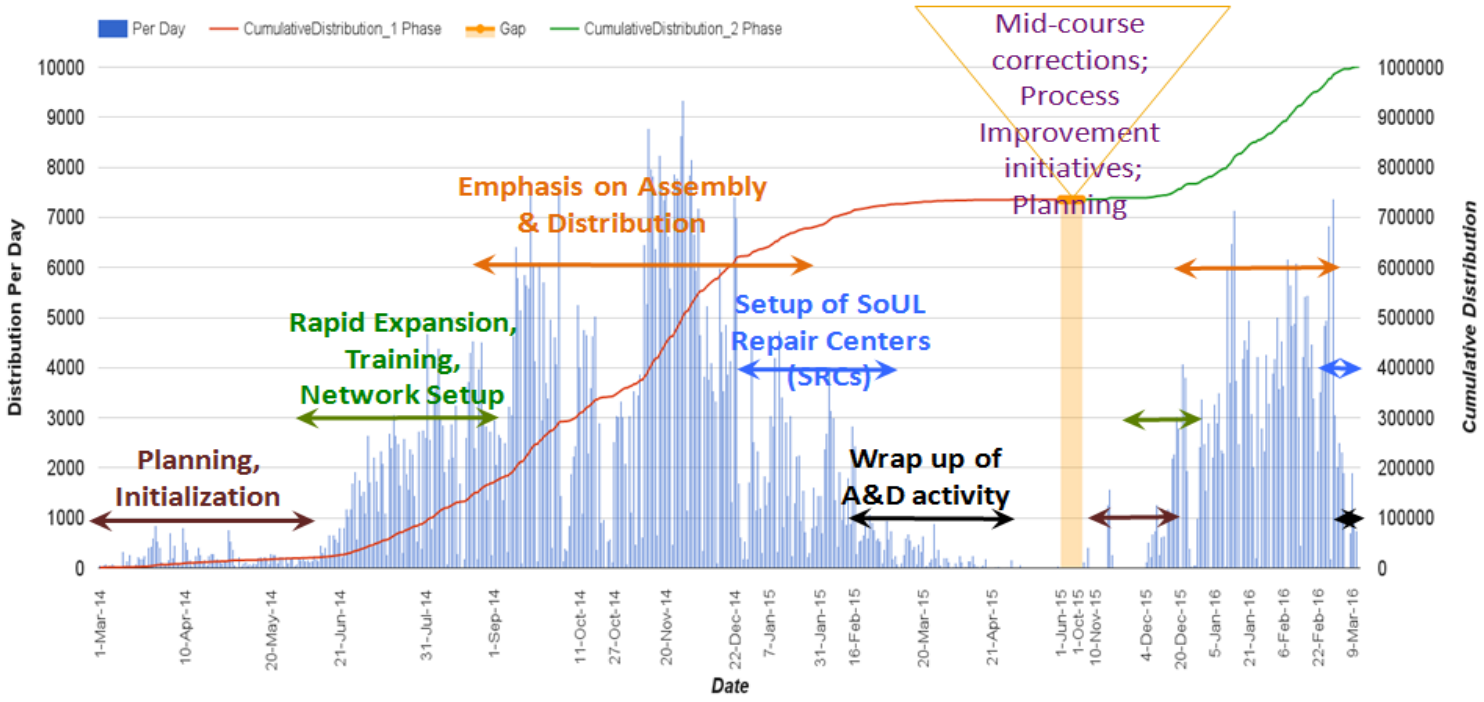
Localization of Solar Energy through Local Assembly, Sale and Usage of 1 Million Solar Study Lamps

Million SOUL

Appendix (January 2014 – March 2016)



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Appendix

January 2014 – March 2016

Indian Institute of Technology Bombay

May 2016

APPENDIX

Appendix A: Design and Techical Specification of theSoUL

A. Design and Technical Specifications of SoUL

This section provides the general technical description of the solar lamp, as well as the model used in Million SouL project.

The SoUL has primarily been designed keeping in mind to help a child to study at night. However, this doesn't imply that usage of lamp is only restricted to studying. It should also be useful for other lighting purposes. Additionally, since the lamp is to be assembled at the local level, its design is such that allows easy assembly of the various components of the lamp. The design of the lamp also allows compact packaging of the lamp. A typical arrangement of components for such design is shown in Figure 1.

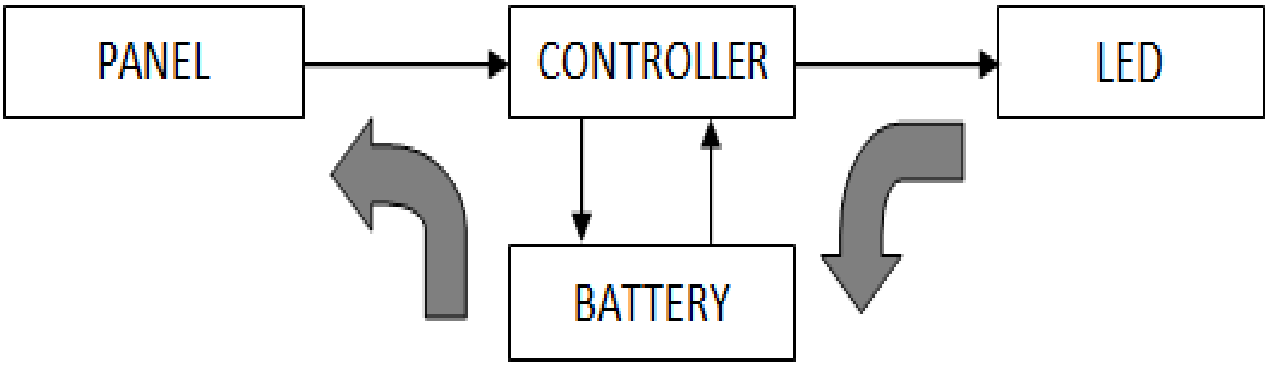


Figure 1: SOUL is equivalent to Solar PV system

The solar study lamp is a Standalone SPV system. It contains four components of Standalone SPV system, viz. Load (LED), Controller, Battery and Solar Module as shown in Figure 1. The primary requirement of this lamp is to provide at least 250 lux of light from the height of 12 inches from the table top. This light level is good enough for reading purposes according to standard lighting requirement.[1]

A.1 Product Design

While designing the lamp, it was stipulated that it should be aesthetically very attractive and at the same time it should meet the given technical specifications. The look of the SoUL is similar to the table lamps for study purpose. SoUL has a base which houses battery, switch, indicator LED and PCB. The base of the lamp provides stability when it is kept on the table for study purpose. The size of about 10 x 10 cm^2 is good enough to provide stability to the lamp. However, a smaller size can also be chosen but it was observed that size of less than 5 x 5 cm^2 does not provide good stability, meaning while arranging the head of the lamp for required position, the lamp falls down. The thickness of the base is designed to accommodate the battery and the circuit required for the lamp. The wire connection to LED is provided from the base through the flexible neck. The height of the LED housing from its base is adjustable because of its flexible gooseneck.

[1]Werner K. E. Osterhaus, "Office Lighting: A Review of 80 Years of Standards and Recommendations", Lawrence Berkeley Laboratory, Berkeley, CA 94720 U.S.A.

The flexibility offered by the use of gooseneck is useful in making adjustment of head of lamp for the sake of convenience for the users. Some flexibility is provided in adjusting the head of conventional table lamps.

The height of LED housing from top of the base is about 1.0 feet. The design of the head is sketched in a way that the intensity of the light falling on table/ book is 250 lux which is sufficient for reading purpose according to the international standards. The other design perspective kept in mind was to make it handy and lightweight because the SoUL is expected to be carried by children. At the same time, it should be rigid enough so that it can sustain a fall from a small height. For rigidity, the body of any lamp can be made from material like metal sheets, Acrylonitrile Butadiene Styrene (ABS) plastic or other plastic material. The ABS plastic is a good choice as it provides good impact resistance and toughness and hence, has been used in the making of SoUL.

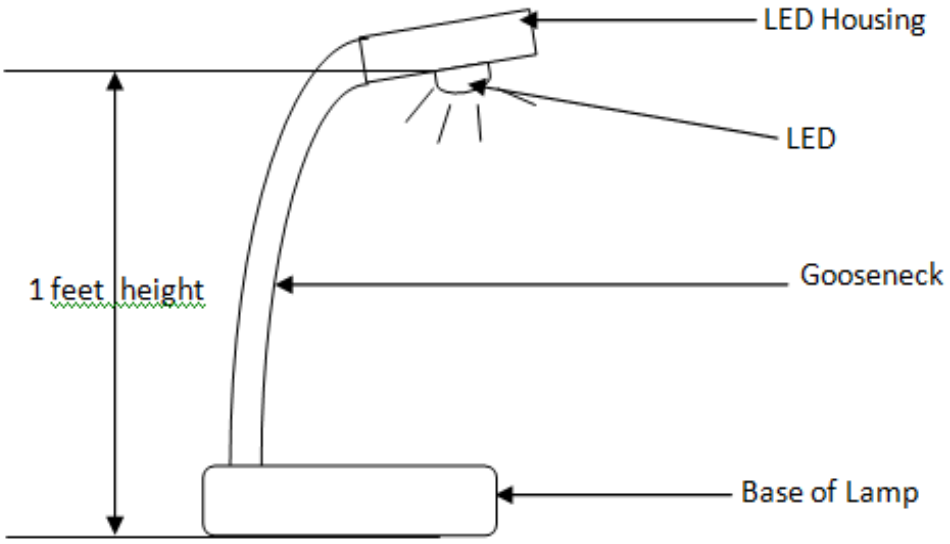


Figure 2: Product Design of SOUL

A.2 Light design

The area of one workbook for child can be considered an area of about 2 x 1 feet (0.185 m^2). SoUL is able to illuminate this area from the height of 12 inches. The lumen efficacy of the selected LED is 150 lumens per watt. The lumen level for 0.5 $W_{p,}$will be 75 lumen (=150 lumen X 0.5W). The standard lux level for general purpose lighting is 150 lux and that for studying is 250 lux according to the international standards for lighting. With simple electronic control, the LED can easily be operated in two modes; mode one is low intensity and the other is high intensity mode. The low intensity mode, that is mode 1, gives 150 lux light level whereas the high intensity mode, that is mode 2, gives 250 lux light level. The power consumption for mode 1 and 2 are 0.192W and 0.352W respectively. Mode 1 and mode 2 are expected to be operational for 8 and 5 hours respectively. The calculation for lux value is done in the following table.

Table B-1: Table for Lux level calculations

Mode	Power(W)	Lumen per watt	ExposedArea under lamp(m^2)	Lux (Lumen m^2)	Standard Light level(Lux)
1	0.192	28.8	0.185	155	150 (general)
2	0.352	52.8	0.185	285	250 (study)

The lux level for mode 1 and 2 is 155 lux and 285 lux. In both the modes the lux level is above the international standard used for lighting (reference). Also note that in practice the light will spread to larger area, the area mentioned in the Table is the area of enough intensity meeting standard light level criteria.

A.3 Electrical Design

The light source is the load (LED) in SoUL. The light source used in the SoUL is a cool white LED of 0.5 W with operating voltage of 3.2 V. This LED has a luminance of 150 lumen per watt within the operating temperature range of -40 to 85 ºC. The system design is based on this load (LED) of 0.5W. This light source is chosen to operate at two intensities. One is full intensity (mode 2, reading purposes) and the other is low intensity (mode 1, general lighting purpose). In the following paragraphs calculations are presented to estimate the battery capacity and solar PV module power requirement:

Table B-2: LED Desired Technical Specifications:

Operating Voltage	Power Consumption (P_{max})	Luminance	CCT
3.2 V	0.5 Watts	75 lumen	5600 K

*Correlated color temperature (CCT)

In order to provide light of constant intensity, LED is driven by LED driver, which in turn takes power from the battery directly. As mentioned earlier, the expected backup for high intensity mode is 5 hours and for low intensity its 8 hours. The electrical design is done for two types of batteries, NiMH and Li-ion. For NiMH battery, two series connected cells of 2.4 Volt and for Li-ion case one single cell of 3.7 Volt is considered in the design. The calculation for required battery capacity for the two cases of batteries, as well as for the two power modes, is shown inTable 9. In the calculation it is assumed that the LED driver is having efficiency of 85% and depth of discharge (DoD) of batteries is 80%. For high intensity mode 2, the voltage and current supplied to LED is 3.2 V and 0.11 A respectively, while for low intensity mode 1 the voltage and current supplied to LED is 3.2 V and 0.06 A current respectively.

Table B-3: Design Table for calculation of battery capacity

Mode	Volt (V)	Current (A)	Power (W)	Energy (Whr)	Efficiency (%)	Energy (Whr)	Battery voltage (V)	Charge (mAh)	DoD (%)	Capacity (mAh)
1	3.2	0.06	0.192	1.54	85	1.81	2.4 (NiMH)	753	80	941
2	3.2	0.11	0.352	1.76	85	2.07	2.4 (NiMH)	863	80	1078
1	3.2	0.06	0.192	1.54	85	1.81	3.7 (Li Ion)	490	80	611
2	3.2	0.11	0.352	1.76	85	2.07	3.7 (Li Ion)	560	80	700

According to the requirement of both the modes, the battery capacity of 1200 mAh has been chosen. Additional battery capacity provides backup for less sunny days.

The wattage of module can be evaluated on the basis of energy required at input side of battery considering the efficiency of controller. The calculations are shown in Table 4:

Table B-4: Design Table for calculation of Solar Panel capacity

Mode	Energy (Whr)	Battery Efficiency (%)	Energy (Wh)	Sunshine Hours (H)	Power (W)	Fill Factor (%)	Peak Power (W_p)
1	1.81	90	2.01	4.5	0.447	70	0.64
2	2.07	90	2.30	4.5	0.511	70	0.73

Hence in both modes, the Peak Power rating of solar panel can be approximated to 1 W_p in order to take care of the cloudy days.

