of diesel or 0.2Kg of Gas (LPG) on a daily basis to meet the lighting energy demands. The thermal users averagely replace 4.17 Kg of Wood, 0.28 Kg of LPG or 0.15 Kg of kerosene. Also, some solar PV and thermal users use grid electricity in meeting their lighting and heating needs[6].

The above values have been used conservatively in the current baseline. Although the baseline is expected to continue evolving, the project will apply the existing baseline ex-ante when calculating the actual Emission Reductions from the project and during verification.

[5] See also the Baseline Survey Report

[6] Detailed computation of these data is attached in the spread sheet annexed separately to the PDD

The proposed project will utilise the energy from the sun and convert it into electrical and thermal energy to replace the above fuel types in meeting household energy demands. Emission reductions will be achieved through substitution of fossil fuel based electric energy, and also through the substitution kerosene, diesel and LPG that would be directly combusted in the absence of power, either as a result of power blackouts or electricity supply. Without the proposed VER project activity, the solar system users would continue to use grid power, LPG, kerosene lanterns, and diesel generators for provision of required household energy (see Annex 2 and Baseline Survey Report).

Even though the Indian energy sector is increasingly becoming fossil fuel intensive, there are no national or sectoral regulations mandating actors in the energy sector to generate electricity through use of renewable energy technologies. From April 2011, the Indian Ministry of New and Renewable Energy (MNRE) provides limited capital subsidies for solar PV technology and solar thermal for water heating through Orb Energy as a registered channel partner. Until April 2011, MNRE used to make low interest loans available for solar thermal, and these were availed by some[7] of Orb Energy's solar thermal customers.

The energy baseline is the fuel consumption of the technology in use or that would have been used in the absence of the project activity to generate the equivalent quantity of energy needed for electric and thermal applications per household. The baseline technology applicable for PV systems is grid electricity connection, LPG (Gas), kerosene and diesel generators, while solar water heating baseline is the grid electricity, LPG (Gas) and kerosene. See detailed baseline information in Annex 2.

The baseline emissions for both solar PV and thermal systems for the project are calculated as the total energy baseline displaced for each fuel type times the applicable emission coefficient for the baseline fuel applicable. For wood, it was established that not all biomass used is renewable. However, for conservativeness, it has been assumed that all the wood is renewable.

The relevant fuel emission coefficients applied are as follows:

1. Kerosene = 71900 Kg CO_2 / TJ
2. LPG = 63100 Kg CO_2 / TJ
3. Diesel = 74100 Kg CO_2 / TJ
4. The Indian grid emission factor[8] = 0.852 tCO_2 / MWh

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scaleCDM project activity:

This section demonstrates the proposed VER project is additional and not the baseline scenario. This is demonstrated by using the "Tool for the demonstration and assessment of additionality"; version 05.2, which is the latest version of the Tool.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activities are defined through the following sub-steps:

[7] Not all customers use this facility.
[8] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Sub-step 1a: Define alternatives to the project activity:

In the absence of the proposed project, reasonable and credible alternatives that are in accordance with current laws and regulations and are available to the project participants or similar project developers that provide outputs or services comparable with the proposed VER project activity are as follows:

i. Thermal Systems
   a) The proposed project activity undertaken without being registered as a VER project activity
   b) Continuation of the current situation where grid electricity kerosene, LPG and fuel wood are used to heat water.

Alternative (a) is not credible because it would face the barriers discussed under step 3 below.

Alternative (b) is more likely since it is the status quo and does not face the barriers faced by the Project. However, this alternative will lead to higher emissions than the proposed Project.

ii. PV Systems
   a) The proposed project activity undertaken without being registered as a VER project activity
   b) Continuation of the current situation where kerosene, LPG and small diesel generator sets are used to provide electricity services instead of solar PV and thermal;
   c) The electricity services that would have been provided by the Solar PV System are supplied by grid electricity.

Alternative (a) is not credible because it would face the barriers discussed under step 3 below.

Alternative (b) is credible since it is the status quo and does not face the barriers faced by the project as described below. However, this alternative will lead to higher emissions than the proposed project.

Alternative (c) is credible for the following reasons:

- 60% of the solar PV systems are replacing grid electricity which is unreliable and emitting higher levels of green-house gases (See the Baseline Study Report).
- According to the Rural Electrification Policy defined by the Central Bank of India,[9] India plans to electrify all un-electrified villages/un-electrified hamlets and providing access to electricity to all households by 2011 for fulfilment of the National Common Minimum Programme (NCMP). Applying the suppressed demand model, the 30% replacements of kerosene lamps already noted in the study could have switched to electricity by end 2011. Under the policy, there are also provisions for financing rural electrification (Chapter 7 of the Rural Electrification Policy)[9].

Sub-step 1b: Consistency with mandatory laws and regulations:

[9] http://www.powermin.nic.in/whats_new/pdf/RE%20Policy.pdf accessed 21/06/2010 and http://www.indiaelectricity.com/power_policy/RE20Policy.pdf.

The identified alternatives are all consistent with mandatory and regulatory requirements in India, taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

For thermal systems, the only realistic and credible alternative that is also consistent with mandatory and regulatory requirements in India is the continuation of the current situation.

For solar PV systems, the realistic and credible alternatives that are consistent with mandatory and regulatory requirements are continuation of the current situation and provision of electricity services from grid electricity.

Step 2. Investment Analysis

This step has not been applied.

Step 3. Barrier Analysis

This step is used to determine whether the proposed project activity faces barriers that:

a. Prevent the implementation of this type of proposed project activity
b. Do not prevent the implementation of at least one of the alternatives

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed VER project activity:

The project faces the following realistic and credible barriers that would prevent the implementation of the proposed project activity without the registration of the proposed project as a VER activity:

(a) Investment barriers
(b) Technological barriers
(c) Barriers due to prevailing practice

a) Investment barriers

Although solar PV and thermal units are being sold in India, the penetration and use of solar energy is low.[10] To improve the penetration it is necessary to reach into semi-urban and rural areas, where the vast majority of India's population lives and where solar solutions are particularly suited due to the unreliable characteristics of India's electricity grid.

To elicit the rural and semi-urban market in India it is necessary to do three things:

- Introduce solar solutions, and convince customers that it is the best alternative for their energy needs (this requires demonstrations and door-to-door sales people for customer acquisition);
- Ensure that it is installed to a high quality, and that customers have reliable after-sales service so that they refer new clients to buy, and solar thereby starts to diffuse (this requires well trained door-to-door technicians);

[10] http://www.ireda.in/pdf/July-September_2007.pdf. For example, according to a report, Status of Solar Thermal Technologies and Markets in India and Europe, Chapter 1 (http://www.teriin.org/opet/reports/solarthermal.pdf), published jointly by Tata Energy Research Institute and CRES - Centre for Renewable Energy sources, the market penetration of solar water heaters in India is still small when compared with some of the European countries in terms of collector area installed per unit population. The installations per 1000 inhabitants are 5.1, 15.2 and 0.52 in Greece, Germany and India respectively.

- Ensure that banks, particularly rural branches of banks, gain confidence in the technology and start to lend for it (this requires local coordination between the vendors of solar, and the manager of the local bank branch).

Below is a detailed explanation of why increased penetration of solar in rural and semi-urban areas requires the three barriers above to be addressed. These points have been well documented in studies considering solar diffusion in emerging markets more broadly, as well as in India in particular.[11]

Barrier No a.1:Low Solar Awareness, and Need to Build Trust and Acquire Customers

The awareness of solar as a solution in rural India is low[12]. Especially if we compare this to the awareness of the conventional alternatives: kerosene lanterns, diesel generator sets, electric geyzers for hot water, etc. Many customers, particularly in rural areas, will not know that solar PV exists as an option to help relieve regular black-outs and reduce their recurring energy expenditures, and many rural and sub-urban homes will not know that solar thermal is an ideal way to reduce their electricity bill.

When it comes to solar thermal, the alternative in rural areas is wood. Everyone obviously knows that wood can be burned to heat water. Similarly people are aware of LPG, and electric geyzer options. When it comes to solar PV, alternatives such as kerosene lanterns have been established in rural India for over one century as a source of lighting. There is little awareness creation that needs to be done for vendors of kerosene lanterns, or kerosene fuel. People know this alternative for when the grid goes down, and know where to go to buy it. A variety of kerosene lanterns is what they already know, and what they use, in the absence of reliable grid electricity. Equally diesel generators are common in larger villages and small towns, and awareness of this alternative is high.

In contrast World Bank studies on solar PV in India for instance have recognised that awareness is low, and that there isn't any pre-existing sale and distribution infrastructure reaching into rural India to convince customers to buy: 'because the industry is still new, marketing networks and support systems for PV are lacking. There is a need to stimulate demand by promoting their availability…'[13]

The remote, dispersed nature of this customer base, and the need to reach out to them to make them aware of solar and to convince them to buy, presents a barrier to solar diffusion. And yet the only way to accelerate the diffusion of solar is to do exactly this: to make millions of customers aware of solar solutions, to build trust in the innovation, and to convince them to buy – one household and one business at a time. Carbon funds can be used to fund the required door-to-do awareness creation and marketing and help alleviate this barrier of lack-of-awareness

To make millions of customers aware of solar solutions, build trust in the innovation, and to convince them to buy – one household and one business at a time – vendors in India directly selling solar in rural India have relied on door-to-door sales people, product demonstrations in

11 These barriers to solar diffusion in India are well documented, and generally accepted. See for example http://www.pnl.gov/aisu/pubs/eemw/papers/Renewable%20Energy%20Technologies.pdf p. 8. To quote from this study, 'The Commercialisation of SPV technology involves high transaction costs such as expensive and time consuming project identification; challenging project implementation in a number of small-scale installations; high costs of credit collection and risks associated with marketing, contracting, and information collection; conducting promotion campaigns and creating after-sales service infrastructure…'

12 http://www.teriin.org/opet/discussions/solarthermal.htm and http://mnre.gov.in/pdf/greentech-SWH-MarketAssessment-report.pdf

13 See page 1 and 2 of the World Bank (1993) India: Pre-Investment Study of the PV Market Development Project (Vols I and II) Washington DC, January.

the villages, and word-of mouth for customer acquisition.[14] This has also been the accepted way of penetrating the rural markets in a variety of developing countries.[15]

This is exactly the strategy that Orb Energy takes to drive the penetration of solar into rural and semi-urban markets. Orb Energy's network of local branches have door-to-door sales teams that reach deep into rural areas of India. These personnel are critical to raising customer awareness and developing customer confidence to invest in solar technology. In addition, Orb Energy uses more than 350 commission agents in Karnataka, appointed to its branches, to help raise customer awareness in solar and generate leads. The sales persons and branch managers are then responsible for following up on these leads and customer acquisition.[16] Carbon funds would not only be used to support the establishment of more branches, but also to train the sales staff and commission agents involved in helping to overcome the barriers of low awareness and lack of trust.

Barrier No. a.2 –Solar Complexity and Need for Quality Installation and After-Sales Service

High quality installation and after-sales service is key to solar diffusion.[17]This is more so for solar than for a kerosene lantern for example. A kerosene lantern is a basic technology requiring little maintenance for lighting. In contrast a solar PV system for lighting uses a deep-cycle flooded battery that needs topping up of distilled water. Also the electronics in the charge controller, inverter, or the loads itself (such as lights) can be prone to break-down and require fixing.

This need for maintenance and service is particularly acute in rural areas, where customers are more remote, and where it may be harder for them to find the required technical expertise to organise after-sales service themselves. Without good installation, preventative maintenance, and a mechanism for complaint handling, solar will fail in the field. And when solar fails in the field, it gets a bad name and diffusion and penetration of the technology is less than it might have otherwise been: 'in the absence of a support infrastructure, many solar electric systems have failed, and these failures have led people to say that solar technology is not viable. However, solar system failure is almost always due to the lack of proper design, installation, management or maintenance, and not solar power systems.'[18]

Of course, the opposite is also true. Where customers are satisfied with the system, they are more likely to recommend it to others. Word-of-mouth acts as a strong catalyst for accelerating solar sales, and diffusion of the technology. As was recognised in a four-country case study relating to solar PV, villagers spend much time visiting each other. As with all new technologies, the first home that installs a system gets scrutinized by the rest of the village. If the first system is successful, other community members soon follow suit and buy systems.[19]

[14] For case studies in India see Miller, D (2009) *Selling Solar; The Diffusion of Renewable Energy in Emerging Market*, Earthscan, London. Just one vendor – Selco – through this approach has actually achieved 100,000 system installations – 1/3 of the total government programmes across the entire country!