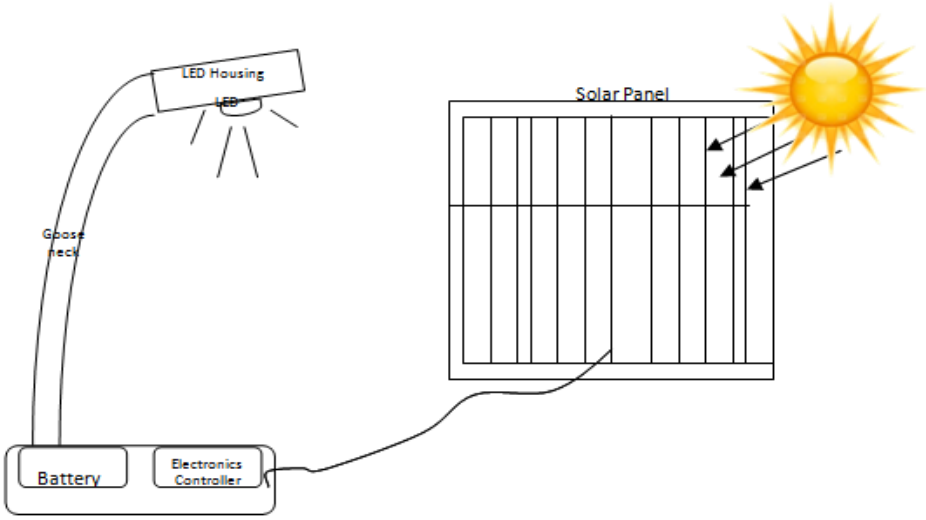


Figure 3: Solar Urja Lamp (SOUL) model

A.4 Solar Panel Design

The solar cells used to make the solar panel for SoUL are crystalline silicon solar cells. This panel is used to charge the battery. The solar cell parameters are generally described at the standard test conditions (STC), where the temperature is considered to be 25°C with 1000W/m^2 radiation and 1 m/s wind speed. But in reality, the atmospheric conditions are different.[2] The temperature of Solar Panel on a normal sunny day can reach to the level of 65 °C. At such a high temperature, the voltage of the solar panel reduces and can be calculated using standard parameters of solar cells as shown below.

Crystalline Silicon Solar cell parameters at Standard Test Condition (STC):
Power O/P of Solar Panel : 1 W
Voltage : 0.47 V
Current density : 30 mA/m^2
Temp : 25 °C.
Voltage Coefficient : 2.3 mV/ °C

Table B-5: Calculations for Solar Cell voltage at 65 °C temperatures

V_{mp} per Cell (V)	**Temp coefficient (mV/ °C)**	**Temp difference (°C)**	**Voltage drop per cell (V)**	**Net Voltage per cell (V)**
0.47	2.3	40	0.092	0.378

The battery selected for SOUL is NiMH, whose terminal voltage is 2.4 V, 1200 mAh. In order to charge this battery the maximum voltage level difference between solar panel and battery should not be higher than 1.4 V. In order to calculate the no of cells required to make this module can be calculated as shown below:
No. of Cells =3.8 V ÷ 0.378 V = **10 numbers** (approx.).
Power Rating /Cell =1 W ÷ 10 = 0.1 W.
Current Rating /Cell = 0.1 W ÷ 0.47 V = 0.212 A = 212 mA.

Area of each Cell =212 mA ÷ 30 mA/cm^2 = 7 cm^2.
Total area of 10 Cells =10 x 7 cm^2= 70 cm^2.
Packaging density of solar panel =50 %
Area of panel Solar Panel =70 cm^2 ÷ 0.5 = **140cm^2.**

The area of the Solar panel will be about 140 cm^2 with 10 cells in series with maximum output voltage of 3.8 V.

Appendix B: Technical Training Manual

The technical training manual used in Million SoUL project is presented here. The same can be updated and used for NaSSoLiM

ABSTRACT

Technical training of the locally hired people is one of the crucial aspects of The SoUL (Solar Urja Lamp) project. Technical training is essential to impart the knowledge and skills of SoUL's testing, assembly, campaigning & distribution activities in the local people hired from the targeted block.

Technical training is conducted over the course of first 2 days, on the 1st day focus is on theoretical aspects including basic concepts of physics, electricity, SoUL components etc. and on 2nd day the focus is on practical aspects such as physical, technical testing of SoUL components, inspection for defects and practically assembling the SoUL.

A specific set of skills & knowledge is essential for performing the tasks such as counting the components, physical tests, technical test, assembly & distribution, supervision of assembly & distribution etc. The objective of designing this technical manual is to elaborate the outline of the basic concepts of physics, electronics & solar and other related information in specific chapters which would be easy to explain during the training session of these local assemblers & distributors

Technical manual is divided into 10 elaborate chapters, which are illustrated to the assemblers & distributors, which runs the trainees through the learning process beginning from theoretic explanation of introduction to basic concepts of energy, electricity, basic mathematics, electrical components of SoUL e.g. Battery, LED, Solar Panel etc. then taking the trainees to the practical experience of testing, inspecting & step by step SoUL assembly process.

Technical manual is designed for the impartment of basic skills & knowledge of physics, electronics, solar energy etc. which could help the trainees for their future endeavors in the field of electronics and solar sector as well.

Assembly process consists of following steps:

I. Testing of components: All the components are inspected for any physical damage. The battery, LED and the PCB panel are also subject to technical tests. The good components continue for assembly, and the faulty/ damaged components are returned to and exchanged with the suppliers.

II. Assembly of the Lamp: This is a multi-step process wherein all the components are assembled to produce the solar lamp, SoUL. The number of components in one lamp ranges from 18-25 (depending on the supplier). The assembly process ranges from simple operations such as screwing in the covers, to the skilled operation of soldering lead wires to the PCB. Proper procedure and importance of soldering is taught to all assemblers. The assembly process also involves intermediate testing of sub-assemblies. Each assembled lamp is assigned a unique code.

III. Final SoUL testing: The final assembled solar lamp is tested to ensure that it is working as per specifications.

IV. Packaging: The solar lamp is packed in cardboard boxes, along with the instruction manual.

TABLE OF CONTENTS

INTRODUCTION

India has one of the largest young populations in the world, with 350 million children under 14 years of age. School education is thus essential for the future of the country. 7.8 Crore (78 million) households in India still use kerosene as their primary source of lighting today. Thus, most of the young students going to school either do not have access to alternate light source or have an erratic supply of electricity, both of which affect their study during later hours of the day.

The light level required for study purposes is about 150 Lux at the reading area. Thus, to provide light for 4 hours every evening, solely for study purposes, requires only 0.7 kWh of electricity per year! A 0.5 Watt LED provides up to 250 Lux of light. A solar powered lamp with LED light can thus provide up to 150 Lux of light at the table in low intensity, and up to 250 Lux of light in high intensity mode, using a 1 Watt solar panel to charge the battery of the lamp, at a cost of Rs.400 – Rs.600 per lamp.

A sustainable adoption of solar energy products has not yet happened in India due to a clear mismatch between the requirements on the field and the scope of past solar lamp programs. Solar lamps are typically required in remote, rural areas at a low cost and with easy availability in the local market, with access to timely and low cost after sales service. However, currently lamps are produced in large urban cities which result in a high cost of lamp due to higher overheads, their minimal availability at local level due to lack of distribution channels, and time consuming and expensive after-sales service since they are based in cities or large towns. Hence, to directly and completely address the requirements, the solar lamp program must be able to involve local people in all aspects of assembly, distribution and after sales service at the local level. This will ensure that the lamps are of low cost, sufficiently available in the local market ensuring market penetration into remote areas, with timely and low cost after sales service using trained manpower available at the local level.

Further, a countrywide large-scale solar lamp program must address, simultaneously, the issues of Scale, Speed and Skill. Million Solar Urja Lamp (SoUL) Project (MSP) is an Indian Institute of Technology - Bombay (IITB) initiative in collaboration with Ministry of New and Renewable Resources (MNRE), which focuses on the ‘localization’ of solar energy. The solar study lamps provided under this program are locally assembled, distributed and repaired & maintained, thus localization of solar energy. In order to achieve scale, the model is designed to be replicated in parallel in multiple blocks, across districts and states. To achieve speed, the assembly and distribution for any block is designed to be completed in stipulated period. In order to target skill development, rural people are trained in the assembling, distribution, repair and maintenance of SoULs in their local areas.

MODULE– 1 Energy

1.1 Introduction

In this module, we will learn about energy and its forms. We shall also across various sources of energy and its principle. Towards the end of this module, we will learn about the solar energy and its benefits over non-conventional form of energy.

1.2 Energy – what is it?

Energy causes things to happen around us. Look out the window.During the day, the sun gives out light and heat energy. At night, street lamps use electrical energy to light our way.When a car is driven by, it is being powered by gasoline, a type of stored energy. The food we eat contains energy. We use that energy to work and play.

We learned the *definition* of energy in the introduction:**"Energy Is the Ability to Do Work."**

1.3 Energy sources

Energy sources are of two types: Non Renewable and Renewable

Energy sources are considered nonrenewable if they cannot be replenished in a short period of time. On the other hand, renewable energy sources such as solar and wind can be replenished naturally.

Non Renewable Energy sources	Renewable Energy sources
1. Crude oil 2. Natural gas 3. Coal 4. Uranium (nuclear energy)	1. Biomass—includes: - Wood and wood waste - Municipal solid waste - Landfill gas and biogas - Ethanol - Biodiesel 2. Hydropower 3. Geothermal 4. Wind 5. Solar
Nonrenewable Energy: Non-renewable energy is energy produced by burning fossil fuels such as coal. They are non-renewable because there are finite resources of fossil fuels on the planet. If they are continually used, one day they will run out.	**Renewable Energy:** The definition of renewable energy includes any type of energy generated from natural resources that is infinite or constantly renewed.

Table 1: Renewable and Non- Renewable Energy

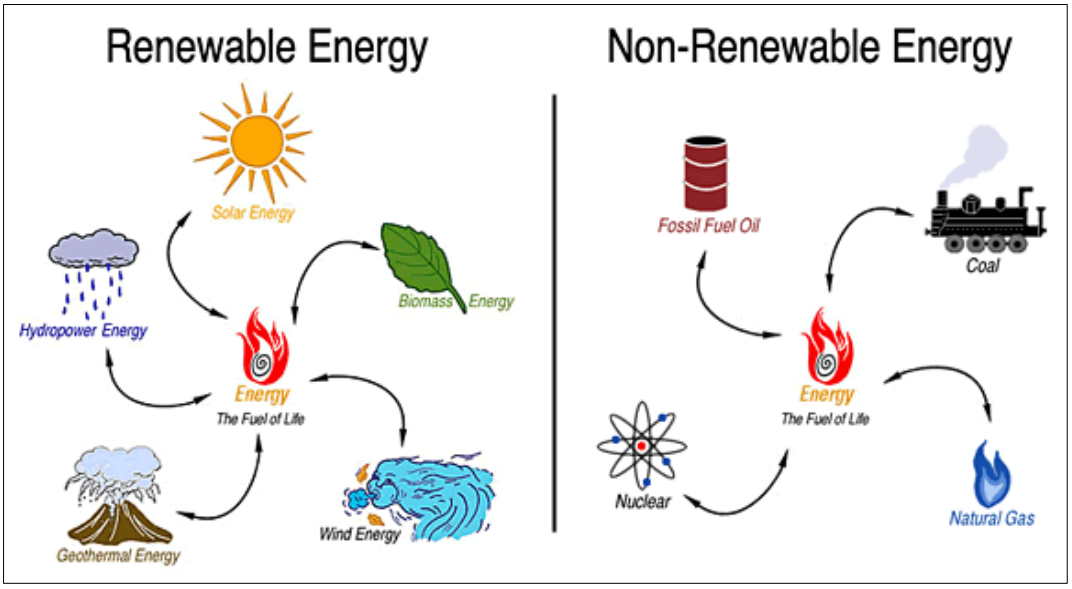


Figure 1: Renewable and Non- Renewable Energy
(Source:http://www.dunsterwoodfuels.co.uk)

Energy can be found in a number of different forms:

- Mechanical Energy
- Electrical energy
- Chemical Energy
- Heat (Thermal energy)
- Solar Energy
- Nuclear Energy
- Gravitational Energy
- Wind Energy
- Magnetic Energy
- Elastic Energy

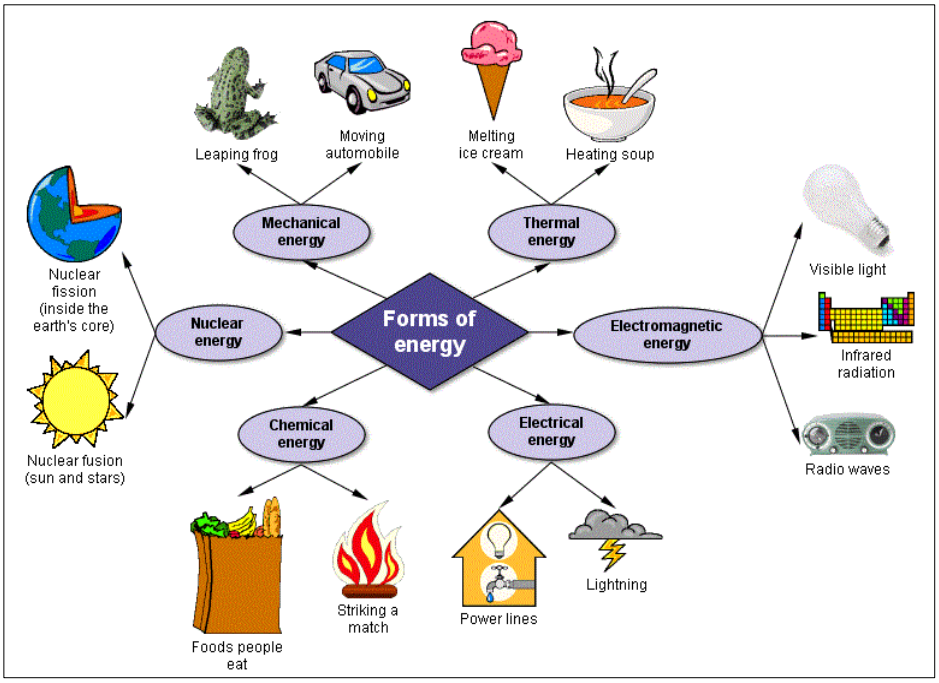


Figure 2: Renewable and Non- Renewable Energy (Source: https://www.pinterest.com)

1.4 Energy Principal

Energy can be transformed into another form of energy. But, it cannot be created and it cannot be destroyed. Energy has always existed in one form or another.

Examples

1. In an electric bulb, electrical energy is converted into light and heat energy.
2. In a bicycle pump, mechanical energy is converted into heat energy. Thus the pump gets hot. Like, if we rub our hands, heat is produced due to friction.
3. In a generator or dynamo, mechanical energy is converted into electrical energy.
4. When you talk on the phone, your voice is transformed into electrical energy, which passes over wires (or is transmitted through the air). The phone on the other end changes the electrical energy into sound energy through the speaker.
5. A car uses stored chemical energy in gasoline to move. The engine changes the chemical energy into heat and kinetic energy to power the car.
6. When we eat, our bodies transform the energy stored in the food into energy to do work. When we run or walk, we burn food energy in our bodies.

1.5 Solar Energy – what is it?

It is Energy from the sun

The sun has produced energy for billions of years. Solar energy is the sun's rays (solar radiation) that reach the earth. This energy can be converted into heat and electricity.

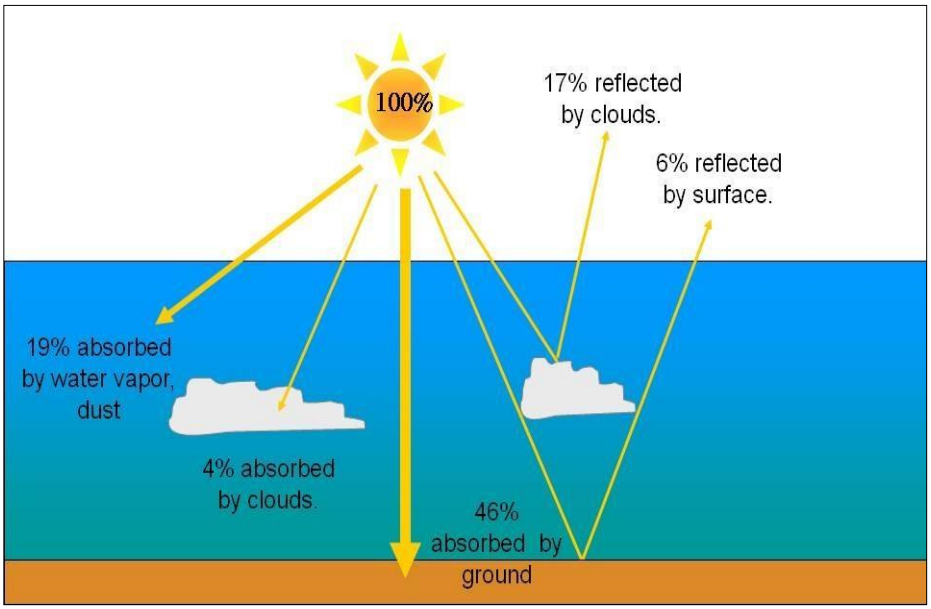


Figure 3: Solar Energy Absorption and Emission
(Source: http://www.ashevillegeothermal.com/)

Solar energy can be used for heat and electricity

When converted to thermal energy, solar energy can be used to heat water for use in homes, buildings, or swimming pools; to heat spaces inside homes, greenhouses, and other buildings; and to heat fluids to high temperatures to operate a turbine to generate electricity.

Solar energy can be converted to electricity in two ways:

I. Photovoltaic (PV devices)or solar cells change sunlight directly into electricity. Individual PV cells are grouped into panels and arrays of panels that can be used in a wide variety of applications ranging from single small cells that Charge calculator and watch batteries, to systems that power single homes, to large power plants covering many acres.

II. Solar thermal/electric power plants generate electricity by concentrating solar energy to heat a fluid and produce steam that is then used to power a generator.

There are two main benefits of solar energy:

- Solar energy systems do not produce air pollutants or carbon dioxide.
- When located on buildings, solar energy systems have minimal impact on the environment.

Questions:

1. What is energy?
2. Name different forms of energy?
3. Distinguish between renewable and Non-renewable energy and give examples
4. What is energy principle?
5. What is solar energy? And list down all the benefits of Solar energy over other non-conventional energy source
6. How does solar energy generate electricity?

MODULE– 2 Electricity

2.1 Introduction

In this module, the fundamentals about electricity, its type and characteristics will be covered. We shall also study Ohm's law, electrical energy and power that shall be used in the further module to calculate the household electricity bill.

2.2 Introduction to Electricity

Electricity is a type of energy that can build up in one place or flow from one place to another. When electricity gathers in one place it is known as static electricity (the word static means something that does not move). Static electricity is the result of an imbalance between negative and positive charges in an object. Electricity that moves from one place to another is called current electricity.

2.2.1 Static Electricity

Static electricity often happens when you rub things together. If you Rub a plastic comb or ruler on a dry cloth and hold it over very small bits of paper you will see the paper jump to the comb; this is electric charge an accumulation of electrons on the plastic Comb which produced a field to attract the bits of paper. **Opposite charges attract each other.**

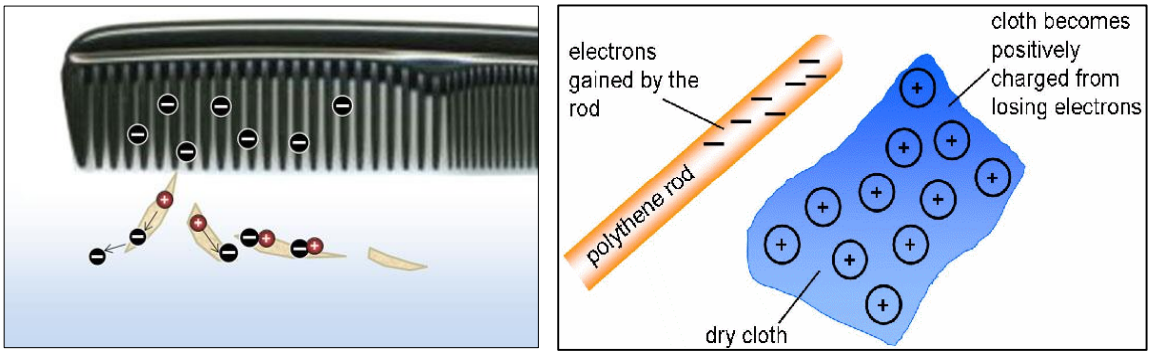


Figure 4, 5: Static Electricity effect (Source: http://physics.stackexchange.com/)

2.2.2 Current Electricity

When electrons move, they carry electrical energy from one place to another. An **electric current** is a flow of **electric** charge. In **electric** circuits, this charge is often carried by moving electrons in a wire. This is called current electricity or an electric current.Electricity is form of energy.We cannot see it but, we can think of electricity as a flow of water in pipe.

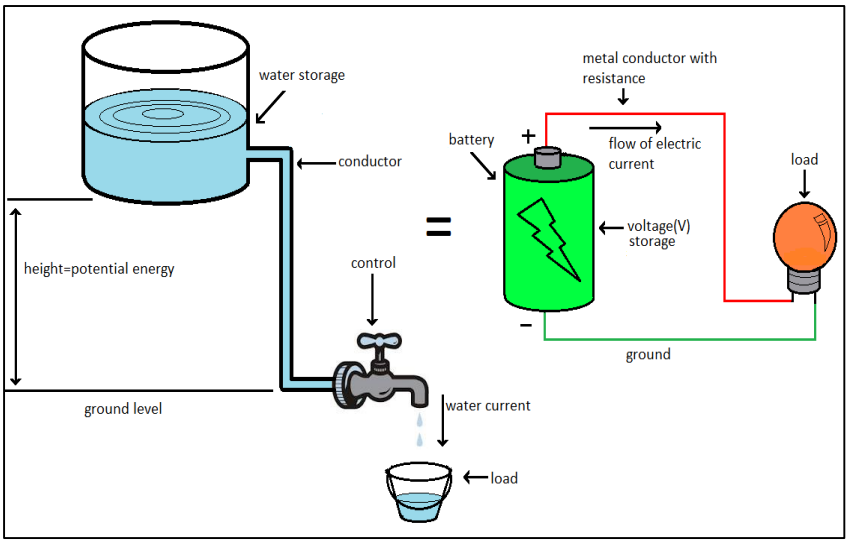


Figure 6: Current Electricity (Source: http://technology-tronics.info/electric-generation/)

As shown in figure 6, water is flowing from high pressure to low pressure through a medium, like a pipe, the same in case of electricity; it also requires a medium to flow.
On the basis of their property, a medium can be categorized as:

Conductors	Semiconductors	Insulators
Some materials allow electric current in them. They are called conductors e.g. • Copper • Aluminum • Platinum • Gold • Silver • Water • People and Animals • Trees	Some materials behave in between a conductor and an insulator. These materials are called semiconductors, e.g. • Silicon • Germanium	Some materials do not allow electric current in them. They are called insulators, e.g. • Glass • Porcelain • Plastic • Rubber

2.2.3 Characteristics of electricity

- **Voltage**: We define voltage as the amount of potential energy between two points on a circuit. One point has more charge than another. This difference in charge between the two points is called voltage

- **Current**:The amount of charge flowing through the circuit over a period of time is called current. It is measured in Ampere.

- **Resistance**:The circuit with the higher resistance will allow less charge to flow, meaning the circuit with higher resistance has less current flowing through it.

- **Energy**:Electrical energy is energy that is caused by moving electric charges. Since the electric charges are moving, this is a form of kinetic energy. The faster the electric charges are moving, the more electrical energy they carry.

- **Power**: It is defined as the **rate at which energy is transferred**

2.3 Voltage

Voltage is an electrical pressure. Just like water pressure, higher the voltage, more the work that can be done. Voltage is measured in volts, V

1/1000th of a volt (V) is a millivolt-mV or 1volt (V) = 1000mV (millivolt)

- Voltage is **supplied by the battery** (or power supply).
- Voltage is **used up in components**, but not in wires.
- We say **voltage across** a component.
- Voltage is measured in **volts**, **V**.
- Voltage is measured with a **voltmeter**, connected in **parallel**.
- The symbol **V** is used for voltage in equations.

2.4 Current

Current is the flow of electricity. It is like the volume of water flowing, so higher current means higher the volume of flow and more the work that can be done.

Current is measured in Ampere (A)

- Current is the **rate of flow of charge (electrons)**
- Current **is not used up**, what flows into a component must flow out
- No current flows when there is a break in the circuit
- Current is measured in **amps (amperes)**, **A**
- Current is measured with an **ammeter**, connected in **series**

We should note here that the current flow is possible only when voltage is available. If the voltage is zero, the current flow will also be zero.

As the diameter of the pipe increases, the amount of water that can flow through it also increases. As shown in figure 7, wire having large diameter indicates lower resistance to current flow.As the cross-sectional area of the wire increase , so does the amount of electric current that can flow through it for the same voltage level.Thus whenever we need to conduct large current,a wire of large diameter should be chosen.

An analogy of electric circuit with water flow has been made for better understanding the concepts of electricity.

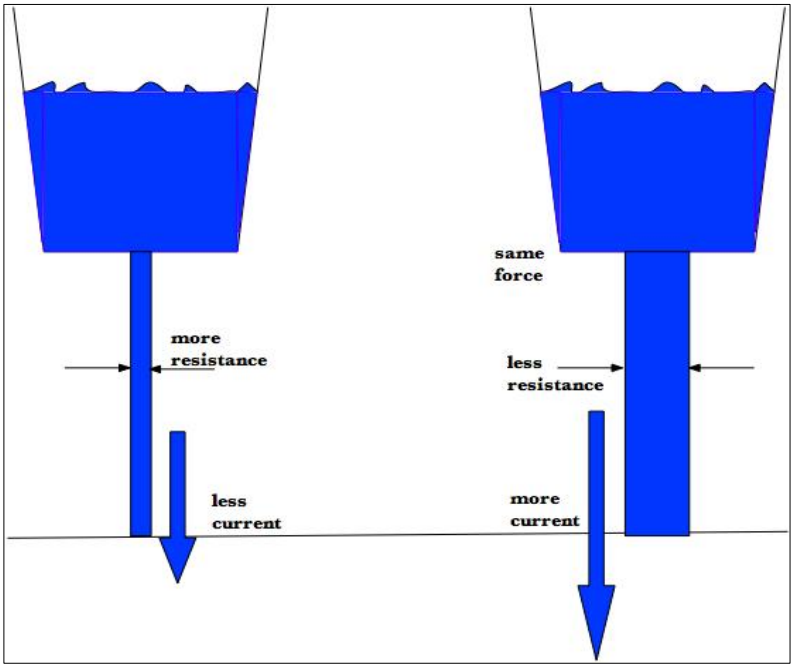


Figure 7: Current Electricity (Source - http://audio-electronics.wikidot.com/ohms-law

2.5 Resistance

Resistance obstructs electrical flow. Resistance can be compared to water flowing through a hole in the bottom of a water container. The smaller the hole, the lesser the flow because the small hole resists the flow of water more than a large one. So, a material with a high electrical resistance, is like a small hole in a water container, it resist the flow and causes less electricity to flow. A material with a low resistance allows electricity to flow easily as would a large hole in a water container. *(*Also refer figure 7)

1/1000th of an Ampere (A) is a 1 milliampere (mA) or 1mA = 0.001A or 1 Ampere (A) = 1000mA (milli Ampere)

Electrical Resistance Symbol:

Figure 8: Electrical Resistance (Source-http://www.circuitstoday.com) http://www.wisegeek.org)

Electrical resistance

Figure 8: Electrical Resistors (Source -

2.6 Ohm's Law

Ohm's Law deals with the relationship between voltage and current in an ideal conductor. This relationship states that:**The potential difference (voltage) across an ideal conductor is proportional to the current through it.**

The constant of proportionality is called the "Resistance", R.

V = I X R

V is the potential difference between two points which include a resistance R.
I is the current flowing through the resistance.

For Current we can write,$\mathbf{I = V/R}$

In other words, if we increase the voltage, then the current will increase. But if we increase the resistance, then the current will decrease.

We saw these concepts in action with the garden hose. Increasing the pressure caused the flow to increase, but getting a kink in the hose increased the resistance, which caused the flow to decrease.