[15] See for example Hankins, M. (1993) *Solar Rural Electrification in the Developing World. Four Country Case Studies: Dominican Republic, Kenya, Sri Lanka, and Zimbabwe*, Solar Electric Light Fund, Washington DC.

[16] The role of door to door sales people in kick-starting the diffusion of an innovation is widely recognised in the more theoretical literature on Innovation Diffusion. They are called 'Change Agents' because of the critical role they play in introducing customers to an innovation, and convincing them of the merits of investing in it. Change agents' role in the diffusion process is unambiguous according to the leading thinkers in this field: 'most change is not a haphazard phenomenon, but the results of the planned and premeditated actions by change agents'. See Rogers and Shoemaker (1971) *Communication of Innovation; A Cross Cultural Approach*, Free Press, New York, p227.

[17] This is an obvious statement, but it is absolutely critical. See for example Cabraal A, et al (1996) 'Best practices for photovoltaic household electrification programs', World Bank technical paper Number 324, World Bank, Washington DC.

[18] Hankins, M Solar Rural Electrification in the Developing World. Four Country Case Studies: Dominican Republic, Kenya, Sri Lanka, and Zimbabwe, Solar Electric Light Fund, Washington DC, p119.

[19] Hankins, M Solar Rural Electrification in the Developing World. Four Country Case Studies: Dominican Republic, Kenya, Sri Lanka, and Zimbabwe, Solar Electric Light Fund, Washington DC, p96.

This has been confirmed by solar vendors in other solar markets. For example, a large corporation in Mexico that entered the solar market, concluded as follows: 'We found that the demonstration effect was absolutely vital to sales….Many do not believe it will work at first, but seeing the lights at night for one month has a positive impact on perceptions'. Similarly a vendor in the Dominican Republic concluded that 'Anyone will be distrustful of someone selling a $500-$800 system. Instead trust is developed when they can see their neighbour's system working and neighbours getting enthusiastic about it'.[20]

Because of the relative complexity of the system, and because of the relatively high initial investment that a customer must make in solar, compared to the alternatives (e.g. kerosene lanterns), Orb offers a full one year warranty on the entire system. In addition, as part of the price, Orb offers three free preventative maintenance visits in the first year. Whether a system is known to be functioning or not, the customer will receive three free 'preventative maintenance' visits from an Orb technician in the first year to check the system, answer questions, and further educate the customer on its use. This is critical to smooth functioning of solar systems, and customer satisfaction. Following the first year, Orb will offer customers an annual maintenance contract (AMC) to ensure they can continue to receive preventative maintenance visits should they wish to do so.

Orb Energy invests considerably in recruiting, employing and training a network of more than 80 technicians in Karnataka. These technicians are stationed in the local areas from where they come, and appointed to one of Orb Energy's branches. Technicians need to be 'local', as then they are close to the market and know the market. Only this way can they meet the requirements of daily installations, preventative maintenance visits, and after-sales visits. They need to be 'trained' because installation of a solar system and customer education following installation is a unique skill-set that will not be known without training (both induction, and on-going refresher training). Finally they need to be stationed at a branch, as their activities – in terms of installation, preventative maintenance, and complaint handling – needs to be coordinated on a daily basis. Carbon funds will be used to finance both the required expansion of the branch network and training of these key technical staff.

Furthermore, Orb has a systematic way of handling complaints. All complaints are first booked at the branch with the Operations Executive – the in-branch administrator. These complaints are daily reported back to Orb Energy's centralised customer care department and logged in the database. Responsiveness against complaints is then tracked centrally, and reported daily to senior management. In this way, Orb strives to ensure that customer complaints are attended to within 48 hours, and fixed not later than 1 week from the time of reporting. The overall aim is that customers should be happy and recommend solar (and Orb in particular) to their neighbours, friends, and colleagues. Only with this approach will solar start to diffuse, and displace the conventional fossil-fuel based alternatives.

Barrier Number a.3 – High Investment Cost and Need to Arrange Finance

The relatively high investment costs of a solar system are recognized as one of the key barriers to its diffusion.[21]Consider the case of solar PV and solar thermal systems in comparison with conventional alternatives.

When it comes to lighting a home or business during power cuts, the most readily available solution in rural India are kerosene lanterns. A kerosene lantern is a low cost item of between

[20] See Miller, D. Selling Solar: The Diffusion of Renewable Energy in Emerging Markets. Earthscan, London, p54-55.
[21] See page 1 and 2 of the World Bank (1993) India: Pre-Investment Study of the PV Market Development Project (Vols I and II) Washington DC, January.

Rs 400 – 700, with a monthly kerosene consumption of 10 litres (Rs 250) per month[22]. In contrast a 40 watt, 4 light solar PV system will cost roughly Rs 25,000 up-front, and have no running costs, except for change of the batteries every 5-6 years.

When a customer buys a solar PV system they are investing in 20 years of power on day one. Or put another way, 75% of the life-time costs of solar (20+ years) are paid by the customer at the time of purchase (up-front). This represents a considerable barrier to solar, compared to conventional alternatives which have lower up-front costs.

Thus it is not surprising that early studies recognised finance as the key to solar penetrating markets.[23] As one such study confirmed: "Institutional arrangements have helped to introduce new technologies (even those that are perceived as expensive as solar photovoltaic power) into rural settings.

This generalised finding was born out in practice in South India, under a successful UNEP programme earlier this decade. Under this programme it was shown that by catalysing two big banks – Syndicate Bank and Canara Bank – and their rural subsidiary banks to increase their lending for solar, rates of solar diffusion increased dramatically in Karnataka and Kerala.[24] Under this programme, these banks introduced lower interest loans for solar PV (5%) that gradually, over 4 years, returned to normal market rates (then 9-10%). With the additional institutional push this programme gave to bank lending, and the additional incentive to customers, the programme delivered 18,000 solar home systems in just 4 years. For the active solar vendors it led to a doubling of sales in just the first year of the programme.[25]

Finance is also important for solar thermal. Here the comparison is more likely to be with an electric geyzer – the typical system a household would use to heat water. A typical electric geyzer costs Rs 6,500. In contrast, an average 150 litre solar energy-based system for a house of 5 in India will cost Rs 25,000. So again, financing is crucial to sales, and even more so in rural and semi-urban areas, where incomes are typically less than in the cities.

Today many nationalised banks are active in the state of Karnataka and are lending for solar. Orb already works with 7 banks in Karnataka, most of which are nationalised banks and their rural subsidiary banks (these include Syndicate Bank, Vijaya Bank, Karnataka Bank, and Canara Bank to name the larger nationalised banks involved). But more than this, even where a bank has established a programme for lending for solar, finance will not adequately flow without local coordination with the manager of the local bank branch. Orb Energy branches and networks will create and facilitate the required coordination.

Key to active participation of the banks in lending for solar ***is getting the local branch manager of the bank on board.*** Where the bank branch manager becomes supportive, lending for solar dramatically improves, and as does the level of solar installations. The solar vendors (and specifically their local managers) play a key role in working with the bank branch managers to educate them about solar, and then to help them process the documents and assess the credit risk of the customers they bring.[26] This is critical, as once convinced,

[22] Based on average lantern usage of 4 hours per day
[23] See for example Cabraal, A. et al, Best Practices for Photovoltaic Household Electrification Programs. World Bank, Washington, D.C.
[24] See UNEP (2007). India Solar Loan Programme: Programme Overview and Performance Report, UNEP RISO Centre, Denmark.
[25] For a discussion on the impact of this programme on solar sales in Karnataka see Miller, D (2009). Selling Solar: The Diffusion of Renewable Energy in Emerging Markets, Earthscan, London.
[26] See UNEP (2007). India Solar Loan Programme: Programme Overview and Performance Report, UNEP RISO Centre, Denmark, p9.

the bank branch managers typically serve as opinion leaders in the areas where they work, and as such their influence goes beyond just the loans they are offering.[27]

This coordination with the bank branch managers is a central function of the head of sales at a local Orb Energy branch. The head of sales works with the local bank branch manager's in several ways: 1) in undertaking coordinated demos in high potential villages where the bank already lends or has an aspiration to lend; 2) in helping customers complete the paperwork in a timely and accurate fashion and providing the relevant documents; 3) in helping collect the down payment; 4) following up with timely after-sales service to ensure the client pays their instalments on time; 5) even helping to collect from defaulting customers.

So only by developing a strong branch network, with capable personnel on site, can Orb Energy ensure that more bank branch managers actually start to lend for solar. And only with this increased flow of finance for solar at the local bank branch level will medium to low income households also be able to afford solar equipment and enjoy its benefits.[28]

The Need for a Branch Infrastructure

To summarise, there are three significant barriers that solar technology faces, that is not faced by the conventional alternatives that emit more greenhouse gases – (a) lack of awareness and need to build trust and acquire customers; (b) relative complexity of solar and need for trained technicians to handle installations, and after-sales service; (c) the higher up-front costs of solar relative to the conventional alternatives, and the need to bring in local finance.

Orb's investment in a branch infrastructure and trained sales personnel, technicians and branch managers, helps it overcome the above barriers to increased solar diffusion in India. Through this investment and its operation since the start of 2007, Orb has already installed more than 10,000 systems in just over 2.5 years. Next year (calendar year 2010) it expects to nearly double this installed base. But investing in a branch infrastructure and training and employing more than 300 personnel in Karnataka alone is costly. In addition to the capital and operating cost of the network itself, there is the cost of financing the inventory (as customers need to see product on hand) and the receivables pending (as customers are reluctant to pay in advance).[29]

From the date of its inception, Orb Energy has envisaged that it would need funds from the sale of VERs to finance the rapid expansion of its branch network and employ an extensive field-staff presence. Without the expectation of these funds, Orb Energy would not have expanded as aggressively as it has done – establishing 60 branches in Karnataka by the end of 2008. Moreover, Orb Energy will not be in a position to expand to reach 150 branches in Karnataka by 2013 without additional funds from VERs. In this sense, the expansion of Orb Energy's branch network has been, and will be, predicated on successful creation and sale of VERs in the market for financing its proposed branch expansion plan.

We can point to other similar business models active, or formerly active, in South India to demonstrate why VER support is critical to help overcome the investment barriers inherent in trying to accelerate the penetration of solar in rural and semi-urban India (see 'case examples

[27] See again UNEP (2007) India Solar Loan Programme: Programme Overview and Performance Report, UNEP RISO Centre, Denmark. For an example of how a branch manager in Syndicate Bank went on to become a key champion of solar throughout the bank and throughout the finance sector in India, see Williams, N. Chasing the Sun: Solar Adventures Around the World, New Society Publishers, Gabriola Island.
[28] http://www.un.org/esa/sustdev/publications/energy_casestudies/section4.pdf
[29] http://www.ptm.org.my/biogen/index.aspx?id=41 Page 39

on prevailing practice' in the subsequent sections).[30]First, we can consider the example of Shell Solar, which entered the India solar market in 1999, and ultimately exited in 2007, after establishing roughly 30 branches, and selling 40,000 systems in 7 years. Shell Solar received initial donor support, but did not receive ongoing support from VERs, and cited lack of sufficient profits in 2007 as the reason for exiting. Second, we can consider the contrasting example of Selco, which, early-on, was able to attract donor support, followed by ongoing support from the sale of VERs. More recently Selco also received an injection of 'charitable capital' to help sustain its business. Over the last 15 years Selco has been able to realise more than 100,000 solar systems installed.

An independent study confirming the higher effectiveness and reach of Orb Energy's branch model vs. the dealership model of competitors is discussed in more detail the common practice analysis section.