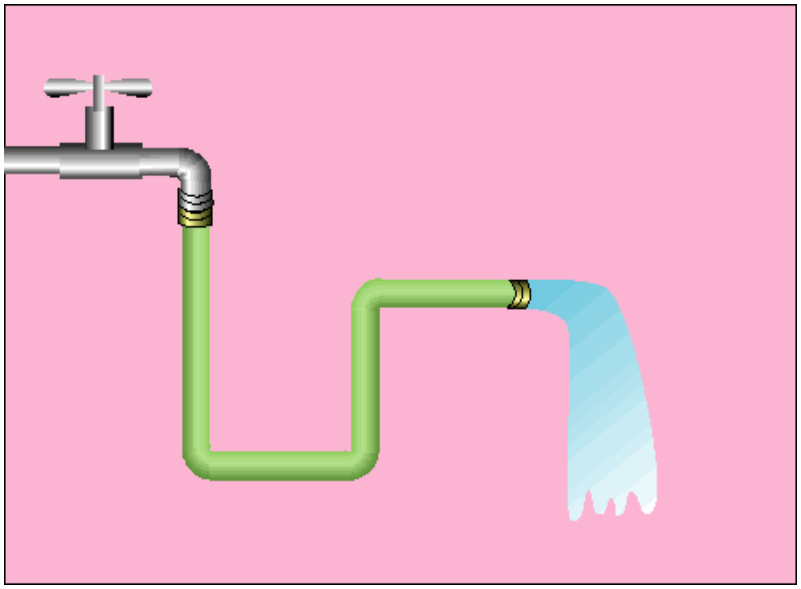
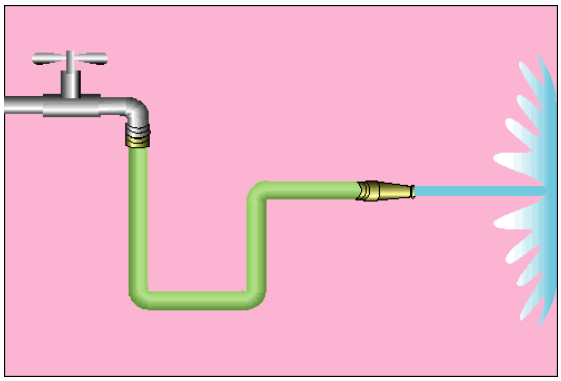
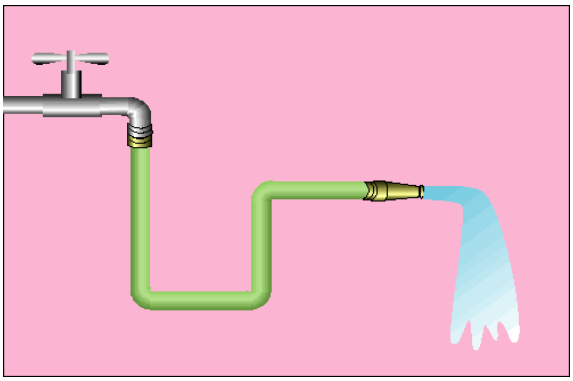


Figure 8: water in the hose analogy to explain current, voltage & resistance
(Source- http://faculty.plattsburgh.edu//ohms-law)

The current is water flowing in the hose. The water pressure is analogous to the voltage of a circuit and the diameter of the hose determines the resistance.

What happens when you put a nozzle at the end of the hose?	What Would happen to the pressure if you decrease the flow (by turning down the faucet) while keeping the nozzle at the hose (constant resistance)?
• In this case, the resistance increases with a constant amount of water flowing through it. • **What happens to the pressure?** • When the resistance increases, and the current is constant, the pressure increases:	• If the resistance is kept constant and the flow is reduced by closing the faucet, the water pressure decreases:
 Figure 9: Water in the hose analogy to explain current, voltage & resistance (Source- http://faculty.plattsburgh.edu//ohms-law)	 Figure 10: Water in the hose analogy to explain current, voltage & resistance (Source- http://faculty.plattsburgh.edu//ohms-law)

The same thing is true of electrical circuits	
If R increases, V has to increase to keep their quotient (I) constant.	**If I decreases, V has to decrease to keep their quotient (R) constant.**
$I = \frac{V}{R}$ ↑ ↑	↓ $I = \frac{V}{R}$ ↓

2.6.1 Use of ohm's equation

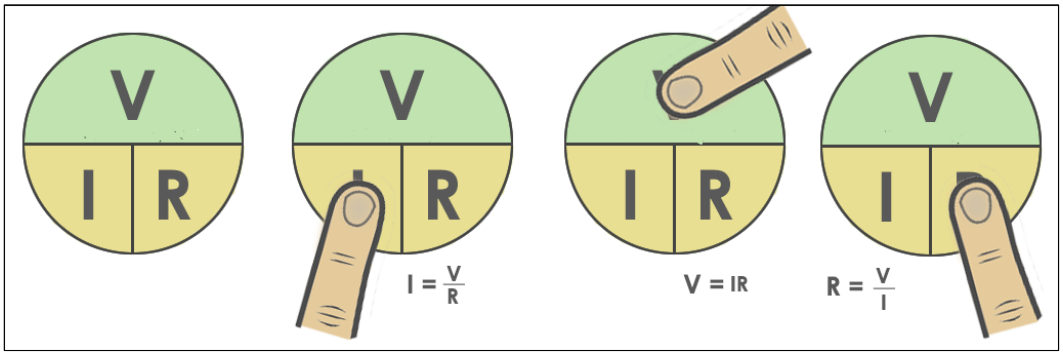


Figure 11: Use of Ohm's Law (Source- http://www.circuitstudy.com)

2.7 Electric Power

When electricity flows in an electrical circuit, it results in work done. The term, power (P), is a measure of the rate of or speed of electrical work done.The more power means the electrical work is done at high speed and less power means the electrical work is done at low speed.

Power of electrical work done or power of electricity depends on electric pressure (electrical voltage) and electron flow rate (electrical current); **Power is measured in Watts (W)**

Electrical Power = Voltage X Current
Power (watt) = Voltage (volt) X Current (ampere)
P (W) = V (V) XI (A)

1/1000th of a watt is a 1 milliwatt (mW) or 1 Watt = 1000 milliwatt (mW)

2.8 Electrical Energy

Electrical energy is the total amount of electrical work done during a given time period. It is product of power of electrical appliances and duration of its usage. Electrical energy is measured in**Watt-hour or Wh**

Electrical Energy = Power x Duration of usage
Energy (E) = Power (watt) x Time (hour)
E (Wh) = P (W) *x* T (h)

A kilowatt-hour is unit that electricity utilizes use when billing in our homes.

1 KWh = 1 unit

2.9 DC Power and AC Power

DC power is the product of DC current and DC voltage, and has a unit Watt

$$P_{dc} = I_{dc} X V_{dc} \text{ (Watt)}$$

A DC circuit is a circuit in which the direction of current flow does not change with time.

PV module produces DC power or DC voltage or DC current

.

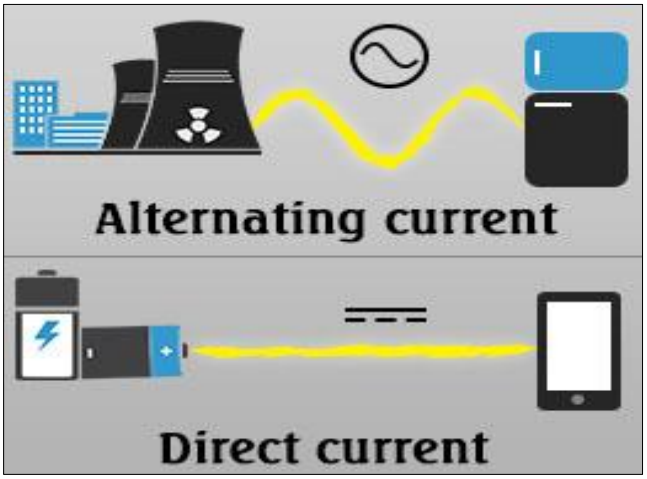


Figure 12: Alternate Current & Direct Current
(Source- http://www.buzzle.com/)

AC power is the product of AC current and AC voltage, Unit, Watt

$$P_{rms} = I_{rms} X V_{rms} \text{ (Watt)}$$

The direction and value of AC current and AC voltage keep changing all the time. The AC current changes its direction 50 times in one second (in this situation it is called that current has 50 cycles)

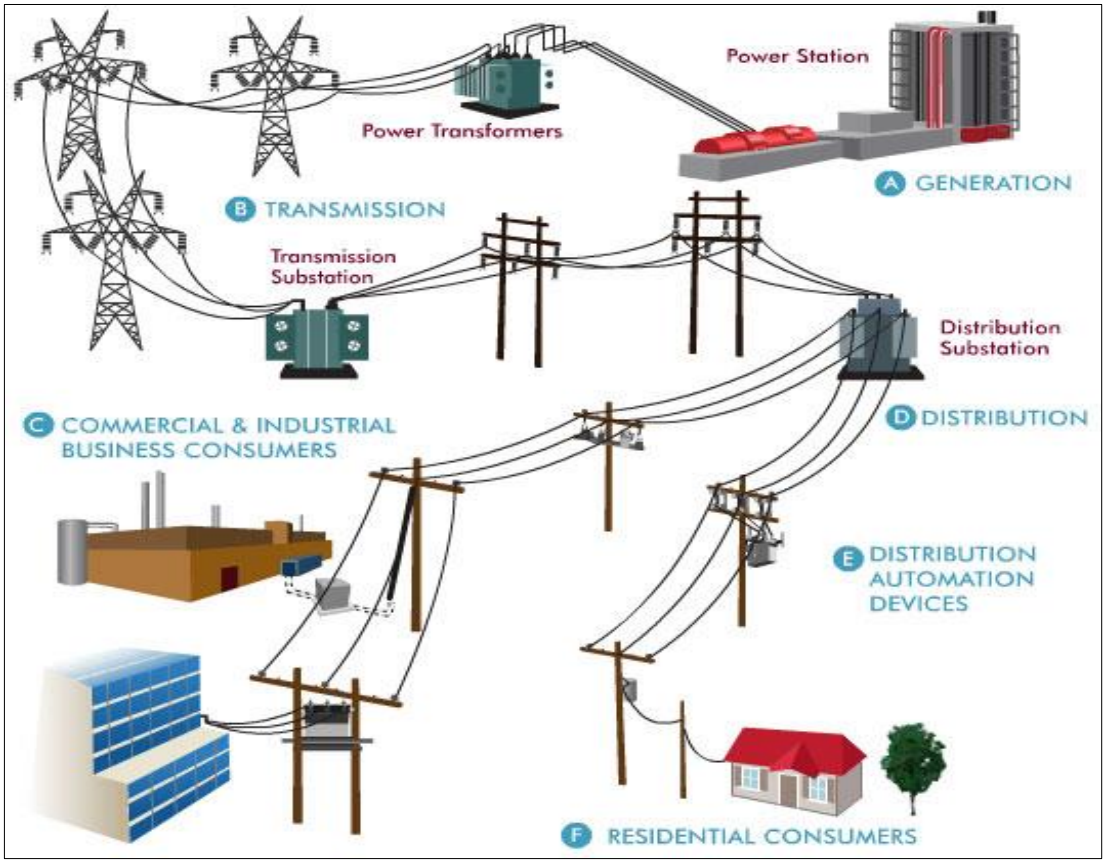


Figure 13: Distribution of electricity (Source- https://www.wpi.edu)

2.10 Fundamental electrical quantities, units and symbols

Quantity Name	Symbol	Definition	Unit
Electric Charge	Q,q	Basic quantity	Coulomb **C**
Voltage	E,emf,V	Voltage is a measure of the energy carried by the charge	Volt **V**
Current	I,i	Current is the rate of flow of charge	Ampere **A**
Resistance	R,Ω	Opposition to electric current (moving charge)	Ohm **Ω**
Power	P	Work per unit time	Watt **W**
Energy	E	Total amount of work done	Watt-hour **Wh**

Questions:

1) What is static electricity?
2) What is the pressure that pushes the electrons in a wire?
3) Consider a 5V battery and a 10V battery. Which of these two batteries can push the electrons with more pressure?
4) What is the flow of electrons in a wire called?
5) Consider two wires, a 1 cm diameter and a 2 cm diameter. Which of these two wires can allow more flow of electrons at same applied voltage?
6) What does electric power depends?
7) An electrical appliance is connected to 50 V which results in 3 A current through the load. What is the power consumed by the load?
8) Energy of 100 Wh is consumed in 1 hour. What is consumed power?
9) An electrical bulb consumes energy at the rate of 100 W and is used for 10 hours. What is the consumed energy?

MODULE– 3 Basic Mathematics and Unit Conversion

3.1 Introduction

This chapter covers the basic unit conversion used in the context of electricity. Towards the end of the module, electricity bill calculation is shown.

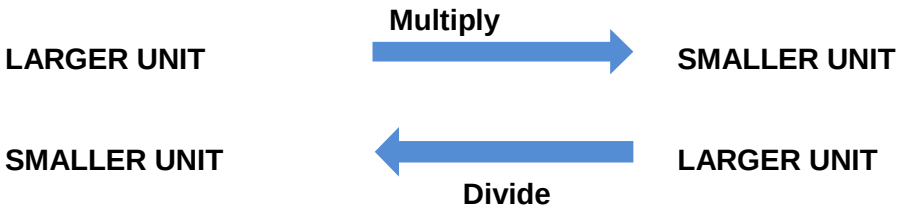
3.2 Basic Multiplication and Division

1 X 10 = 10	1 X 0.1 = 0.1
10 X 10 = 100	0.1 X 10 = 1
10 X 100 = 1000	100 X 0.001 = 0.1
100X 100 = 10000	0.1 X 0.1 = 0.01
10 X 1000 = 10000	0.001 X 0.001 = 0.000001
100 X 1000 = 100000	1000 X 0.01 = 10
10 X 100000 = ……..	0.01 X 0.01 = ……
50 X 100 = ……..	0.5 X 10 = ……..
55 X 1000 = ……	0.5 X 0.001 = ……
500 X 200 = ……..	0.25 X 0.1000 = …….

1/10 = 0.1	0.1/0.1 = 1
1/100 = 0.01	0.001/1000 = 0.000001
1/1000 = 0.001	0.1/0.001 = 100
1/10000 = 0.0001	0.001/0.001 = 1
0.1/10 = 0.01	0.0001/0.001 = 0.1
0.1/100 = 0.001	1/1 = 1
5/1000 = ……..	0.5/0.1 = …….
5000/500 = …….	0.005/100 = …….
0.500/0.001 = ……..	0.0005/1.0 = …….
1000/10 = …….	0.250/0.100 = ……..