Conclusion

Conventional technologies and alternatives to solar energy used by rural and semi-urban customers do not face the same investment barriers as solar energy. Kerosene lanterns, diesel generator sets, wood and electric geyzers for water heating are all standard technologies, or applications, well known and easily available to customers. By contrast for solar to compete, 3 barriers need to be addressed: (a) awareness creation and customer acquisition where populations are remote and dispersed, (b) the need for high quality installation and after-sales service across large territories (c) local coordination for access to solar finance. The rapid roll-out of Orb Energy's branch infrastructure is key to quickly addressing these barriers and accelerating solar diffusion in rural and semi-urban parts of Karnataka. And the creation and sale of VERs are critical to supporting such an expansion.

b) Technological barriers

For effective diffusion and utilization of solar systems in a country, there needs to be wide-spread technological knowledge on system design, installation, and maintenance. In India, relatively little knowledge and skills pertaining to solar systems and after-sales service presently exists.[31]For this reason, where solar systems are poorly designed or after-sales service is not provided, there have historically been high rates of failure in India. For example, India's Controller and Auditor General reported (after an extensive field survey) that "most of the PV systems were not working due to lack of proper maintenance, poor performance of the systems, and apathy of the users…" Specifically the report found a failure rate of 33% to 100% for street lighting, and 25% to 94% for solar home systems.[32]

A solar PV system is not easy to design and install without specific training and technological knowledge pertaining to the system – e.g. how to angle the solar panel, how to do the wiring, which loads can be connected, how to measure and top-up the battery, etc.[33] [34] Equally, for the system to continue to work properly, a customer must receive user education. In the case

[30] Incidentally we can also point to an example from a neighbouring country - Bangladesh - of where carbon credits have been generated and sold by an aggregating body – IDCOL – on behalf of the country's vendors of solar systems in rural areas. In recognition of the challenges of selling, installing, servicing, and financing solar in rural areas of Bangladesh, IDCOL, a quasi-government body offers a grant per system installed to the vendors to support their infrastructure (e.g. branches and staff). To help fund this grant, it has been successful in qualifying the overall solar project for carbon credits. The IDCOL project had 200,000 solar installations (over 10 years) by 2008. This is expected to result in 85,000 tCO2e reduced per annum. See www.IDCOL.org (download 'IDCOL's Solar Energy Program).

[31] See Chapter 1, http://www.teriin.org/opet/reports/solarthermal.pdf

[3232]See TERI (1995) *PV Solar Systems Survey* as referred to in Miller, D (2009), Selling Solar; The Diffusion of Renewable Energy in Emerging Markets, p75-76 (See scan 12 in attached file "Scan for Footnotes referenced in the PDD.pdf").

[3333] Hankins, M (1993) Solar Rural Electrification in the Developing World. Four Country Case Studies: Dominican Republic, Kenya, Sri Lanka, and Zimbabwe, Solar Electric Light Fund, Washington DC, 1993, p81 (See scan 13 in attached file "Scan for Footnotes referenced in the PDD.pdf)

[34] See Miller, D (2009) Selling Solar: The Diffusion of Renewable Energy in Emerging Markets, Earthscan, London, p65.

of solar PV, customers need to know how much power (e.g. how many hours of lights/radio etc.) they can use per day so as not to over-use the system. But equally this applies to solar thermal: with the right information and usage patterns, households can optimize the use of their solar equipment and ensure that they have the right amount of hot water when they need it.

As discussed earlier (under 'Investment Barriers'), customers cannot be expected to maintain the system themselves. They need a technician to assist them on an on-going basis: "while the simple design and dependability of the solar home system allows a single technician to service a large number of customers, the need for local technical support remains. Users can perform simple maintenance functions. However, field experience shows that very few households can service their systems themselves over long periods of time."[35]

There is a very high correlation between solar project success and high quality installation and after-sales service. For example, World Bank experience in the South Pacific found that the success of solar programmes was highly correlated with training and equipping of technicians, and ensuring they had sufficient access to spare parts.[36]Similarly, the IFC's Photovoltaic Market Transformation Initiative was most successful in India (compared to Morocco and Kenya). The IFCs own study confirms that where projects failed, it was often due to low quality installation and service. By contrast successful projects addressed this critical barrier.[37]

Solar thermal for water heating also needs more regular maintenance than an electric geyzer. This is particularly the case where customers have 'hard water' – e.g. using bore-well water with higher mineral content - as is the case for most rural customers as they are not connected to municipal water mains. In such situations, the evacuated glass tubes should be cleared on a 6-monthly basis, and in case of a flat plate, copper-tubed system, the tubes will need to be cleaned with an acid wash on a more frequent basis still. Without this the collectors will seize-up, and the system will stop working. No such issues are encountered during use of electric geyzer or heating water using wood.

As established earlier (under 'Investment Barriers') where systems continue to function, solar is able to compete against the alternatives, and starts to penetrate the market. But where it fails in the field, solar develops a 'bad name', and its diffusion will remain limited. For this reason Orb must invest heavily in recruiting, training, and equipping its technicians, and in establishing monitoring and tracking mechanisms to ensure that after-sales service is effectively implemented and that solar can effectively diffuse.

Orb has already developed a network of more than 80 trained technicians in Karnataka. The vast majority of these technicians come from the same rural areas that they are then responsible for servicing. Orb invests in training each technician with 2-day induction training, according to a standard set of technical training modules. They then receive regular refresher training on an ongoing basis. All technicians are equipped with a tool bag that carries the tools they need for installation and service. Orb provides largely standard systems so that technicians are familiar with their installation. Moreover, all systems come with a standard user manual, and technicians are trained and instructed to take a customer through this user manual, following installation, as a way of guiding the customer education process. Finally,

[35] Cabraal, A et al (1996) 'Best practices for photovoltaic household electrification programs', World Bank Technical Paper Number 324, World Bank, Washington DC,p66.
[36] See Liebenthal, A et al (1994) 'Solar Energy : Lessons from the Pacific Island Experience', World Bank Technical Paper Number 224, World Bank, Washington DC. And see Hill R (1994) 'The successful implementation of photovoltaics in Developing Countries' presented at the 12th European Photovoltaic Solar Energy Conference, Amsterdam, April (See scan 14)..
[37] http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_SellingSolar_PartTwo_CaseStudies2/$FILE/PartTwo_CaseStudies2.pdf p4 (See scan 16).

Orb offers 3 free preventative maintenance visits in the first year, and thereafter, offers its customers an annual maintenance contract for regular preventative maintenance. Orb even agrees to sign up other company's solar customers, where they are not receiving adequate service, and want regular and reliable after-sales service from Orb.

Orb has also put in place a variety of 'systems' to monitor the quality of products, installation, and after-sales service. Orb has implemented an in-coming product quality system to ensure that only functioning components and systems are delivered to the field. To monitor the quality of installation, Orb's more senior technicians are mandated to carry out random spot-checking of installations, to determine their quality, and report this back to head office. For after-sales service, Orb's customer care division (under the market department) allocates preventative maintenance visits, and follows up until each pending service visit and complaint is closed. There is daily reporting on pending complaints to most senior management. And finally, the market department rolls-out a quarterly customer satisfaction survey to ensure that customers are overall happy with the system and level of service they receive.

All of these efforts – training and equipping of technicians, and setting up adequate monitoring systems – represent an additional cost for Orb, and for solar energy. Conventional technologies – such as kerosene lanterns, diesel generator sets, and geyzers - are largely established in the market and customers can easily turn to local electricians or technicians for quality installation, and after-sales service. But as discussed at the outset, this level of technical knowledge pertaining to solar is still not prevalent in India, and must be provided in this case by Orb. This represents an additional barrier to solar diffusion in India. Carbon finance will be used to develop the required skills to ensure the provision of the necessary installation and maintenance services.

c) Barriers due to prevailing practice

The Orb Energy solar project is unique in India. Orb is already India's largest solar sales and service company in terms of branches country-wide (125) and personnel (400). Under this project, it further envisages an expansion from 60 branches in Karnataka to 150 branches by 2013. The only other company with a similar direct solar sales and service model to Orb is Selco, which has just 25 branches and 140 personnel. So in this sense, ***the scale*** at which Orb proposes to operate is totally unique and unprecedented in India and the state of Karnataka in particular.

Moreover, Orb is unique in innovating with a branch model for solar system delivery, installation, and service. This is different from usual solar distributors and dealership channels that are free to set prices and set their own standards of service and operating procedures. Orb also established dealers who run an Orb Energy branch, and 'must' work according to the common pricing and standards as set for all of Orb's direct-run branches..

The common practice analysis details the difference between Orb's branch model and the competitors' dealership model in terms of cost and efficacy. It is concluded therein that there is no other similar project activity (without carbon support) and the project faces prevailing practice barrier. For details, also refer step 4.

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The barriers identified above affect the implementation of solar as an alternative to grid electricity and fossil fuels. The barriers are not faced by kerosene lanterns, diesel generators, wood, or grid electricity as an alternative to the project. If these barriers are not addressed

through the project, more people will continue to rely on largely fossil based electricity and other fuels in meeting their household energy needs as explained above.

Step 4: Common practice analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity:

The Orb Gold Standard certification relates only to Karnataka so competitor activity outside the borders of Karnataka is not considered.

In order to identify relevant competitors, a master list was created to include all significant and branded manufacturers / sellers of SWH or SHS in Karnataka and their branches and dealerships.

Competitor	Total Sales Centres in Karnataka	Total Sales Centres in Karnataka (excluding Bangalore non-rural)	Number of Districts	Type of Operation		
				Branch	Dealer	Unknown
Orb Energy	**73**	**73**	**26**	**73**		
Emmvee Solar	39	35	19		35	
SELCO Solar Pvt Ltd	26	25	17	25		
Tata Solar	21	14	10		14	
V Guard Solar	16	15	13		15	
MSIL Solar	5	4	4		3	1
Supreme Solar	5	2	2		2	
Ammini Solar Pvt Ltd	4	3	2		3	
Conergy Energy Systems (India) Pvt. Ltd	4	2	2		2	
Kotak Urja Pvt. Ltd.	4	3	3		3	
Rashmi Solar	4					
Anu Solar *	3 (25)	2 (25)	2 (25)	2 (25)		
Jain Irrigation System Ltd	3	3	3		3	
Sun Zone Solar	3	2	1		1	1
Thrive Energy Technologies Pvt Ltd	3	2	2		2	
Andromeda Energy Pvt Ltd	2	2	1		2	
Deepa Solar	2					
Sundaram Solar	2					
DISOL	1	1	1		1	
Hindustan Solar	1	1	1		1	
Nucifera Solar	1	1	1			1
Sudarshan Solar	1	1	1	1		
Sun Solar Systems	1	1	1			1
Tata & EMVEE	1	1	1		1	
Vijaya Industries	1	1	1		1	
Total	**153**	**121**		**28**	**89**	**4**

Data sources used to identify the existence of competitors and their branches and dealers included;

- 'List of Manufacturers empanelled under Refinancing scheme implemented through NABARD' from the Indian Ministry of New and Renewable Energy. This includes Solar PV manufacturers and sellers approved by the MNRE to access the current subsidy support scheme for small scale solar PV solutions.

This is considered the most authoritative and complete listing of small solar system manufacturers and dealers currently available[38]

- Lists of manufacturers Solar Water Heaters from the Ministry of New and Renewable Energy 'ETC Manufactures Solar Water Heating System (SWHS)' and 'FPC Manufactures Solar Water Heating System'. These show Solar Water Heater manufacturers and sellers approved by the MNRE to access the current subsidy support scheme for Solar Water Heaters. These are considered the most authoritative and complete existing listings of SWH manufacturers and dealers of SWH operating in Karnataka currently available.[39]

- Web sites of known competitors[40]

- A survey of Orb branch managers in Karnataka who provided details of known competitor dealers and branches within each branch trade area.

Excluding Orb there are around 121 competitor solar Sales Centres in Karnataka, excluding Bangalore. Activities within Bangalore as the largest metro city in Karnataka are ignored. Only branches / dealers outside of Bangalore are considered.

To narrow this list to relevant competitors, the following additional data sources were used;

- Published case studies on competitor activities
- Published reports on competitor activities
- Published statements by third parties that are either providers of carbon finance to, or recipients of carbon credits from, competitors
- The list of the competitors is mentioned below:

Relevant competitors are defined as those that;

- Operate in Karnataka
- Collectively comprise the majority of the Karnataka sales of SWH and SHS
- Do not receive funding linked to carbon emissions reductions
- Include coverage of Rural markets outside Metro markets
- Operate at scale
- Offer the same technologies as Orb

[38] Ministry of New & Renewable Energy, SPV Division, available for selection from the menu at http://www.mnre.gov.in/information/manufacturesindustriesarchitectsconsulting-organisation/ accessed in early February 2012

[39] Available for selection from the menu at http://www.mnre.gov.in/information/manufacturesindustriesarchitectsconsulting-organisation/ accessed in early February 2012

[40] All accessed in January 2012.
http://www.tatabpsolar.com/regional.html
http://www.vguard.in/dealernetwork.php
http://www.photonsolar.com/html/marketing-channel.html#
http://www.nuetechsolar.com/market/dealernetwork.asp
http://www.anusolar.com/support.php
http://www.emmveesolar.com/karnataka.htm
http://www.rashmisolar.com/index.php?page=contactus
http://suntechnics.de/in/pointof_us.htm
http://www.hykonindia.com/hykon_offices.htm
http://www.anusolar.com/

These criteria are described in brief below:

Operate in Karnataka:
The Orb Gold Standard certification relates only to Karnataka so competitor activity outside the borders of Karnataka is not considered.

Majority of Karnataka sales:
The aim is to consider all of the significant players. There may also be small competitors serving localised areas. It is difficult to identify them all and they are generally of limited relevance when considering additionality because they operate at very limited scale. However some are included where encountered.

No carbon funding:
Competitors that rely upon funding linked to carbon emission reductions are not relevant to testing Orb's claims. This is because the test for additionality is about emissions reductions that would not have been achieved in the absence of the funding generated form emissions reductions credits.

Carbon funding in the Indian SHS and SWH market is known to exist in 3 broad forms;

1. Registered schemes: Carbon funding provided via schemes such as CDM and Gold Standard, where the evidence and details are on a register accessible to the public.
2. Non registered arrangements: This includes carbon finance arrangements where the details of approval and monitoring are not accessible to public scrutiny. This includes carbon finance arranged directly between the parties without registration under a formal multi-party programme. Some voluntary programmes follow this format. Information about the detail of such arrangements is more difficult to obtain, but are typically brought into the public domain through announcements by parties involved.
3. Indirect 'clean energy' incentives: Significant funding has been provided to support the diffusion of clean energy for the rural poor in emerging economies, including India. Such funding has in the past been provided into this sector in India by organisations such as the World Bank, REEEP (the Renewable Energy and Energy Efficiency Partnership), The Shell Foundation, and the United Nations Environment Program, the Indian Ministry of New and renewable Energies, among others. Such funding is motivated typically by a combination of carbon emission reduction and poverty alleviation objectives. Such funding has been important internationally and within India in launching new markets and enterprises for SWH and SHS and at times for sustaining their operations. But it is difficult to identify it specifically as 'carbon' finance as distinct from general market or economic development assistance.

Operate at scale:
A competitor operating at a modest, localised level, does not impact the question of additionality when considering operations at large scale. In this study the test for scale is those competitors with physical branches or dealerships in at least 10 Districts in Karnataka, excluding Bangalore.

Same products:
The Orb business model is built around solar water heaters and solar home lighting systems. The most relevant competitors are those selling both of these, or one of these predominantly.

As per an external study conducted by Claros Consulting, (an Australian based firm that specializes in solar markets, and specifically rural adoption of solar energy), the competitors that comprise the majority of the non-Bangalore market are EMMVEE, V-Guard, SELCO, Tata and ANU. Together they represent 75% of the non-Bangalore Sales Centres. Each has significant coverage (greater than 10 districts) and they are significantly larger than the next largest competitors. Each meets the other criteria defined for Relevant Competitors with the exception of SELCO.

SELCO is excluded from the set of relevant competitors because, while it operates through direct branches, SELCO has utilised Carbon Finance from the sale of Emissions Reduction credits (ERs). SELCO has for many years, and continues today, to receive carbon finance via the non-registered route through a well established intermediary. The evidence for this use of Emissions Reductions is extensive and includes;

- Multiple public statements by the CEO of SELCO. These include confirmation that SELCO sells Emissions Reduction credits, uses the funds to reduce the cost to end customers, and indications of the volume of off-sets sold.

- Multiple public statements by organisations that purchase the SELCO credits. These organisations include AVIS, Blackwell Publishing, SAS Airlines, Carlson Wagonlit, Chime Communications, and Sabban.

- Third party accounts and case studies about SELCO, including first-hand experience with SELCO's use and creation of ERs.

- Public statements by Carbon Neutral that they have facilitated the sale of off-sets between SELCO and the end purchasers. ANU also has CDM projects utilising SWH in Karnataka . However this is deemed to not exclude ANU as a relevant competitor as the projects are limited to Bangalore. The Bangalore market has been removed from consideration for the current analysis as being distinct from the non-Bangalore Karnataka market on which Orb is focussed.

With SELCO excluded, the relevant competitors that satisfied the selected criteria for the analysis are Emmvee, V-Guard, Tata and Anu.

Table 5: Analysis of Competitors Involved in Solar Thermal and PV in Karnataka

Company	Type of Company	Other lines of business	Channel for sales and service	Support from ERs
TATA BP	Manufacturer of solar PV panels and solar water heaters	Large-scale export of PV modules to Europe, US, Africa, Asia	Only 1 branch in Bangalore; rest dealers and distributors[41]	No
V-Guard	Manufacturer of solar water heaters	Voltage Stabilizers, Cables, etc	Only 2 branches in Hubli and Bangalore; rest dealers and distributors[42]	No

41 See http://www.tatabpsolar.com/regional.html

42 See http://www.vguard.in/dealernetwork.php

Anu Solar	Manufacturer of solar water heaters	None	No branches. Webs-site refers to only 'on-line' platform for service.[43]	Yes
Emvee Solar	Manufacturer of solar water heaters and PV panels	Limited Export Volume	Dealer network[44]	No

The relevant competitors mentioned in Table 5 above cannot be compared with Orb energy as they adopt a different approach than Orb Energy and rely on a dealer and distributor network to reach the local market. In contrast, Selco, Shell Solar (now Environ Energy) and Orb Energy have opted for the more expensive but effective approach of solar sales and service through its own network of branches. The same has been demonstrated below taking examples of case studies from Selco and Shell Solar.

Case of Selco

Selco launched its business operations in 1994, initially with the help of grants; first from the Solar Electric Light Fund in the US, followed by soft loans from USAID. It also attracted early start-up equity under a quasi-charitable, quasi-private sector body called E&Co. Later it received further support in the form of grants and soft-loans from the same fund as Shell Solar India, the Photovoltaic Market Transformation Initiative (PVMTI) as managed by the IFC.[45] More recently it has received a joint investment from three charitable institutions (Good Energies Foundation, the Lemelson Foundation, and E&Co).[46] The funding received is on concessionary terms (e.g. not fully commercial) in recognition of the social impact that Selco has in rural markets.[47]

Like Shell Solar India, Selco has used its investments to build a network of branches that reached deep into rural India. To date it has established 25 branches (called energy service centres) and employs 140 personnel, mainly through its branch network.[48] It deploys the same approach of selling door-to-door, and relying on its own trained technicians for installation and after-sales service. It was also the pioneer in attracting key banks like Syndicate Bank to start lending for solar, and worked closely with the branch staff of Syndicate Bank to encourage local branches to start lending for.[49] And like Shell Solar India, Selco received (substantial) donor support to do all of this. But Selco also took the critical step of establishing a contract to sell the VERs it generated.[50]With a combination of donor and VERs support, Selco has been able to sustain a growing business from 1994 to the present day, and has sold more than 100,000 solar systems (PV and solar thermal) over 15 years.[51]

Case of Shell Solar

43 See http://www.anusolar.com/support.php

44 See http://www.emmveesolar.com/karnataka.htm

45 See write up by co-founder of Selco India (Neville Williams) in which he documents the early fund-raising activities, and the critical role of donor funding: such as $160k USD from USAID, $100k USD from the Indian Renewable Energy Development Agency under the World Bank's Renewable Resources Development Project, and $1mln USD in low interest finance and $100k USD grant from PVMTI (IFC). See Williams, Neville (2005). *Chasing the Sun ; Solar Adventures Around the World*. Gabriola Island, Canada. More recently Selco's founder won the Ashden Awards, and such prize money was plowed back into the business. See http://asiacleantech.wordpress.com/2007/12/23

46 http://www.selco-india.com/investors.html

47 Described in the press as 'social growth financing'. See http://www.goodenergies.com/Foundation. In particular see press release at http://www.goodenergies.com/files/files/view/95 from 12th January, 2009.

[48] http://www.selco-india.com/milestone.html. In the above press release it says Selco has 25 branches – slightly more than the 21 branches quoted on their website.

[49] Williams, Neville (2005). *Chasing the Sun ; Solar Adventures Around the World*. Gabriola Island, Canada. Including installing solar systems in the bank branches themselves to serve as a demonstration to potential customers.

[50] http://asiacleantech.wordpress.com/2007/12/23/. As of 2007 Selco had sold 4,500 tonnes of carbon dioxide (CO2) to Britain-based Carbon Neutral.

[51] http://www.selco-india.com/milestone.html

Shell Solar (a former subsidiary of the Royal Dutch Shell Group of Companies) entered the India market in 1998 through the establishment of a wholly owned subsidiary - Shell Solar India (SSI). SSI reached deep into rural areas through its network of 27 branches, and a total field staff of more than 200 of its own personnel. It had arrangements with more than 16 partner banks, and carried out extensive product demonstrations, and door-to-door selling campaigns to sell its systems. In addition, it had its own network of field-level technicians' team who carried out all installations and after sales-service.[52] To facilitate this expansion,

SSI relied on donor support: a $4 mln package under the Photovoltaic Market Transformation Initiative that included low interest working capital loans, bank guarantees, and a grant.[53] With this support Shell Solar was able to expand its branch network, and sell / install 30,000 solar systems before Shell exited in 2007. [54] At this point Shell sold SSI business to a small company, Environ Energy, who has since either closed many of the branches, or converted them to dealerships, and reduced staff dramatically. When asked why Shell exited the business it explained "It was not bringing in any profit for us there, so we transferred it to another operator".[55]

Orb is facing the same barriers which forced Shell Solar to exit, and forced Selco to rely on donor funding and VER support for expansion. Except in the case of Orb, the need for assistance from VERs is even greater considering the rapid expansion of its branch network. In just three years, Orb has grown to 3 times the size of Selco in terms of personnel and total number of branches. Or put another way, it took Shell Solar India seven years to reach 26 branches, while Orb surpassed this number in its first full financial year of operations. To sustain Orb's branch network at its present scale and to continue the planned expansion to 150 branches in Karnataka by 2013, Orb will need to create and sell its VERs to overcome the prevailing barriers to solar in the market place.

Effectiveness of Solar Sales and Service through Branch Network

To make millions of customers aware of solar solutions, build trust in the innovation, and convince them to buy – one household and one business at a time, vendors like Selco, Shell Solar, and Orb have relied on direct solar sales and service through their own branch network. This is a more expensive approach, but it is also a more effective approach with regard to solar dissemination.

Between 1994 and 2009 (15 years) Selco sold 100,000 solar systems, representing a compounded annual growth rate of roughly 56%. In contrast if we look at the India-wide figures available with the Ministry of New and Renewable Energy, in tables 6 and 7 below, we see much lower rates across India.[56]Between 1996 and 2007 (eleven years), the compounded annual growth rate on an India-wide basis for solar home systems (Selco's primary PV product) was just 24%. Between 2002 and 2009 (just seven years), the

[52] For an account of the Shell Solar India case study see Miller, D (2009) *Selling Solar; The Diffusion of Renewable Energy in Emerging Market*, Earthscan, London. The risk of a quick exit is that rural customers are then left without adequate guarantees for after-sales service. For article on Shell Solar's exit from India (and Sri Lanka) and the risks to its customers left behind, see Hirschman W (2007) 'Shell's solar light dims', *Photon International*, November 2007 pp 98-100. Also see http://www.guardian.co.uk/business/2007/dec/11/oil.bp

[53] IFC (2002) Progress on the IFC/GEF Photovoltaic Market Transformation Initiative (PVMTI), World Bank, March.

[54] The risk of a quick exit is that rural customers are then left without adequate guarantees for after-sales service. For article on Shell Solar's exit from India (and Sri Lanka) and the risks to its customers left behind, see Hirschman W (2007) 'Shell's solar light dims', *Photon International*, November 2007 pp 98-100.

[55] http://www.guardian.co.uk/business/2007/dec/11/oil.bp

[56] When approached for Karnataka-specific installation data for solar PV and solar thermal systems, the Government's state-level nodal agency – Karnataka Renewable Energy Development Limited – said they could not provide such data. Similarly the Ministry of New and Renewable Energy (MNRE) does not provide state-level data for solar sales / installations. Instead we must refer to MNRE data on an India-wide basis as a proxy for rates of compounded annual rates of growth in Karnataka.

compounded annual growth rate of solar water heating systems (also sold by Selco) was just 35%.

Table 6: Rollout of Solar PV units in India (1996-2007)

Solar application	Number of Units 1996	Number of Units 2007
Solar street lights	30,917	61,321
Solar home systems	37,465	313,859
Solar lanterns	36,519	565,658
Solar mini-grids	141	N/A

Source: Unit installation data from Ministry of New and Renewable Energy (MNRE), 2007, Prabhakara (former Secretary of MNRE), New Delhi, 1996.