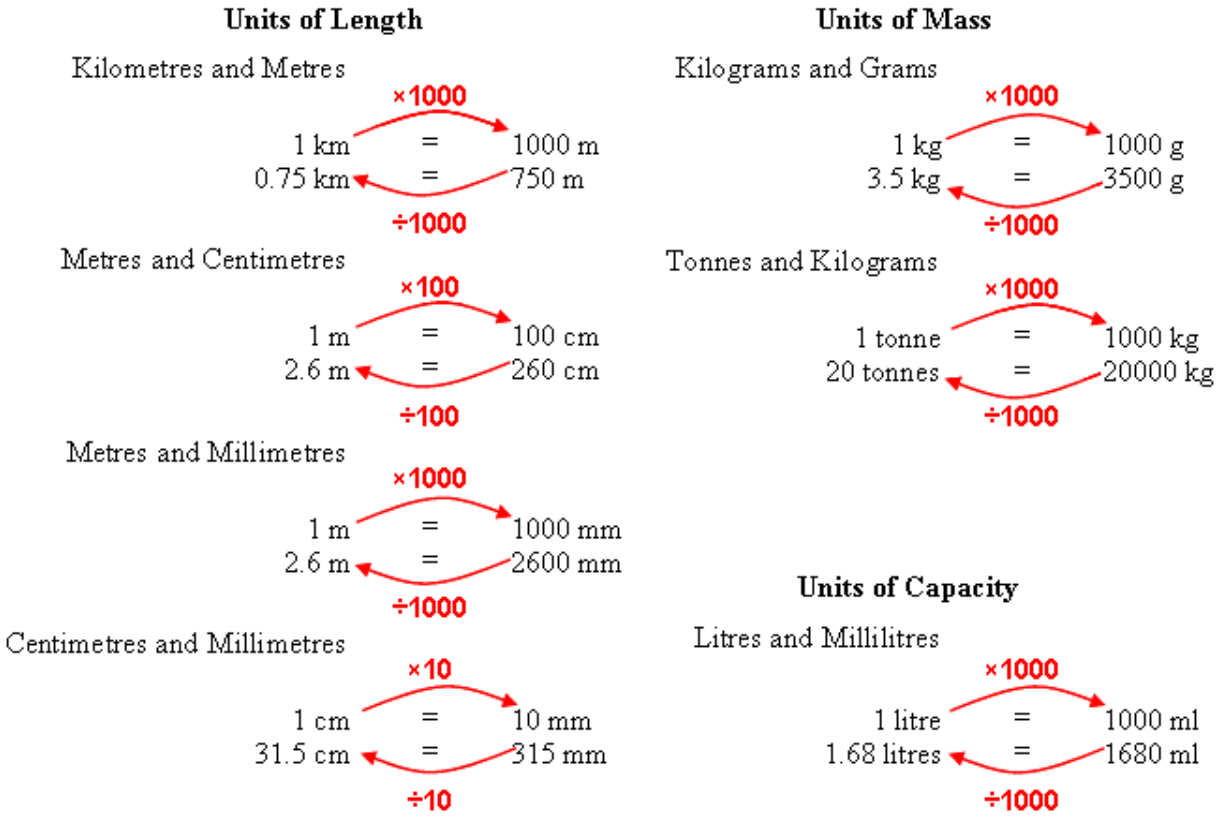
3.3 Unit Conversion

In order to convert from larger unit to smaller unit, we have to multiply (With the number which depends on the unit to convert to as shown in the example below) and in the same way, in order to convert from smaller unit to larger unit, we have to divide.



PREFIX	VALUE
Kilo (K)	1000
Mega (M)	1000,000
Giga (G)	1000,000,000
Centi (c)	0.01
Milli (m)	0.001

Examples



DO IT YOURSELF

1 mV = ……V
10 KW = ……W
5 A = ……mA
10 W = …….. KW
10 mW = ……W
100 mA = ……A
2.4 V = …… mV
230 mA = ……A
0.5 W = ……KW
3 KWh = ……..Wh

3.4 Electricity bill calculation

Monthly Electrical energy bill calculation: We can compute easily, the energy consumed by a device, knowing its power. The power of an object will be in watts or kilowatts. To calculate the total energy consumed by the device, multiply the power with the no. of hours the object has worked. We will get the energy consumed in kilowatt hours (kWh). One electrical energy unit is equal to one kilowatt hour. Our monthly electricity bill is given in terms of electrical energy units. So by knowing the cost of one unit, we can easily compute the monthly electricity bill by multiplying it with the total energy consumed in 1 month.

Example: Estimation of total daily energy requirement of a house and monthly energy consumption and electricity bill?

Name of Appliances	Power Rating (in watts)	Average Daily hours of usage (in hours/day)	Number of Appliances (in Numbers)	Daily Energy Requirement (watt x hour x number) or Wh
CFL	12	5	2	120
FAN	50	10	1	500
BULB	60	5	1	300
TV	150	5	1	750

1. Daily Energy Requirement

From above table the total daily energy requirement of household
= (120 + 500 + 300 + 750) Wh
= 1670 Wh/day
Now, we know that 1KW = 1000 watts or 1000 W = 1 kW
So, 1670 W = 1.6 KW
And 1670 Wh/day will be equal to 1.6 KWh/day
Once you know the daily energy requirement for a given application, it is easy to find out monthly energy requirement.

2. Monthly Energy requirement

Monthly energy requirement = daily energy requirement X Number of days in month
= 1670 (Wh/day) X 30 (days/month)
= 50100 Wh or 50.1 KWh

3. **Monthly electricity Bill**

The “one unit of electricity” is equal to 1000 Wh or 1 KWh
Or 1 KWh = 1 Unit of electricity,
So, 50.1 KWh = 50.1 Units in a month
And if 1 Unit cost ₹ 5/- then
Monthly electricity bill will be = 50.1 X 5 ₹
= 250.50 ₹

Questions

Fill the following table:

Name of Appliances	Power Rating (in watts)	Average Daily hours of usage (in hours/day)	Number of Appliances (in Numbers)	Daily Energy Requirement (watt x hour x number) or Wh
TUBE LIGHT	40 W	4	1	
BULB	60 W	8	1	
CFL	18 W	5	1	
FAN	60 W	10	1	
TV	100 W	4	1	
CD PLAYER	30 W	1	1	
WATER PUMP	100 W	1	1	

MODULE– 4 Battery

4.1 Introduction

This module discuss about battery, its parameters and types.

4.2 Battery – what is it?

An electric **battery** is a device that converts stored chemical energy into electrical energy.

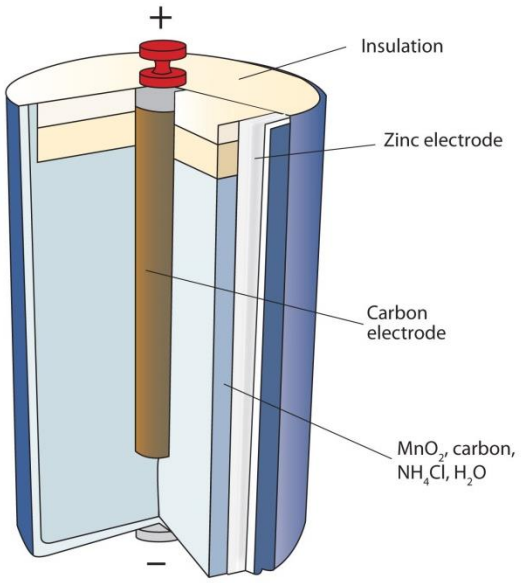
<table>
<tr><th colspan="3">BUILDING BLOCKS OF BATTERY</th></tr>
<tr><td>ANODE
(-)</td><td>The anode on a battery is always negative</td><td rowspan="4"> 
</td></tr>
<tr><td>CATHODE
(+)</td><td>Each cell contains a positive terminal, or cathode</td></tr>
<tr><td>ELECTROLYTE</td><td>Electrolytes allows current to flow out of the battery to perform work</td></tr>
</table>

Figure 14: Dry Cell(Source- http://catalog.flatworldknowledge.com)

4.2.1 Example of a Battery – Lemon Battery

A lemon battery is a simple battery. A piece of zinc metal and a piece of copper are inserted into a lemon and connected by wires. The zinc and copper are called the electrodes, and the juice inside the lemon is called the electrolyte.

The energy for the battery does not come from the lemon, but rather the chemical change in zinc (or other metal). The lemon merely provides an environment where this can happen, but they are not used up in the process.

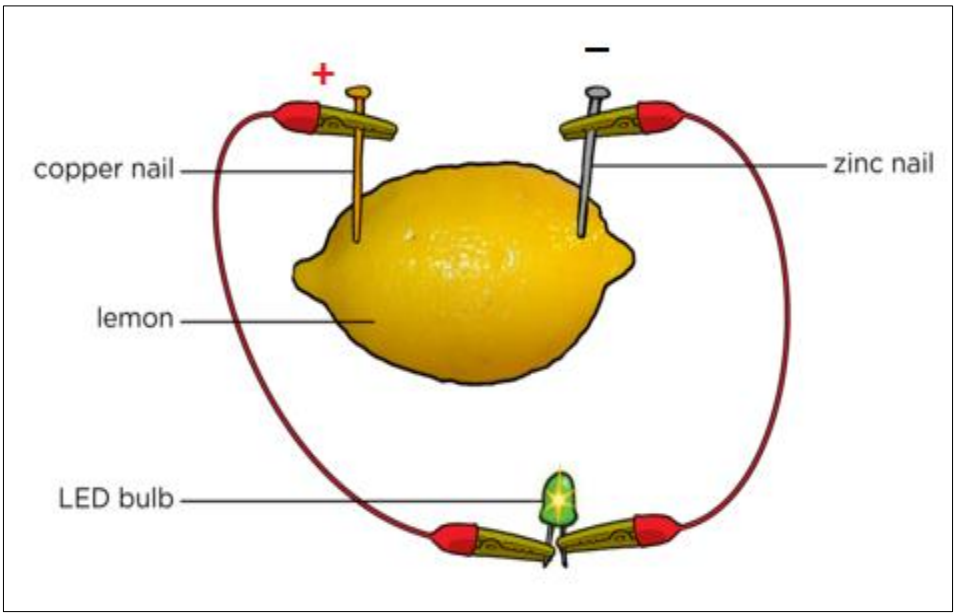
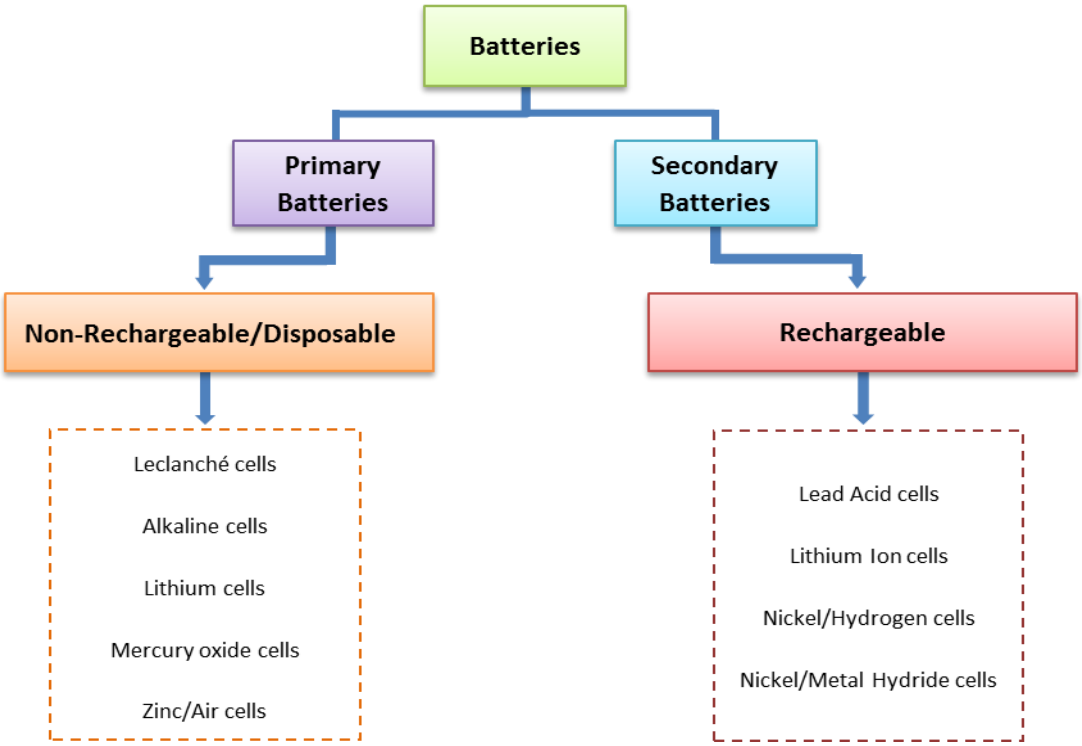


Figure 15: Lemon Battery (Source- http://www.mstworkbooks.co.za)

4.3 Types of Battery

Batteries can be divided into two major categories, Primary Batteries and Secondary Batteries.
A primary battery is a disposable kind of battery. Once used, it cannot be recharged.

Secondary batteries are rechargeable batteries. Once empty it can be recharged again. This charging and discharging can happen many times depending on the battery type.



4.4 Parameters of Battery

Battery terminal voltage	A battery's terminal voltage is the voltage difference between its two electrodes. The battery terminal voltage Changes with the condition of battery .The terminal voltage increases when battery gets charged, the terminal voltage decreases when battery gets discharged
Open circuit voltage	This is the maximum possible voltage at output terminals of battery when circuit is open.
Nominal terminal or operating voltage	It is actual voltage available at the output terminals of the battery on which load can operate.
Cut-off voltage	It is a voltage up to which the load can be operated and below which the battery should be disconnected from the load in order to prevent it from over-discharge.
Battery storage capacity (C)	The capacity of a battery is the capacity to store the charge in the battery. It is the product of current (in Amperes) it can deliver for a given time (in hours). **Capacity (C) = Current (A) X Hour (h)**
How much current battery can supply?	In practical, there is no source which can supply an unlimited amount of current. Similarly, battery is a device that can supply different amount of current. **Current (I) = $\frac{\text{Capacity (Ah)}}{\text{Discharge duration (h)}}$ (amperes)** If our discharge duration is small, we can draw large current from battery.
How much is energy stored in battery?	**Energy (watt-hour) = Capacity (Ah) X Voltage (V)** Large capacity battery and higher terminal voltage battery stores higher amount of electrical energy.
What is the power of the battery?	**Battery power (watt) = Terminal voltage (V) X Current drawn (A)**

Depth of Discharge (DoD)	In practical applications, all the charge stored in a battery cannot be used for running load. Only some percentage of total charge stored can be used. The percentage of total charge that can be used for running the load is referred as Depth of Discharge. 50% DoD means that only 50% of the total stored charge can be used. As the DoD of battery increases (due to use of its stored charge), the terminal voltage of battery decreases. Manufacturers specify allowable DoD level for their batteries. The battery should not be discharged below manufacturers specified level in order to prevent damage to battery. If the batteries are discharged below their DoD rating, then the life of the batteries decreases very fast.

State of Charge (SoC)	The state of charge indicates the amount of charge (in percentage) that is still there in the battery. **SoC (%) = 100% - DoD (%)** **Or** **DoD (%) = 100% - SoC (%)** As we keep using battery, its DoD percentage increases and SoC percentage decreases. For higher SoC, the battery will have higher terminal voltage and for lower SoC, the battery will have lower terminal voltage. Thus when a fully charged battery is utilized to supply the charge to a load and as the amount of stored charge in the battery decreases, its terminal voltage keeps decreasing. In this way, at any state of discharge if we measure the terminal voltage we can estimate the state of charge of a battery.
Charging/Discharging Rate or C – rating	Discharging battery at high rate is not safe; similarly charging battery at high rate is also not safe.
Life cycle	Life of a battery can be given in terms of the number of charge-discharge cycles it can provide. One charging and discharging operation of a battery is referred as one cycle of battery.