Table 7: Rollout of Solar Thermal Units in India (2002-2009)

Year	Installed Capacity Sq m	Basis
2002-03	100,000	Actual installations using MNRE schemes
2003-04	150,000	
2004-05	200,000	
2005-06	400,000	
2006-07	400,000	
2007-08	450,000	
2008-09	600,000	MNRE Plans
11th plan end, 2012	5 million	
2022	20 million	
2030	40 million	

Source: MNRE, Dr. Arun K. Tripathi, Director, 20.01.2009, Scheme on Development of Solar Cities, Slide Presentation

Like Selco, Orb's network of branches have door-to-door sales teams that reach deep into rural areas – today Orb employs more than 100 sales personnel in Karnataka. These personnel are critical to raising customer awareness and developing customer confidence to invest in solar technology. They directly sell solar systems, arrange for local demonstrations, and coordinate with local banks for solar customer loans. Their efforts are further supported by hundreds of Orb's commission agents, appointed to the branches, to help raise customer awareness in solar and generate leads.[57] Finally, Orb's trained technicians are key to high quality installation and service that builds customer confidence and trust in the technology, and underpins future sales.

The above personnel operate out of Orb's branch network in Karnataka. Although more expensive to develop such a network, Orb's compounded annual rate of growth (like that of Selco) is considerably higher than the prevailing norm:

Orb vs. India-Wide Growth	2007	2009	Orb	India-Wide

[57] The role of door to door sales people in kick-starting the diffusion of an innovation is widely recognised in the more theoretical literature on Innovation Diffusion. They are called 'Change Agents' because of the critical role they play in introducing customers to an innovation, and convincing them of the merits of investing in it. Change agents' role in the diffusion process is unambiguous according to the leading thinkers in this field: 'most change is not a haphazard phenomenon, but the results of the planned and premeditated actions by change agents'. See Rogers and Shoemaker (1971) *Communication of Innovation; A Cross Cultural Approach*, Free Press, New York, p227.

			CAGR	CAGR
PV (systems)	581	2219	85%	24%
Thermal (Sq. Metres)	2182	7499	95%	34%

Based on the above, we can conclude that solar sales and service through Orb's branch network is a more effective way to increased dissemination of solar technology.

Branch vs. Dealership: Higher Cost, Higher Efficacy

Orb Energy maintains that the strategy of establishing branches that directly serve solar customers is completely different to the approach of appointing independent dealers, who set their own standards of service, and selling to them for re-sale to customers. An independent study was conducted to compare the effectiveness and cost of Orb's branch model with the dealership model of relevant competitors. The study was conducted by Claros Consulting, an Australian based firm that specializes in solar markets, and specifically rural adoption of solar energy.

As part of the study, relevant competitors to Orb and involved in marketing and distribution of products similar to that distributed by Orb were identified as mentioned in Table 5 above. The smaller competitors encountered during the study have been aggregated as 'other'.

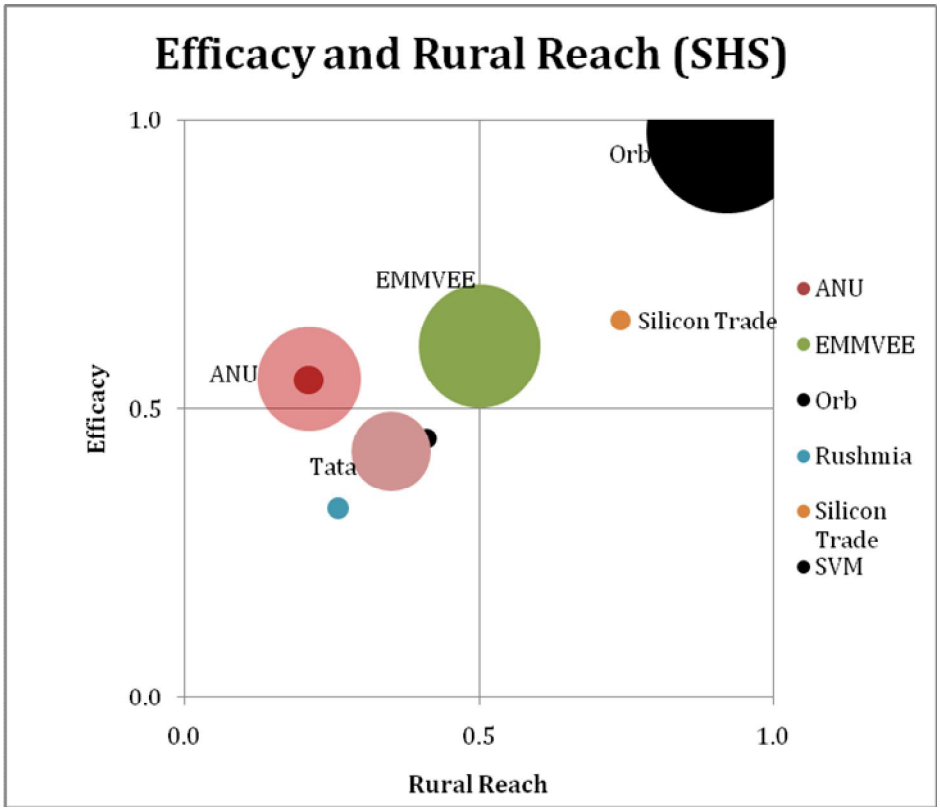
Interviews were conducted with the owners/managers of 22 sales centres of relevant competitors. The target interviewees were selected by random selection of districts and covered all relevant competitors and some smaller competitors. In all, due to multiple brands in some sales centres, 32 brand/sales centre data sets were produced and analysed. The results of the study have been summarized below:

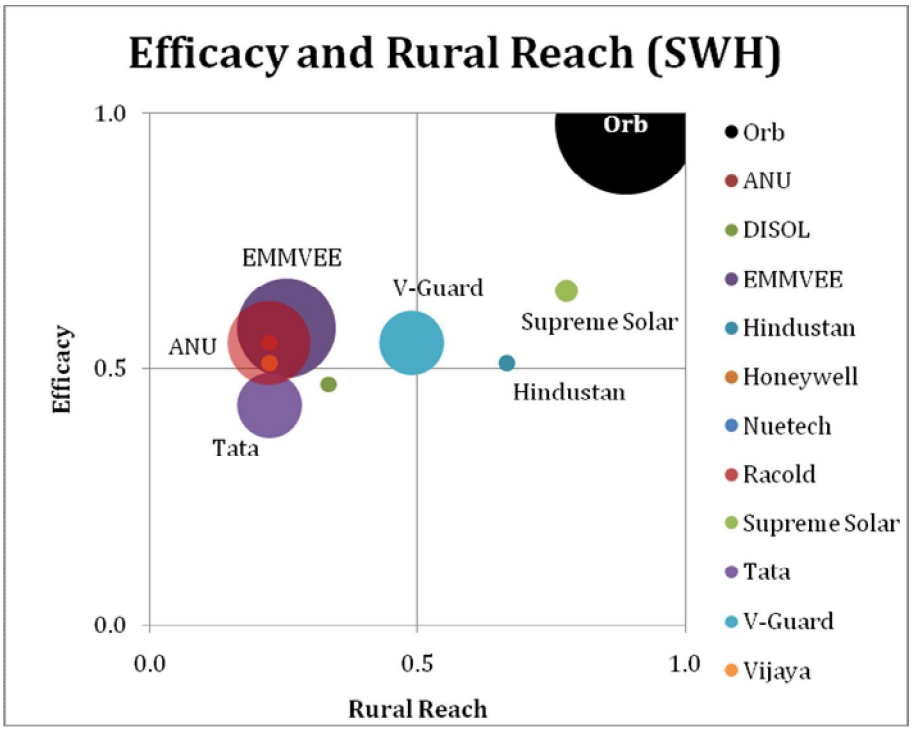
(1) Effectiveness:-

The idea of effectiveness is divided broadly into Reach and Efficacy. Reach is about the level of access that potential end-users have to adopt the technology. Efficacy is about how well the technology, once installed, performs over its anticipated operating life.

a. Reach:-

Orb's superior reach with respect to its competitors is demonstrated by the following bubble charts (found on pages 25-26 of the study):


Efficacy and Rural Reach (SHS)
1.0
0.5
0.0
Efficacy
0.0
0.5
1.0
Rural Reach
Orb
EMMVEE
ANU
Tata
Silicon Trade
ANU
EMMVEE
Orb
Rushmia
Silicon Trade
SVM


Efficacy and Rural Reach (SWH)
1.0
0.5
0.0
Efficacy
0.0
0.5
1.0
Rural Reach
Orb
EMMVEE
V-Guard
Supreme Solar
ANU
Hindustan
Tata
Orb
ANU
DISOL
EMMVEE
Hindustan
Honeywell
Nuetech
Racold
Supreme Solar
Tata
V-Guard
Vijaya

i. **Solar Home Lighting System Sales on Credit:-** The proportion of total Solar Home Lighting System (SHS) sales that are made on credit (rather than cash) is an indicator of how far down the income distribution the purchasers lie.

The study finds that the proportion of SHS sold on credit is significantly higher for Orb than for competitors, at 85% compared with an average of 48% for competitors. This substantially higher proportion of credit sales for SHS implies that Orb reaches more deeply into the lower income rural population, those who are unable to afford to purchase outright on cash.

ii. Coverage:-

Orb has by far the greatest number of Sales Centres among the relevant competitors. Orb has 73 Sales Centres in Karnataka compared with the next highest of 35 for EMMVEE. Orb is present in 26 Districts of Karnataka compared with the next highest of 19 for EMMVEE.

This greater coverage in number of Districts and spread within those Districts implies a greater reach into areas not reached by others. By appointing such branches Orb Energy provides different levels of service outputs as compared to selling via dealers (as most of its competitors do). These include guaranteeing high quality installation through installation by its own trained technicians and preventative after-sales service.
For each service completed, an Orb technician receives a fee of Rs 50 in addition to their salary. Prior to April 2011, the fee was Rs 40 per service. During 2011, penalties were imposed on service technicians on 1,904 occasions for non-compliance, that is, 7.6% of services.

Further, the direct run branches inspire more trust in local bank branch managers to lend for solar. Orb also coordinates with local banks for awareness raising activities such as product demos, which are critical to maximizing bank lending for solar in rural areas. Orb Branches pro-actively engage on an average 4 financial institutions, while competitor branches on average engage 0.5 financial institution branch managers. Orb, to a significant degree, provides access to solar technology to rural populations at a level that far exceeds competitors.

b. Efficacy and Costs

The study also finds that "Orb provides substantially more pro-active preventative maintenance than occurs under the models of relevant competitors. This suggests that equipment installed by Orb is more likely to operate correctly and to have a longer operating life than equivalent equipment installed by relevant competitors. In order to provide this higher level of servicing and efficacy, the additional cost to Orb is approximately 5% increase on Orb branch operating costs. However, when comparing the

additional costs between Orb and relevant competitors it is the entire cost of free maintenance servicing that is an additional cost to Orb. This is because the relevant competitors are manufacturers. They do not incur the cost of the free servicing. That cost is incurred by the independent dealers of the manufacturer. This means that the additional cost incurred by Orb that was not incurred by relevant competitors in 2011 was Rs 13.0 lakh". (Refer Page 14 of Study).

The study also states that the cost to train Orb's 83 technicians (who conduct installation and after-sales service) was approximately Rs 3 lakh (83 installers x Rs 3,600 per installer). This contrasts with competitor dealers of which 55% use formal training. If Orb had trained 55% rather than 100% of its installers, the cost saving would have been around Rs 1.3 lakh (83 installers x 45% x Rs 3,600).

Orb also conducted 3,534 post-installation inspections in 2011. Each inspection costs Orb an average Rs 52 to conduct, for a total cost of Rs 1,83,768, or an annual pro-rata cost of Rs 2.2 lakh. Relevant competitors do not incur the majority of these costs. The study also provided further inputs on following parameters concerning 'efficacy':-

i. **Customer Satisfaction Surveys:-** Orb conducts regular customer satisfaction surveys. The report substantiates a high level of satisfaction with Orb among past purchasers. High satisfaction levels mean that those customers are likely to recommend Orb to others. Referrals such as these increase reach, and therefore efficacy.

ii. **Warranty:-**
   1. SWH warranties are the same for Orb and most of the relevant competitors, with the exception of Tata which is much lower than Orb.
   2. SHS warranties are overall of similar strength when comparing Orb and the relevant competitors. Orb offers markedly longer warranties on those components that historically have been the main cause of premature failure of systems - batteries and controllers.

Thus, it can be concluded that Orb stands out as the only competitor to deliver high efficacy, and to take this deeply into rural areas and at scale.

(2) **Costs:-**

As detailed above, there is significant evidence that Orb's higher level of efficacy and reach add directly to Orb's costs compared to those of relevant competitors. Indications of the differences in cost between the Orb branch model and competitor dealership model are developed considering the range of activities undertaken by Orb beyond that of competitors.