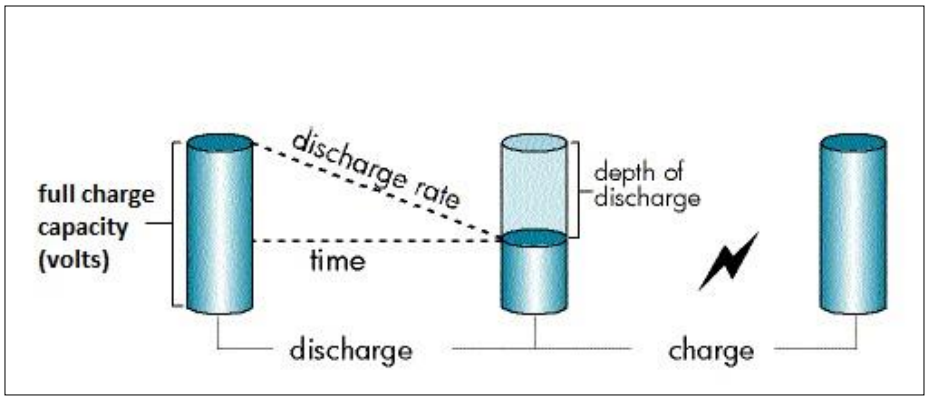


Figure 16: Discharge rate & depth of discharge (Source- https://support.hp.com)

4.5 Series and Parallel Connection of Batteries

In order to meet the requirement of voltage or current we can connect several batteries in series or parallel. When batteries are connected together in series, the overall voltage increases but current remain the same. When the batteries are connected together in parallel, the overall current increases but the voltage remains the same. In all series or parallel connections of batteries, the total energy of the batteries always gets added irrespective of the batteries are connected in series or parallel.

In order to connect batteries in series and parallel, it is recommended that all the batteries that are to be connected together should be of the same ratings, i.e. same terminal voltage and same capacity.

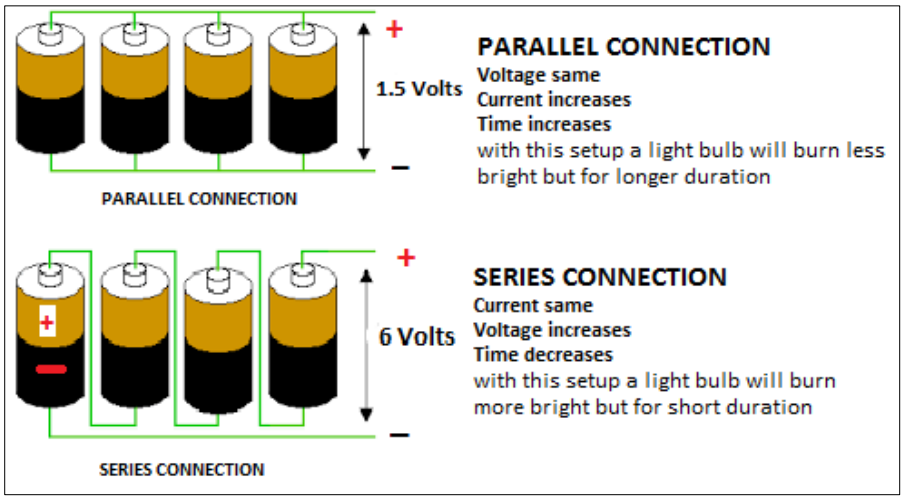


Figure 17: Series & parallel Connection of Batteries

Questions

1. If we have 12 V battery of capacity 500 Ah, then calculate the power of battery and the amount of energy stored in the battery?
2. Consider a 12 V battery with a charge capacity of 150 Ah. Find the amount of current given by battery if it is discharged in 5 hours?
3. Classify different types of batteries and explain different parameters of the battery?
4. If we have two 3 volt batteries, what would be the total voltage if connected in series? And what would be the total voltage if connected in parallel?
5. What is an electrolyte?
6. Name some rechargeable batteries?

MODULE – 5 Light Emitting Diode (LED)

5.1 Introduction

This module will discuss the working principle of light emitting diode (LED). It shall cover the usage of bicolor LED and PCB

5.2 LED – what is it?

Light Emitting Diodes are semiconductor devices that convert electrical energy into light energy.

Alight emitting diode (LED) is designed to light up in a DC (direct current) circuit. In a DC circuit, a LED converts electric current directly into light.

The LED is much more efficient than an incandescent light bulb or a fluorescent light bulb (also known as a mercury vapor bulb), which give off more heat, wasting energy.

Figure 18: LED (Source- https://www.zamnesia.com)

5.3 How LED Works

LED lights up by using a small semiconductor crystal. When the crystal is energized with electrical current, the semiconductor emits light.

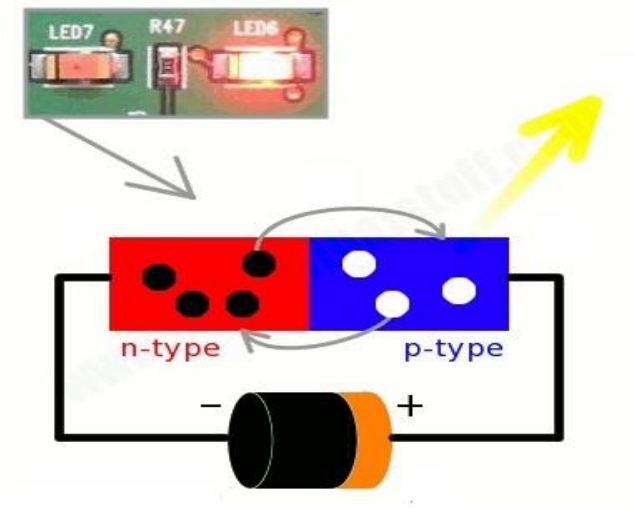


Figure 19: Working of LED (Source-https://explainthatstuff.com)

The LED semiconductor has n-type (negative) and p-type (positive) material. These two materials give the LED the ability to light up. When current is allowed to flow from the p-type material to the n-type material, the LED emits light.

Some important points about LED

A small reflector (like the reflector surrounding a car headlight lamp) surrounds the semiconductor crystal, making the LED brighter.

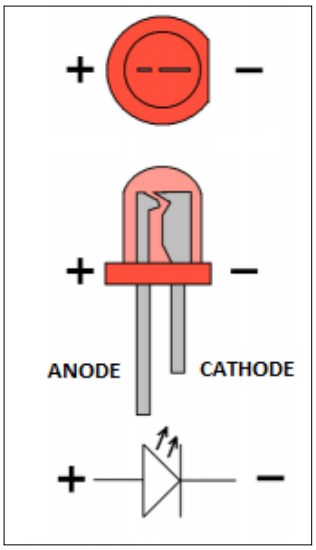


Figure 20: Diagram of LED (Source- https://en.wikipedia.org/wiki/Light-emitting_diode)

- A LED has two legs that are used to connect it into a circuit. The legs, called leads, also help pull heat away from the LED circuit.
- The legs of the LED are not the same. One leg is longer than the other. The longer LED leg is known as the anode. The shorter LED leg is known as the cathode.
- The anode leg helps direct current from the p-type material to the cathode. The anode leg is connected in a circuit towards the positive terminal of the battery. If the LED is connected backwards it will not light up.
- All LEDs are made with a maximum voltage they can connect to without being destroyed. This voltage is typically between 1.5 volts and 3.6 volts. Voltages higher than labeled on the LED packaging will result in a LED that is destroyed.

5.4 How does LED get its color?

Light Emitting Diodes are made from exotic semiconductor compounds such as Gallium Arsenide (GaAs), Gallium Phosphide (GaP), Gallium Arsenide Phosphide (GaAsP), Silicon Carbide (SiC) or Gallium Indium Nitride (GaInN) all mixed together at different ratios to produce a distinct wavelength of color.

Thus, the actual color of a light emitting diode is determined by the wavelength of the light emitted, which in turn is determined by the actual semiconductor compound used in forming the PN junction during manufacture.
Therefore the color of the light emitted by an LED is NOT determined by the coloring of the LED's plastic body although these are slightly colored to both enhance the light output and to indicate its color when it's not being illuminated by an electrical supply.

5.5 Bicolor LED

A bicolor light emitting diode has two LEDs chips connected together in "inverse parallel" (one forwards, one backwards) combined in one single package. Bicolor LEDs can produce any one of three colors for example, a red color is emitted when the device is connected with current flowing in one direction and a green color is emitted when it is biased in the other direction.

This type of bi-directional arrangement is useful for giving polarity indication, for example, the correct connection of batteries or power supplies etc. Also, a bi-directional current produces both colors mixed together as the two LEDs would take it in turn to illuminate if the device was connected (via a suitable resistor) to a low voltage, low frequency AC supply.

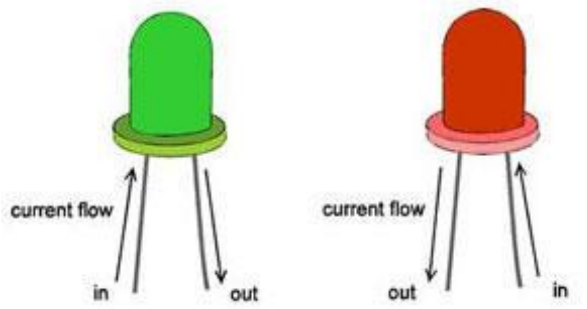


Figure 21: B-Color LED (Source- http://www.engineersgarage.com/)

5.6 PCB – What is it?

A **printed circuit board** (**PCB**) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate.

PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer (outer and inner layers).

Multi-layer PCBs allow for much higher component density. Advanced PCBs may contain components - capacitors, resistors or active devices - embedded in the substrate.

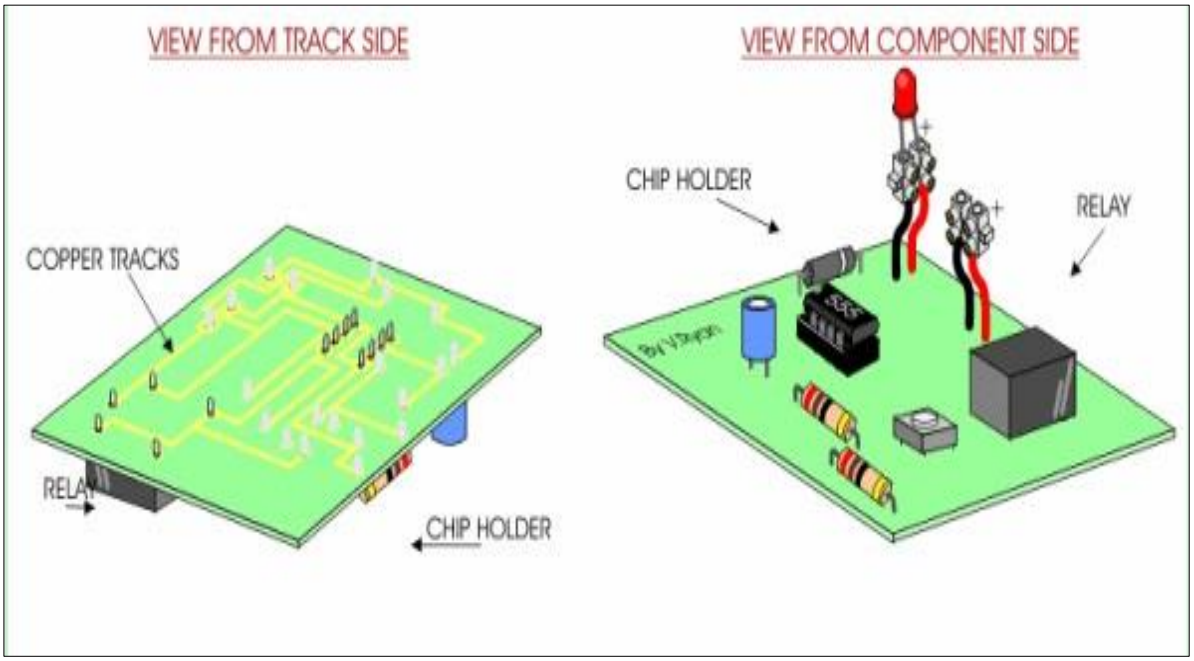


Figure 22: B-Color LED (Source- http://www.technologystudent.com)

MODULE – 6 Solar Panel

6.1 Introduction

This module will cover another form of energy: Solar Energy. This modules also discuss on how sunlight can be converted into electricity and the benefits of usage of solar energy

6.2 Solar Panel – What is it?

Solar panels are active solar devices that convert sunlight into electricity. One solar panel is made up of many small solar cells.

Solar cell: Semiconductor device that converts sunlight into direct current (DC) electricity.

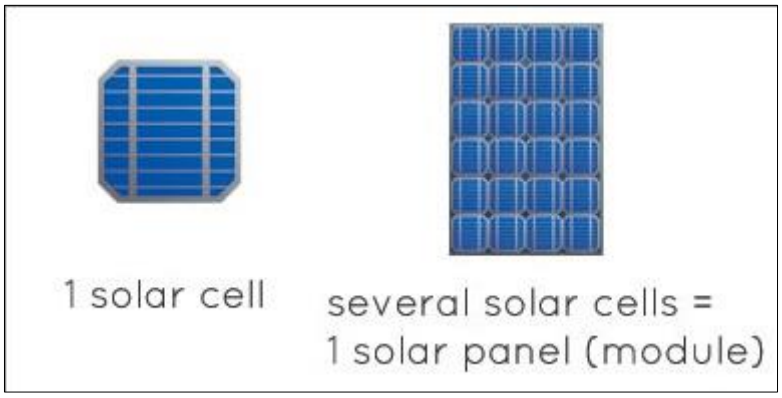


Figure-23: Solar Cells (Source: http://gogreena.co.uk/)

A solar cell is essentially a PN junction with a large surface area. The N-type (negative) material is kept thin to allow light to pass through the PN junction.