Conclusion

It can be concluded on this evidence that the Orb branch model is more effective than the dealership model of relevant competitors and that this greater effectiveness comes at a higher operating cost.

Orb is the only relevant competitor to deliver high efficacy, and to take this deeply into rural areas and at scale. Key to achieving this is the unique business model of Orb. Delivering tight performance at scale requires strong processes and controls. Company controlled branches provide both greater legal and operational ability to implement and enforce the required control. The unique model of Orb requires a higher cost to operate than the dealer model of competitors.

On this evidence it is clear that the Branch based business model of Orb delivers greater effectiveness than relevant competitors but in order to do so Orb incurs greater costs.

Sub-step 4b: Discuss any similar options that are occurring:

As discussed in sub-step 3c, Orb Energy's project is unique in terms of the scale it is attempting to reach in a relatively short period of time – 150 branches in Karnataka by 2013 – so as to better target the nascent rural and semi-urban market for solar. Also, as explained above, none of the similar activities identified follow the branch based business model of Orb that delivers greater effectiveness in terms of reach and efficacy.

On this basis, it is fair to say that no similar options are occurring in Karnataka, or India, involving such a rapid expansion of a formal branch network to accelerate the penetration of solar systems in rural and semi-urban areas.

Based on the above, therefore, the proposed project by Orb Energy is not a common practice in the region.

Furthermore, it can be concluded that existence of the competitors does not contradict the claim that the proposed project activity is financially/economically unattractive or subject to barriers.

Date	Event
25 July 2006	Initial discussions started between The Carbon Neutral Company (TCNC) and Orb Energy to discuss the potential of developing the project as a carbon credit project.
4 August 2006	TCNC shared confidentiality agreement and Letter of Intent (LoI) with Orb Energy.
7 August 2006	Letter of Intent signed by Orb Energy
17 August 2006	Non - disclosure agreement signed by TCNC and Orb Energy
30 August 2006	Incorporation of Orb Energy Pvt. Ltd.
5 October 2006	Feasibility studies done by TCNC for Solar Thermal and Solar PV
11 October 2006	ERPA shared by TCNC with Orb Energy based on volumes estimated by feasibility study
26 October-7 November 2006	Further discussions between Orb Energy and TCNC to try to negotiate carbon credit pricing and proceed to ERPA
13 November 2006	TCNC pull out of discussions. Emission Reduction Purchase Agreement (ERPA) could not be reached and Orb Energy started looking for other potential carbon buyers.
December 2006 to September 2007	Orb Energy carries out search for alternative buyer. Contacts multiple parties. . Multiple discussions took place with Aviva, Climate Care etc. to negotiate ERPA for the project
14th September, 2007	Pioneer Carbon send draft Term Sheet to Orb Energy and negotiations commence.
28th November 2007	Term Sheet signed between Orb Energy Pvt Ltd and Pioneer Carbon Limited-Start date of project
12th September 2008	ERPA between Orb Energy Pvt. Ltd. and J.P. Morgan Ventures Energy Corporation (which took over Pioneer Carbon) for sale of VERs
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Carbon consideration timeline

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>The project is small scale because the total output of the solar PV and thermal units combined do not exceed the limit of 15 MW until after 2010. The two methodologies chosen for the project are as follow:
For solar PV systems, the methodology AMS-I.A: “Electricity generation for the user” has been applied because:

Eligibility Criteria	Justification
1.This category comprises renewable electricity generation units that supply individual households/users or groups of households/users included in the project boundary. The applicability Is limited to individual households and users that do not have a grid connection except when; The emissions reduction per renewable energy based lighting system is less than 5 tonnes of CO2e a year and where it can be shown that fossil fuel would have been used in the absence of the project activity by; (i) A representative sample survey (90% confidence interval, ±10% error margin) of target households; or (ii) Official statistics from the host country government agencies. The renewable energy generation units include technologies such as solar, hydro, wind, biomass gasification and other technologies that produce electricity all of which is used on-site/locally by the user, e.g., solar home systems, wind battery chargers . The renewable generating units may be new installations (Greenfield) or replace existing onsite fossil-fuel-fired generation. To qualify as a small-scale project, the total output of the unit(s) shall not exceed the limit of 15 MW.	Although some of the households and users have a grid connection, the project qualifies for this approved methodology because the emissions reduction per renewable energy based lighting system is less than 5 tCO2e a year, and it has been shown, through a baseline survey, that fossil fuel would have been used in the absence of the project activity. The result of the survey, which was based on a representative sample survey (90% confidence interval, ±10% error margin) of target households, is available as separate report. The renewable energy generation units are solar that produce electricity which is used on-site/locally by the user. The total output of the unit(s) is limited to 15 MW.
2. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is	Not applicable.

implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	
3. Combined heat and power (cogeneration) systems are not eligible under this category.	Not applicable.
4. If the unit added has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The unit has only renewable component. No non renewable component is present. Therefore not applicable.
5. Project activities that involves retrofit or replacement of an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	The proposed project does not involve retrofit or modified unit hence, not applicable.
6. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not applicable as the project activity does not involve the addition of renewable energy generation units at an existing renewable power generation facility.

For the Solar thermal systems, the methodology AMS-I.C: “Thermal energy production with or without electricity”, the methodology has been applied because:

Eligibility Criteria	Justification
1. This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	The proposed project comprises of solar heaters that supply users with thermal energy that displaces fossil fuel use.
2. Biomass-based cogeneration systems are included in this category. For the purpose of this methodology cogeneration shall mean the simultaneous generation of thermal energy and electrical energy in one process. Project activities that produce heat and power in separate element processes (for example heat from a boiler and electricity from a biogas engine) do not fit under the definition of cogeneration project.	Not applicable
3. Emission reductions from a biomass cogeneration system can accrue from one of the following activities: (a) Electricity supply to a grid; (b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; (c) Combination of (a) and (b).	Not applicable
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	The total installed/rated thermal energy generation capacity of the project equipment is less than 45 MW thermal.
5. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	Not applicable.
6. The following capacity limits apply for biomass cogeneration units: (a) If the project activity includes emission reductions from both the	Not applicable.

thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the maximal limit of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant); (b) If the emission reductions of the cogeneration project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal; (c) If the emission reductions of the cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.	
7. The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.	Since the project is not adding renewable energy units at an existing renewable energy facility, hence not applicable.
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	The proposed project activity does not seek to retrofit or modify an existing facility for renewable energy generation, hence not applicable.
9. New Facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the ìGeneral Guidelines to SSC CDM methodologiesî.	Not applicable.
10. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely	Not applicable.

renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	
11. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	Not applicable.
12. If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	Not applicable.
13. If the project activity recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions.	Not applicable.
14. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided: (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology AMS-III.K. Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM	Not applicable.

project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.	

Since both solar PV and solar thermal components of the project meet the requirements of the approved methodologies, the methodologies AMS-I.A and AMS-I.C have been applied.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	Sunshine days in a year
Data unit:	Days
Description:	Annual sunshine days for the area where the solar units will be in operation
Source of data to be used:	India's Ministry of New and Renewable Energy (MNRE)
Value of data	300[58]
Description of measurement methods and procedures to be applied:	-
Any comment:	Although the number of sunshine days is more than 300, this figure is used to be conservative.

Data / Parameter:	Daily bulb usage
Data unit:	Hours/day
Description:	Daily bulb usage
Source of data to be used:	Based on the approved small scale baseline and monitoring methodology AMS-1.A, paragraph 7 option 3.
Value of data	3.5
Description of measurement methods and procedures to be applied:	Default value provided in the UNFCCC approved methodology for small scale projects.
Any comment:	-

Data / Parameter:	$EF_{C,MGrid,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor for the Southern Grid
Source of data to be used:	CO2 Baseline Database for the Indian Power Sector, version 4
Value of data	0.852
Description of measurement methods and procedures to be applied:	The value is published annually by the Central Electricity Authority and the calculation is done in consistency with applicable tool.
Any comment:	This value will be fixed ex ante for the current crediting period and will be revised at the renewal of crediting period.

[58] http://mnre.gov.in/pdf/Solar%20(Lantern%20&%20heater)%20Eng.pdf, and http://mnre.gov.in/spv-intro.htm

Data / Parameter:	Specific heat capacity of water
Data unit:	KJ/(Kg ^{0}C)
Description:	Specific heat capacity of water
Source of data to be used:	The Engineering tool box
Value of data	4.187
Description of measurement methods and procedures to be applied:	Default value from technical manual
Any comment:	This value is fixed ex ante for the current crediting period and will be revised at the renewal of crediting period.

Data / Parameter:	ΔT
Data unit:	^{0}C
Description:	Temperature increase for solar thermal heating
Source of data to be used:	Orb solar technical manual and test results (annexed separately)
Value of data	40
Description of measurement methods and procedures to be applied:	Technical test runs conducted by the Madurai Kumaraj University commissioned by Orb Energy
Any comment:	This value has been conservatively determined

Data / Parameter:	$NCV_{fossil\ fuel}$
Data unit:	TJ/t
Description:	Net calorific value of baseline fossil fuels
Source of data to be used:	IPCC default values 2006 values (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)
Value of data	Kerosene: 0.0438 Diesel: 0.043 LPG: 0.0473
Description of measurement methods and procedures to be applied:	-
Any comment:	This value is fixed ex ante for the current crediting period and will be revised at the renewal of crediting period..

Data / Parameter:	$EF_{fossil\ fuel}$
Data unit:	tCO_2/TJ
Description:	Carbon dioxide emission factor for the baseline fossil fuels
Source of data to be used:	IPCC default values 2006 values (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)
Value of data	Kerosene: 71.9 Diesel: 74.1 LPG: 63.1
Description ofmeasurement methods and procedures to beapplied:	-

Any comment:	This value is fixed ex ante for the current crediting period and will be revised at the renewal of crediting period.

Data / Parameter:	Average number of bulbs per household
Data unit:	Number
Description:	Average number of bulbs per household
Source of data to be used:	Installation data report for all new installations.
Value of data	5
Description of measurement methods and procedures to be applied:	Technicians installing the solar units will rely upon, direct measurement, receipts, observation and estimation when recording baseline data.
Any comment:	-

Data / Parameter:	Average mass of fossil fuel for water heating
Data unit:	Kg/day
Description:	Average mass of fossil fuel used to heat water per day (for households with fossil fuel baseline)
Source of data to be used:	Installation data report for all new installations.
Value of data	Kerosene: 0.15 LPG: 0.28
Description of measurement methods and procedures to be applied:	Established from a statistically significant sample of the household population using the solar units. Sample is based on 90% confidence interval, ± 10% error margin.
Any comment:	-

Data / Parameter:	Average mass of fossil fuel for lighting
Data unit:	Kg/day
Description:	Average mass of fossil fuel used to lighting per day (for households with fossil fuel baseline)
Source of data to be used:	Installation data report for all new installations.
Value of data	Kerosene: 0.153, LPG: 0.20 and Diesel: 0.617
Description of measurement methods and procedures to be applied:	Established from a statistically significant sample of the household population using the solar units. Sample is based on 90% confidence interval, ± 10% error margin.
Any comment:	-

Data / Parameter:	Volume of water heated
Data unit:	Litres per day
Description:	Volume of water heated per day per unit (for households with grid electricity baseline)
Source of data to be used:	Installation data report for all new installations.
Value of data	50% of thermal capacity
Description of measurement methods and procedures to be applied:	Established from a statistically significant sample of the household population using the solar units. Sample is based on 90% confidence interval, ± 10% error margin.
Any comment:	The volume is calculated based on the units sold and baseline unit being replaced.

B.6.3 Ex-ante calculation of emission reductions:

>>

Baseline Emissions from Solar PV units

Baseline electrical energy demand per unit PV system is calculated based on the energy requirement of the household per day. The project has four baseline energy sources comprising the following:

a) Electricity
b) Kerosene
c) LPG (Gas)
d) Diesel

a) Electricity

According to the applicable methodology, AMS.I.A, paragraph 8 (C), the value of 3.5 hour per day of lighting need is assumed and applied. The baseline emission per household for lighting is therefore calculated as:

$BE_{El,y}$ = (Daily bulb usage in hours*Average number of bulbs per household * Average bulb size in W* 365 sunshine days in a year)* $EF_{C,MGrid,y}$ in tonne/ MWh.

$$= 3.5 * 5 * 60^{59} * 365 * 0.852 = 0.3265\ tCO_2e/yr$$

b) Kerosene, LPG and Diesel

For the fossil fuels baseline lighting situations, the baseline emissions per household are calculated as:

$BE_{Fossil\ fuel,y}$ = Average mass of fuel (Kg/day) * $NCV_{fossil\ fuel}$(TJ/t) * $EF_{fossil\ fuel}$(tCO_2/TJ) * 365 sunshine days in a year

Fuel Type	Fuel mass	NCV	EF_{fuel}	Days	$BE_{fossil\ fuel}$ tCO_2e/yr
Kerosene	0.153	0.0438	71.9	365	0.142
LPG	0.20	0.0473	63.1	365	0.218
Diesel	0.617	0.043	74.1	365	0.610

Baseline Emissions from Solar Thermal Units

Baseline thermal energy demand per thermal unit system is calculated based on the energy requirement of the household per day. The project has four baseline energy sources comprising the following:

a) Electricity
b) Kerosene
c) LPG (Gas)
d) Wood

a) Electricity

[59] We have assumed 60 watt as average household bulb size. This is extremely conservative. The data reference used is for 1996 and it reflects the poorest of rural households. It is noted that households with a higher income tends to use a bulb with a higher wattage. See page 62 http://www.esmap.org/filez/pubs/indiastrategiessixstates.pdf.

For solar thermal systems, the baseline emission (tCO_2e/yr)per unit system is calculated based on the mass of water heated per day (Kg/day) times temperature change of the heated water (ΔT^0C) times the specific heat of water (kJ per Kg per ^0C) times sunshine days in a year (days per year) / (kJ to kWh conversion).

BE_y = Average mass of water heated per day (Kg/day) * $\Delta T(^0C)$ * the specific heat capacity of water (kJ per Kg per ^0C) * 300 sunshine days in a year) / (kJ to kWh conversion) * $EF_{CM,grid,y}$ in tCO_2/MWh

$=M_{water}$ * 40 * (4.18/3600) * 300 *((365-annual days before installation)/365) * 0.852

b) Kerosene and LPG

For the fossil fuels baseline thermal heating, the baseline emissions per household are calculated as:

$BE_{Fossil\ fuel,y}$ = Average mass of fuel (Kg/day) * $NCV_{fossil\ fuel}$ (TJ/t) * $EF_{fossil\ fuel}$ (tCO_2/TJ) * 300 sunshine days in a year.

Fuel Type	Fuel mass	NCV	EF_{fuel}	Days	$BE_{fossil\ fuel}$ (tCO_2e/yr)
Kerosene	0.124	0.0438	71.9	300	0.117
LPG	0.28	0.0473	63.1	300	0.25

Project Emissions (PE_y)

The project has no emissions and therefore; PEy = 0.00 tCO_2e/yr

Emission Reductions

Emission Reductions,R_y= Baseline Emissions (BE_y) –Project Emissions ($PE_{y)}$ – Leakage(L_y)

ER_y = BE_y – (PE_y + L_y)

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of project activity emission reductions (tonne CO_2 e)	Estimation of baseline emission reduction (tonne CO_2 e)	Estimation of leakage (tonne CO_2 e)	Estimation of emission reductions (tonne CO_2 e)
2010	0	6,032.8	0	6,032.8
2011	0	8,585.1	0	8,585.1
2012	0	11,386.3	0	11,386.3
2013	0	14,526.0	0	14,526.0
2014	0	14,526.0	0	14,526.0
2015	0	14,526.0	0	14,526.0
2016	0	14,526.0	0	14,526.0
Total	**0**	**84,108.2**	**0**	**84,108.2**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	Thermal units Sales
Data unit:	Number of units
Description:	Number of Thermal units by size

Source of data to be used:	Sales Records
Value of data	Varies
Description of measurement methods and procedures to be applied:	All systems sold are recorded in Orb Energy's centralised customer database. These records can be compiled to provide the annual sales figures used for calculation of emission reductions.
QA/QC procedures to be applied:	Sales invoices will be used to check for consistency of records
Any comment:	Daily records will be used to enable the calculation of operating days in a year based on the date the solar system is sold.

Data / Parameter:	Photo voltaic units sales
Data unit:	Number of units
Description:	Number of Thermal units by size
Source of data to be used:	Sales records
Value of data	-
Description of measurement methods and procedures to be applied:	All systems sold are recorded in Orb Energy's centralised customer database. These records can be compiled to provide the annual sales figures used for calculation of emission reductions.
QA/QC procedures to be applied:	Sales invoices will be used to check for consistency of records
Any comment:	Daily records will be used to enable the calculation of operating days in a year based on the date the solar system is sold.

Data / Parameter:	Number of units not operating
Data unit:	Number
Description:	Number of Solar PV and Thermal systems not operating
Source of data to be used:	Field survey
Value of data	0
Description of measurement methods and procedures to be applied:	Number of units not operating shall be determined based on percentage fraction of units found not operating on a sampling basis through field survey.
QA/QC procedures to be applied:	CME PO shall conduct field survey with expert assistance
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

The Chief Executive Officer (CEO) is the head of the project and is responsible for overall running and monitoring of the project. The key parameters to be monitored in the project are:

a) Daily sales by type of unit and size
b) Number of units that are not in operation

Currently Orb Energy operates a centralised database where information on the each customer is stored. The customer information is captured on the solar unit order form and contains the following:

a) Name of customer

b) Solar unit type and size
c) Components sold with the system
d) Date of installation
e) Invoice amount
f) Location of the user and Orb Energy branch where the unit was bought from
g) Name of technician who did the installation
h) Malfunctioning reported cases and the appropriate action taken to address the problem

Currently, Orb Energy ensures successful installation of solar unit by having the technician doing the installation to complete Installation Form (IF). The IF form has all the information of the household. The form is signed by both the technician and the customers as proof of successful installation of the unit.

Data captured in the IF will then be compiled into the right format and be entered in a special centralised system for analysis for use. Also, using centralised database system already existing which contains information on the customer's solar units as per the purchase order, Orb Energy personnel generate monthly maintenance schedules which are sent out to Orb branches showing the list of customers whose solar units are due for service in that particular month. Also the database contains information of reported cases of breakdown and action taken. From this a list of systems pending maintenance and repair is also circulated daily to the CEO, COO, and the management team.

The centralised database will be used by the monitoring team to generate all data on the number of systems sold and their sale dates, the capacity of each system and the number of solar units not in operation. In turn, this will give the total emission reductions from the project – to be calculated for each given calendar year. Once generated, the CEO will review and sign-off on the report. The data will be stored in hard copy and in electronic format, and archiving will be done electronically as per the stipulated period after end of crediting period.

Detailed organisational structure of Orb Energy is annexed separately

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>
Date of Completion: 01/12/2008

The project participants have determined the baseline and monitoring methodology, which are as follows:

JP Morgan Ventures Energy Corporation,
J.P. Morgan| Floor 3 (BS03-0300), 25 Bank Street, Canary Wharf, London,
E14 5JP |
T: +44 (0)207 742 7783T: +44 (0)207 742 7783

And

Orb Energy Pvt. Ltd
No.893, 3rd Cross, MC Layout,
Vijaynagar, Bangalore 560 040, India

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
28/11/2007[60]

C.1.2. Expected operational lifetime of the project activity:

>>
Over 21 years 0 months

C.2 Choice of the crediting period and related information:

Renewable Crediting Period (7*3 years)

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
12/09/2010

C.2.1.2. Length of the first crediting period:

>>
7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
N/A

C.2.2.2. Length:

>>
N/A

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
Government of India in its notification[61] dated 14th September, 2006, directed that "construction of new projects or activities or the expansion or modernisation of existing projects or activities listed in the Schedule to the above mentioned notification entailing capacity addition with change in process and or technology in any part of India shall be undertaken only after the prior environmental clearance from the Central Government or as

[60] Term Sheet signed between Orb Energy Pvt Ltd and Pioneer Carbon Limited
[61] http://envfor.nic.in/legis/eia/so1533.pdf

the case may be, by the State Level Environment Impact Assessment Authority, duly constituted by the Central Government".

The proposed project involves the sale, installation, and service of solar PV systems and solar thermal systems at the residential and commercial level, both in urban and rural areas. The project is neither out of order with the surrounding nor is it listed in the above mentioned notification among those that require EIA clearance before they can be undertaken.

Because it is not a requirement by law or legislation in India, the project has not undergone an EIA process.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
N/A

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>
To ensure that potential stakeholders attended the meeting, a newspaper advertisement was placed on the most prominent local newspaper (Deccan Herald) informing and inviting the public to attend. In addition to the newspaper advert, email and letters invitations were sent out to various groups and individuals inviting them to the meeting.

The stakeholder consultation meeting was organised and held on 9th December 2008 at Orb Energy's head office in Bangalore. During the consultation forum, minutes were taken and compiled.

List of invitees and those who attended the meeting annexed separately.

E.2. Summary of the comments received:

>>
As mentioned in section E.1 the stakeholder consultation meeting was organised and held on 9th December 2008 at Orb Energy's head office in Bangalore. During the consultation forum, the comments from stakeholders were invited. The comments were received and recorded in the form of minutes of the meeting and were compiled.

After being informed about the project design, implementation process and expected outcomes and benefits, the stakeholders raised some questions and clarifications on energy conservation during actual use and during solar equipment production and their comparable savings. They also wanted to know how Orb Energy services can be brought closer to beneficiaries so that energy use and cost can be brought down.

E.3. Report on how due account was taken of any comments received:

>>

The consultation process did not identify any negative impact from the project. However, the stakeholders' concern on 'bringing the service closer to people' will be addressed by ensuring that more branches are opened so that service personnel don't cover long distances to provide after sale service and maintenance. The project proponent considered this concern and will include it in project planning and design.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Orb Energy Pvt. Limited
Street/P.O.Box:	No.893, 3rd Cross, MC Layout, Vijaynagar, Bangalore 560 040
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	India
Telephone:	+91 80 23145931 - 5
FAX:	+91 80 23145930
E-Mail:	damian.miller@orbenergy.com
URL:	www.orbenergy.com
Represented by:	Damian Miller
Title:	Chief Executive Officer
Salutation:	Mr.
Last Name:	Miller
Middle Name:	-
First Name:	Damian
Department:	
Mobile:	+91 9900242665
Direct FAX:	
Direct tel:	
Personal E-Mail:	damian.miller@orbenergy.com

Organization:	J P Morgan Ventures Energy Corporation
P.O. Box:	E14 5JP
Building:	J.P. Morgan | Floor 3 (BS03-0300), 25 Bank Street, Canary Wharf, London, E14 5JP |
City:	London
State/Region:	London
Postfix/ZIP:	
Country:	United Kingdom
Telephone:	+44 (0)207 742 7783T: +44 (0)207 742 7783
FAX:	
E-Mail:	
URL:	
Represented by:	Jay Shotton
Title:	Environmental Products - Portfolio Manager
Salutation:	Mr.
Last Name:	Shotton
Middle Name:	
First Name:	Jay
Department:	
Mobile:	07500 073070
Direct FAX:	
Direct tel:	
Personal E-Mail:	Jay.x.shotton@jpmorgan.com

Annex 2

BASELINE INFORMATION

Orb Energy thermal systems sold ranges from 100 litres to more than 2000 litres. Each customer purchases the unit depending on his requirement. The baseline for thermal and PV was established through a survey for units already sold...

Based on the survey done, the sample was drawn from both rural and urban customers and their fuel usage types has also been classified for urban and rural, (*see Thermal Cluster and PV Cluster Worksheet Tabs in the ER calculation excel sheet*).

Fuel Usage proportion among Rural and Urban Clusters

From the survey, it was established there is different in the fuel usage proportion between rural and urban households.