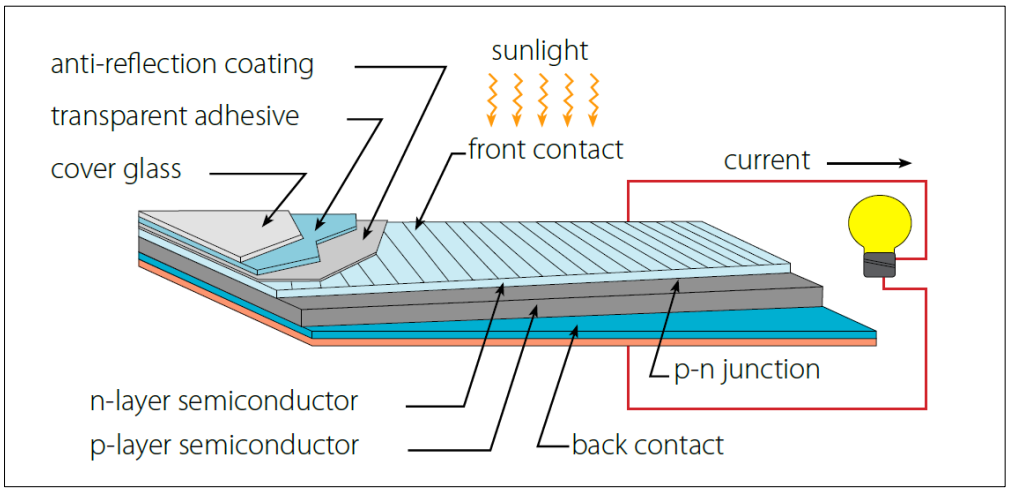


Figure-24: P-N Junction (Source:http://ffden-2.phys.uaf.edu/)

6.3 How it converts sunlight into Electricity?

When sunlight hits the semiconductor, an electron springs up and is attracted to the n-type semiconductor. This causes more negative electrons in the n-type semiconductor and more positive electrons in the p-type, thus generating a flow of electricity in a process known as the **"photovoltaic effect".**

6.4 Series and Parallel Connection of Solar Cells

Series: Solar cells connected in series (- to + to - to +) will increase the voltage output while the current remains the same.

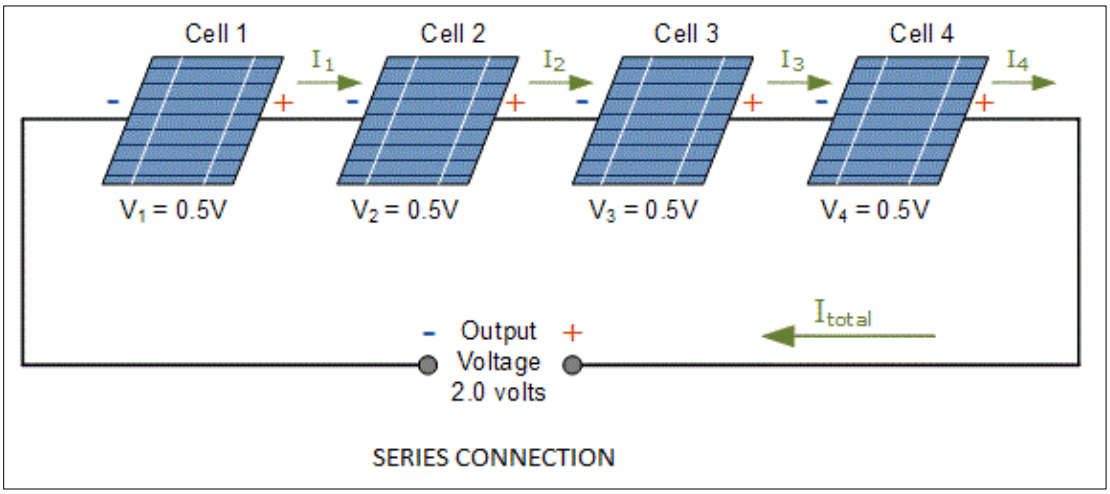


Figure-25: Solar Cell (Source:http://www.alternative-energy-tutorials.com/)

Parallel: Solar cells connected in parallel (- to - and + to +) will increase the current output while the voltage remains the same.

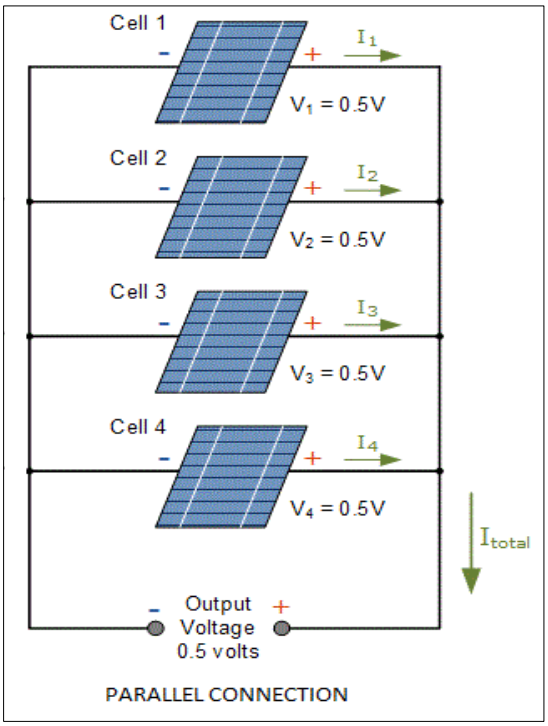


Figure-26: Solar Cells (Source:http://www.alternative-energy-tutorials.com/)

6.5 Benefits of using Solar Panel

Solar energy is not only sustainable, it is renewable and this means that we will never run out of it. It is about as natural a source of power as it is possible to generate electricity.

- The creation of solar energy requires little maintenance. Once the solar panels have been installed and are working at maximum efficiency there is only a small amount of maintenance required each year to ensure they are in working order.
- They are a silent producer of energy. There is absolutely no noise made from photovoltaic panels as they convert sunlight into usable electricity.
- There are continual advancements in solar panel technology which are increasing the efficiency and lowering the cost of production, thus making it even more cost effective.
- During operation solar electricity power plants produce zero emissions.

Questions:

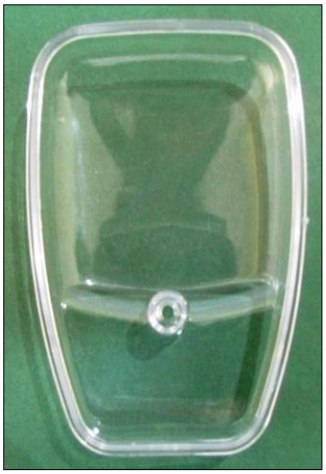
1. A PV panel produces AC or DC?
2. Can a solar panel generate electricity in moonlight?
3. What should be facing direction for a solar panel?
4. Name the semiconductor used in solar panel?
5. What is photoelectric effect?
6. If we have two 1 watt panel connected in series, what would be the effective voltage? Can we calculate it?
7. What is a PN junction?

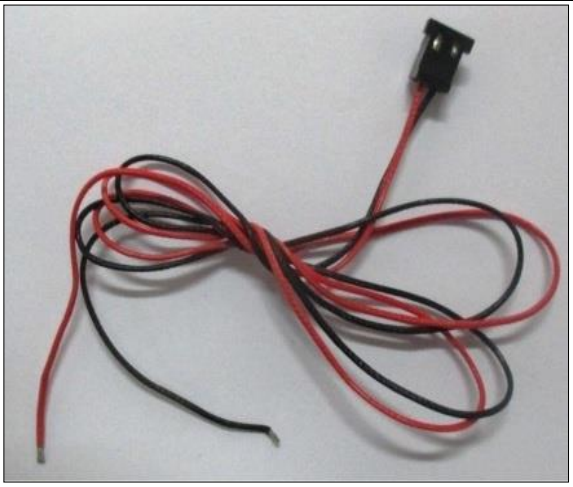
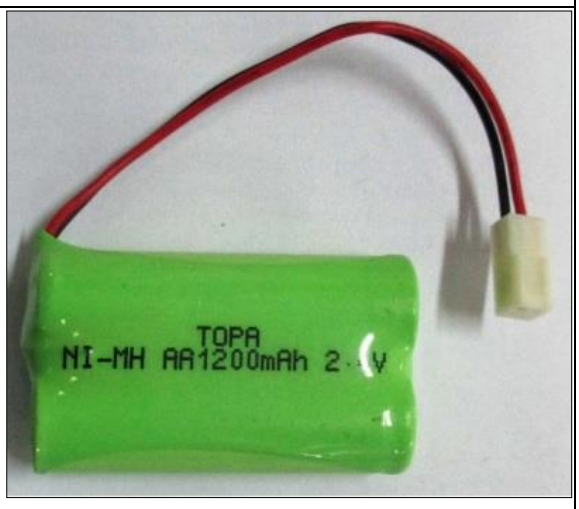
MODULE – 7 Physical testing of SoUL components

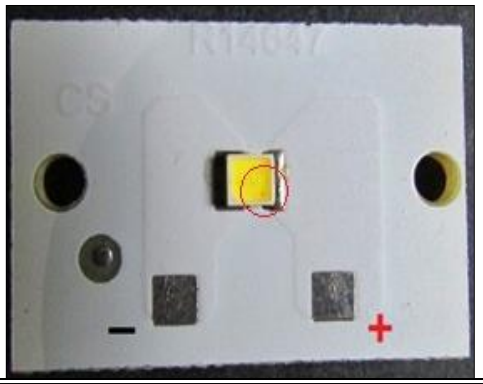
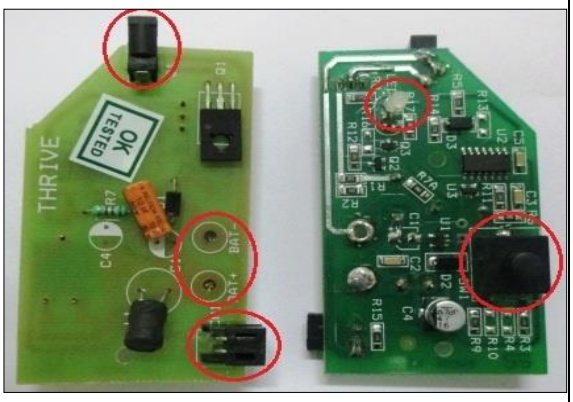
7.1 Introduction

This module covers the physical testing of all the components used in assembling Solar Urja Lamp (SoUL). The photographs used in this module is of Vendor A

Sr. No.	Name of Part	Manual Testing	Actual Photograph
1	**BASE COVER (Top)**	• Check for any scratch or breakage • Check all cavities i.e. switch/indicator LED/Gooseneck/screw fixings	
2	**BASE (Bottom)**	• Check for any scratch or breakage • Check all cavities i.e. screw fixings	

3	**LED CAP**	• Check for any scratch or breakage • Check all cavities i.e. Gooseneck/screw fixings	
4	**LED FACE (Transparent)**	• Check for any scratch or breakage • check all cavities i.e. screw fixings	
5	**LED REFLECTOR**	• Check for any scratch or breakage • Check all cavities i.e. screw fixings	

6	**GOOSENECK**	• Checkflexibility and any breakage • Check inside clearance along the length • Check the length, it should be 1 feet	
7	**LOAD WIRE**	• Check for any cuts or bends, • Check plastic connector and joints of wires with it • Check length of wire, it should be 1.6 inches	
8	**BATTERY**	• Check plastic connector, and wire joints with it • Check plastic covering of two cells i.e. green plastic cover, it should not be tempered • Check for wire cuts	

9	**LOAD LED**	• Check for any scratch on LED strip • check terminals • Check for a tiny dot inside LED	
10	**SOLAR PANEL**	• Check for any physical breakage of panel body • Check for any scratch on the face of panel • Check for any cuts on wire • Check for dimension of connector pin • Check the wire length, it should be 2.5 meter	
11	**PCB** **(PRINTED CIRCUIT BOARD)**	• Check status of switch by pushing it multiple times • Check status of indicator LED for proper solder of three legs • Check status of DC socket • Check status of Load LED connector point • Check status of Battery connection points • Check for any breakage of PCB and other visible components on it	

MODULE – 8 Technical testing of SoUL components

8.1 Introduction

This module covers the technical testing of components that make up Solar Urja Lamp. The usage of Multimeter is also described in this module.

8.2 Multimeter – What is it?

A Multimeter or a multitester, also known as a VOM (Volt-Ohm meter or Volt-Ohm-milliammeter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical Multimeter would include basic features such as the ability to measure voltage, current, and resistance.

Multimeter may also have other functions, such as diode and continuity tests.
(Multimeter used through the whole testing purpose is MECO's 603)

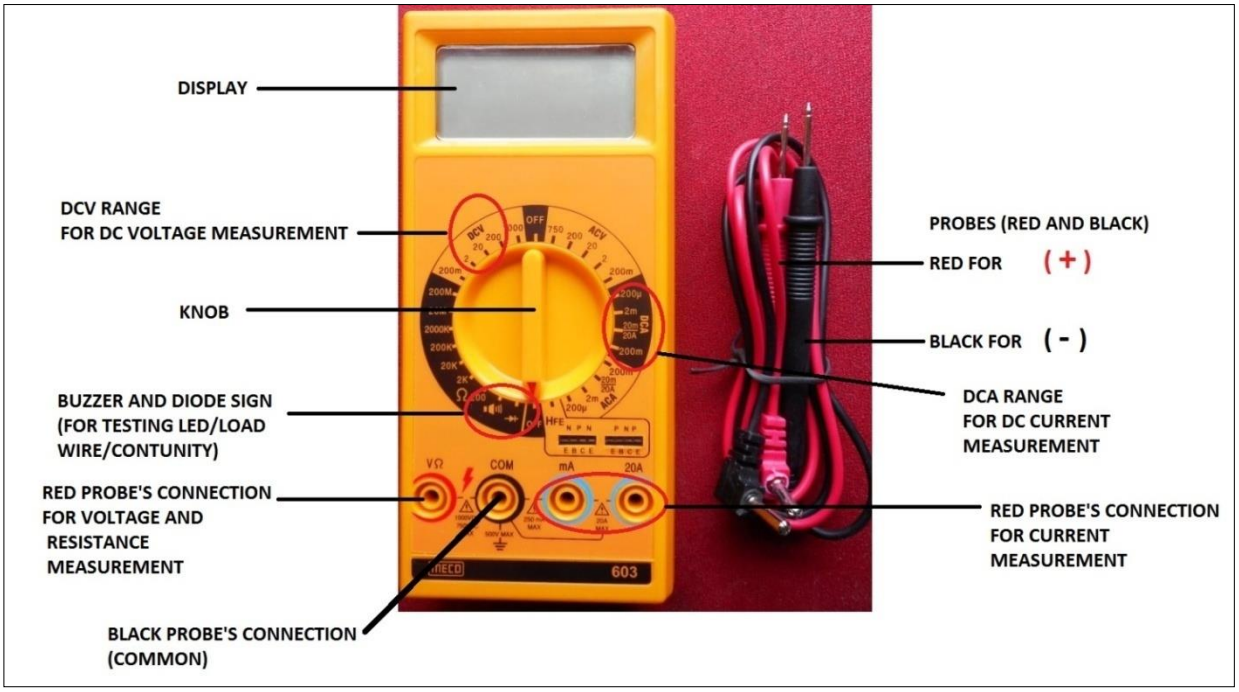


Figure-27 Multimeter with Probe

Points to remember when working with Multimeter

General precautions	Be sure the test leads/probes and rotary switch/knob are in the correct position for the desired measurement
	Never use the meter if the meter or the test leads look damaged
	When not in use, keep the digital Multimeter knob in OFF position
	Keep your fingers behind the finger guards on the test probes when making measurements
	To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.
Continuity Check	Before starting any measurement activity, you should check the Multimeter for continuity. For this, set the knob at buzzer position and connect its leads together, if it gives 'BEEP' sound, it means Multimeter is in good working condition, if not ,it means there is any problem with it
Voltage measurement	While measuring voltage, never touch the bare probe tips together as it will lead to a short circuit.
	If you forget to put the red lead into appropriate socket for voltage measurement and the red lead is connected to current socket in the Multimeter, a voltage measurement in this situation may lead to a short circuit through the Multimeter
	Be careful when working with voltages above 60 V DC or 30 V AC rms. Such voltages pose a shock hazard
Current measurement	Set the right current range before measuring higher current otherwise it will blow the digital Multimeter fuse.
	When the Multimeter knob is set to current measuring mode and you forget to change it to voltage measuring mode before taking voltage measurements, it may be a cause of potential hazard.
	Don't try to measure the current in household AC mains as it is dangerous.
Resistance measurement	A resister should be measured stand-alone otherwise connected components in the circuit may affect the reading
	Never measure resistance in a circuit when power is applied