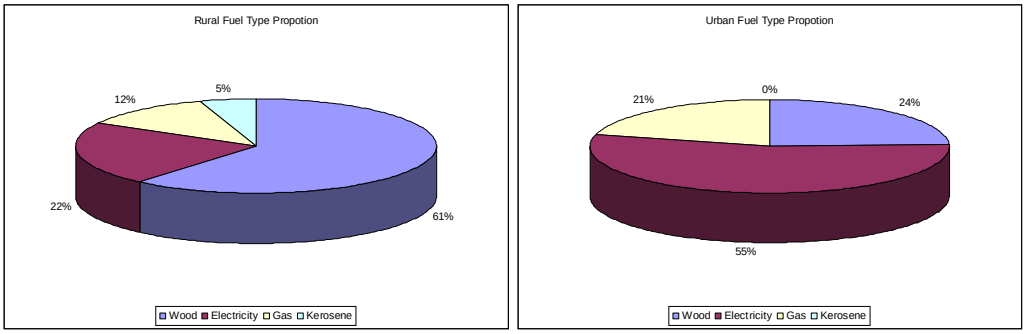


Figure 5: Solar Thermal Fuels Type Proportion for Rural and Urban Clusters

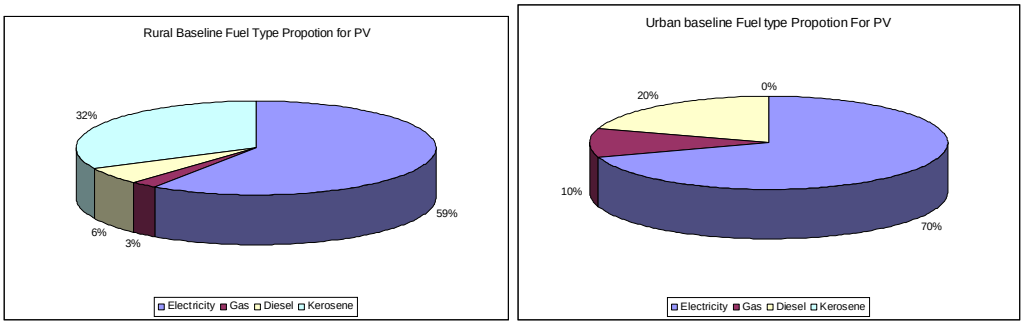


Figure6: Solar PV Fuels Type Proportion for Rural and Urban Clusters

However, on doing the aggregated fuel type proportion without urban or rural cluster, the overall fuel proportion is shown below. For detailed calculation, *see Thermal Baseline Raw Data and PV Baseline Raw Data Worksheet Tabs in the ER calculation excel sheet*

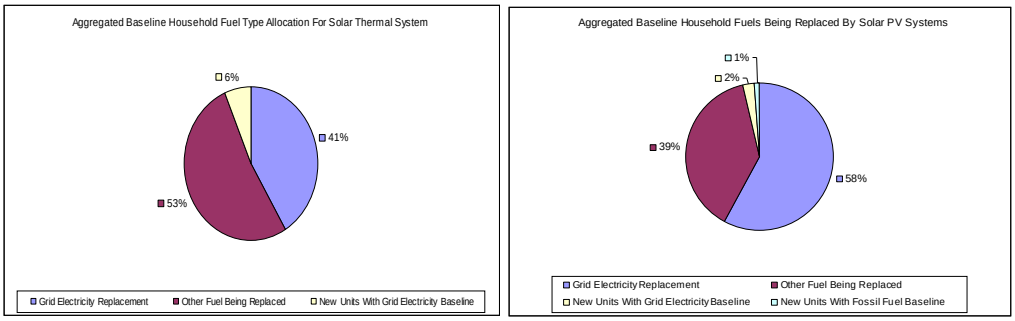
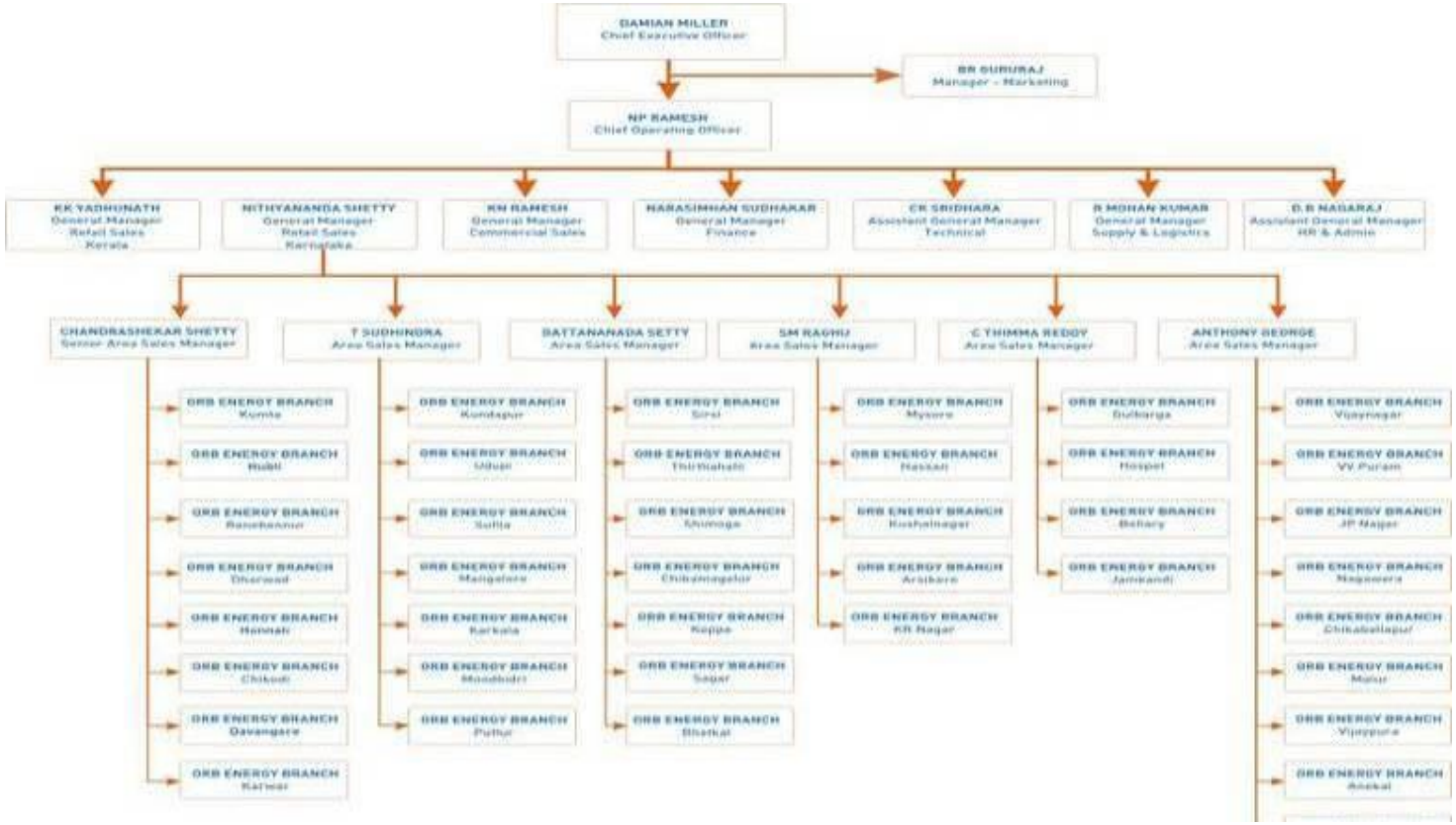


Figure 7: Fuels Type Proportion for Solar Thermal and PV respectively

Based on the above, cluster proportion percentages shall be applied when calculating emission reduction from the project.

Annex 3

ORB ENERGY'S ORGANISATIONAL STRUCTURE



ANNEX 4

STAKEHOLDERS COMMENTS REPORT

Newspaper Advertisement for the First Round Stakeholders' Consultation Forum

DECCAN HERALD — Metrolife — Monday, December 8, 2008

'he action was fun'

orn in Miami, 23-year-old Natalie Martinez is a Cuban-American d actress. She is best r her role as Miller on the show House. When she was as chosen as the face and JLO by Jennifer d became the rson for it. Starring y navigator, Case, ce marks her fea-

are my favourite films of all times.

There's a touch of Gladiator in Death Race, don't you think?

Absolutely, the fight to death and Jason as the wronged man. Maybe that's what I love about both these films — the fight for justice, desire for freedom and loyalty. It's something you can relate to in many ways.

You have a whole bunch of action scenes in Death Race. Did you get hurt?

Oh yeah. I had bruises on my arms and legs. There was a scene where we had to get out of the car at about

themselves from an impending watery grave.

Anil Kapoor in *Slumdog Millionaire.*

New version of

Main Kab Saas Banoongi tonight at 8 pm on SAB tv.

Luxurious party spots

From the soirees to the coolest places to chill out, this episode of *Top Ten Wild Party Spots* gets you on the hottest guest lists for all of the top ten Best Party Spots. Get a sneak peek at the most exclusive, most explosive and most exciting spots to let it all hang out.

Whether it is a celebration of the full moon or just a full cocktail, there are a million reasons to get down and party. It's a wild ride with college co-eds, fearless fetishists and playboy playmates. Watch the show tonight at 11 pm on Discovery Travel and Living.

orb energy

Orb Energy Invites Stakeholders To Consultation Meeting On Carbon Credits

Orb Energy, India's leading provider of solar solutions, invites stakeholders to attend its consultation meeting on voluntary emission reduction rights (VERs). Orb intends to use the proceeds from the sale of VERs to improve access to solar energy solutions in rural India. If you are interested to attend please call our customer care number on +91 9900520505

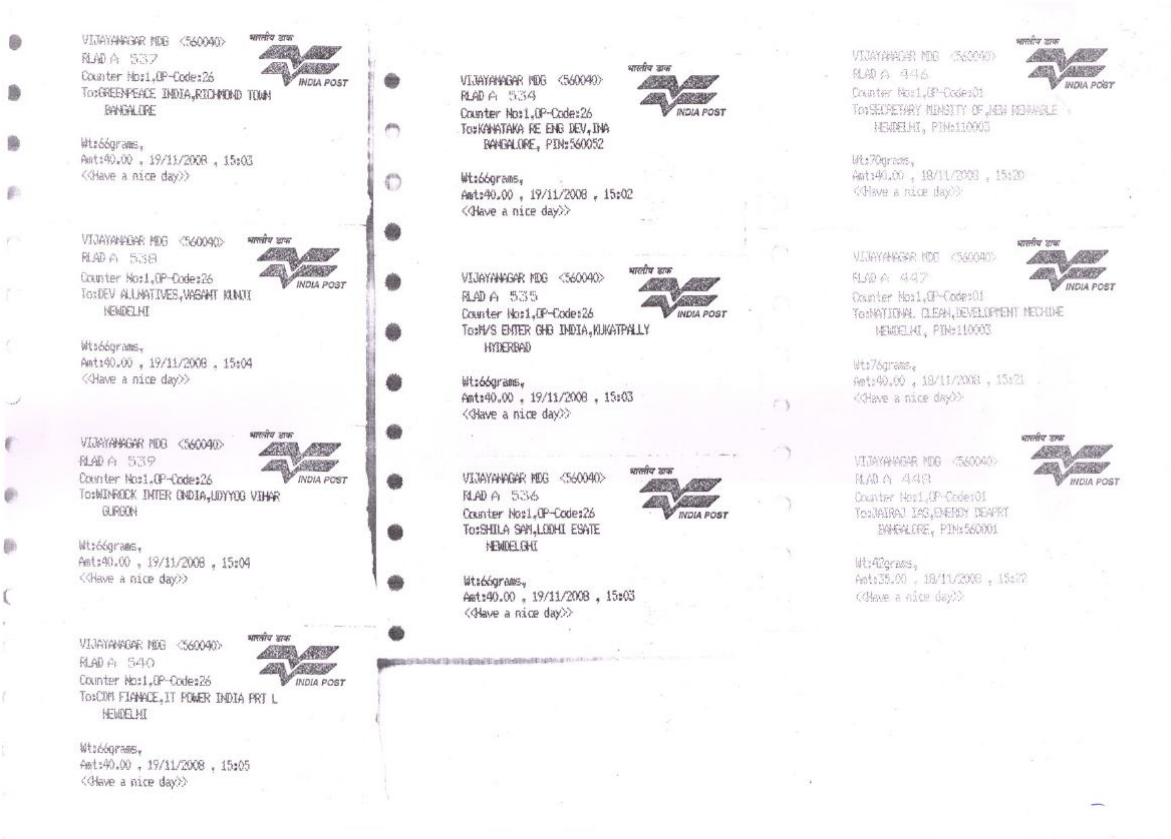
Head Office
Orb Energy, #873, 3rd Cross, MC Layout
Vijaynagar, Bangalore 560040
www.orbenergy.com

Sunstream

Send your feeedback to dhmetro@deccanherald.co.in

ANNEX 5

List of Invitee for First Round of Stakeholders Consultation



ANNEX 6

List of Attendance First Round of Stakeholders Consultation

Orb Energy Solar Project Participant List

Participant list stakeholder consultation				
Date and time: 09/12/2008 9 am to 1 pm				
Location: Orb Energy Office				
Name of participant, job/position in the community	Male/female	Signature	Organisation (if relevant)	Contact details
Deepak Zade	m		MITCON	09822684106
Damian Muller	M		Orb Energy	+919900247665
S.K. SOOD	m		IAEMP www.iaemp.org	9901911910 9241778571
SHARAVAN KUMAR	M		PIPEX	9900866009
[illegible]	M		Orb Energy	9901977886
N.P. RAMESH	M		Orb Energy	9980098490

ANNEX 7

DNA Notification Postage Confirmation