8.3 Specifications

Specification of Technical Components used in SoUL

Sr.No.	PART	SPECIFICATION
1	**BATTERY**	Rechargeable **Ni-MH** **1200 mAh** (Charge/Capacity) 2.8 V (Maximum Voltage) **2.4 V** (Nominal Voltage) 2.1 V (Minimum Voltage)
2	**SOLAR PANEL**	**1W** (Maximum Power) **4.95 V** (Voltage at Maximum Power) 0.202 A or, **202 mA** (Current at Maximum Power) **5.80 V** (Open circuit voltage i.e. at No Load) 0.23 A or **230 mA** (Short Circuit Current i.e. at No Load)
3	**LOAD LED**	**0.5 W** (Maximum Power) 3.2 V (Operating Voltage) 50-60 mA (Low intensity Drain Current) 100-120 mA (High intensity Drain Current)

Specification table for different vendor's SoUL kit

TECHNICAL SPECIFICATIONS		**LAMP VENDORS**			
LAMP COMPONENTS		**Vendor A**	**Vendor B**	**Vendor C**	**Vendor D**
SOLAR PANEL	Rated Power	1.0 Watt	1.0 Watt	1.0 Watt	1.0 Watt
	Voc,Voltage (open circuit)	5.5 V	5.8 V	6.0 V	4.7V V
	Isc,Current (short circuit)	220 mA	230 mA	230 mA	270 mA
BATTERY	Voltage	2.4V	2.4V	2.4V	2.4V
	Capacity	1200mAh	1200mAh	1200mAh	1200mAh
	Type	Rechargeable Ni-MH	Rechargeable Ni-MH	Rechargeable Ni-MH	Rechargeable Ni-MH
MAIN LED	POWER	0.5 Watt	0.5 Watt	0.5 Watt	0.5 Watt

General Precautions before Testing of Technical components

- Always check the status of Multimeter before performing any test
- Always keep all the components over any insulating surface
- Do not perform any test with wet hands
- Avoid dusty and moisturize places for testing any electronics components
- Do not sit on ground when performing test or Do not stand bare foot when performing test
- Do not hold the PCB bare hands; hold it using a piece of paper or any soft piece non conducting material like cotton cloth or polythene
- Do not put pressure over any component, hold them smoothly
- Always check solar panel in sunlight

NOTE: All testing for Vendor A's SoUL kit and Multimeter used for testing purpose is MECO's 603

8.4 Testing of Battery

BATTERY	Rechargeable **Ni-MH** **1200 mAh** (Charge/Capacity) 2.8 V (Maximum Voltage) **2.4 V** (Nominal Voltage) 2.0 V (Minimum Voltage) *(look at label on the battery for these values)*	
MULTIMETER SETTING	**BLACK PROBE (-)**	**COM**
	RED PROBE(+)	**VΩ** *for voltage measurement*
	KNOB	**DCV-20**
TESTING PROCEDURE	Measure Battery Voltage by connecting Multimeter Probes to the Battery Connector*(Red probe to Red wire side & Black probe to Black wire side of Connector)*	
ACCEPT COMPONENT	✓ Battery Voltage of a newly manufactured Battery should come in the range of**2.4 V – 2.8 V** (usually in **2.5_ V** series)	
REJECT COMPONENT	X**When Battery Voltage Less than 2.4 V**	
SAFETY PRECAUTION	• Safe separation between the Probes to avoid Short/Fault of Battery • Never DROP the battery if you can help it as Ni-MH batteries damage internally quite easily • Never store Ni-MH in the refrigerator • Never expose to extreme heat • Don't put batteries in the same pocket as keys or coins—especially 9V batteries	

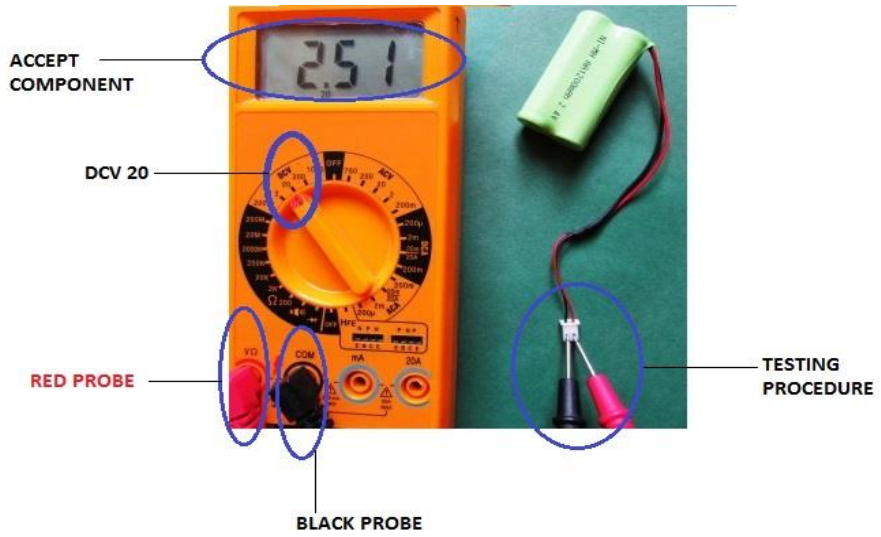


Figure 28: Testing battery using Multimeter

8.5 Testing of Solar Panel

Voltage Measurement

SOLAR PANEL	Maximum Power , (**Pmp**) = **1 Wp** Voltage at Maximum Power, (**Vmp**) = **4.95 V** Open circuit voltage i.e. at No Load ,(**Voc**) = **5.80 V** *(look at back side of the panel for this values)*	
MULTIMETER SETTING	**BLACK PROBE(-)**	**COM**
	RED PROBE(+)	**VΩ** *for voltage measurement*
	KNOB	**DCV-20**
TESTING PROCEDURE	Measure **Open Circuit Voltage (V_{oc})** by connecting Multimeter Probes to the DC Jack of Solar Panel, under direct sunlight *(Red probe to the inside& Black probe to the outside of DC Jack)*	
ACCEPT COMPONENT	✓ **V_{oc}** depends on intensity of Sun light falling on Solar Panel which Changes throughout the day and year. **Voc** should come≥**4.3V (for Vendor D Solar Panels) and ≥5V (for Vendor B & C Solar Panels)**	
REJECT COMPONENT	X When,**V_{oc}<4.3V (for Vendor D Solar Panels) and V_{oc}<5V (for Vendor B & C Solar Panels)**	
	▪ Always keep panel in sunlight while taking measurements	

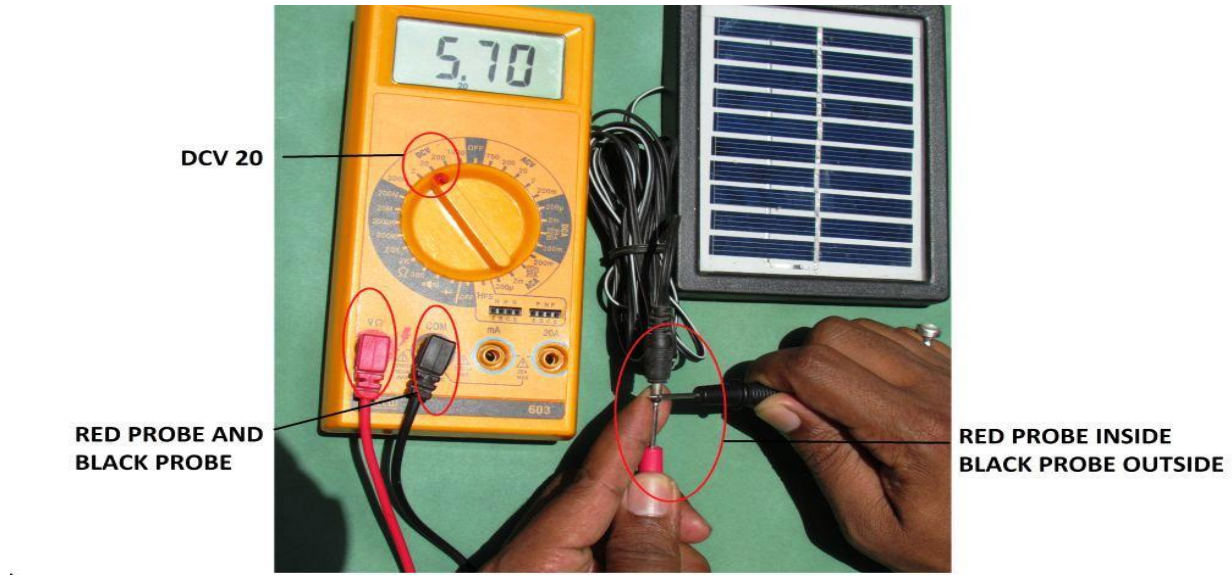


Figure 29: Testing solar panel voltage using Multimeter

Current Measurement

SOLAR PANEL	Maximum Power = **1Wp** Current at Maximum Power , **Imp= 200mAOR0.2 A** Short Circuit Current i.e. at No Load, **Isc = 230 mA OR 0.22 A** *(look at back side of the panel for this values)*	
MULTIMETER SETTING	**BLACK PROBE (-)**	**COM**
	RED PROBE(+)	**mA OR 20A** *for current measurement*
	KNOB	**DCA-200m OR DCA-20A**
TESTING PROCEDURE	Measure **Short Circuit Current (I_{sc}) of Solar Panel** by connecting Multimeter Probes to the DC Jack of Solar Panel, under direct sunlight *(Red probe to the inside& Black probe to the outside of DC Jack)*	
ACCEPT COMPONENT	✓ **I_{sc}** depends on intensity of Sun light falling on Solar Panel which changes throughout the day and year. When **I_{sc}** gives Positive value of Current	
REJECT COMPONENT	X When **I_{sc}** gives Zero Current or Negative Value of Current	
IMPORTANT TIP	▪ Value of current depends upon the intensity of sunlight, keep panel for some time in sunlight while testing for current ▪ When testing for current in milliampere insert RED PROBE at mA and set KNOB at DCA 200m, And for testing current in ampere insert RED PROBE at 20A and set KNOB at DCA 20A	

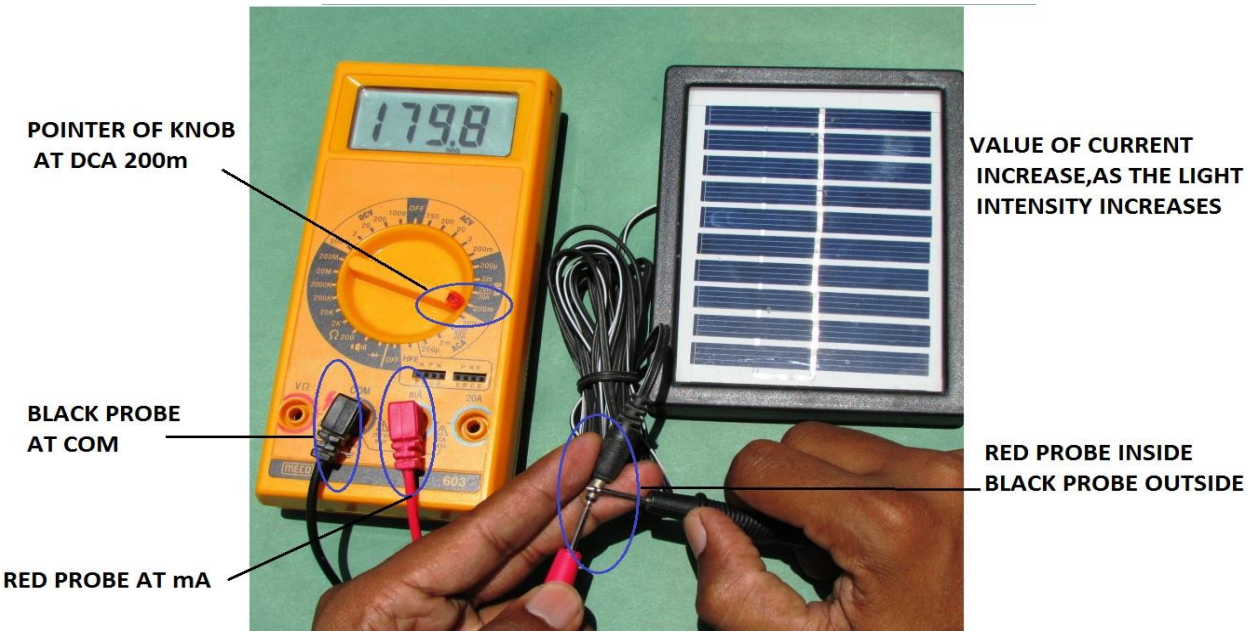


Figure 30: Current measurement using Multimeter

8.6 Testing of Load LED (Light Emitting Diode)

LOAD LED	**0.5 W** (Maximum Power) 3.2 V (Operating Voltage) 50-60 mA (Low intensity Drain Current) 100-120 mA (High intensity Drain Current)	
MULTIMETER SETTING	**BLACK PROBE (-)**	**COM**
	RED PROBE(+)	**VΩ**
	KNOB	**Buzzer OR Diode**
TESTING PROCEDURE	Check whether **LED is Glowing or not** by connecting Multimeter Probes to the Terminals of LED Strip *(Red probe to +ve & Black probe to –ve Terminal)*	
ACCEPT COMPONENT	✓ When it is **Glowing**	
REJECT COMPONENT	X When it is **Not Glowing**	
IMPORTANT TIP	• Do not Test LED by putting RED probe on –ve terminal of LED and BLACK probe on +ve terminal of LED	

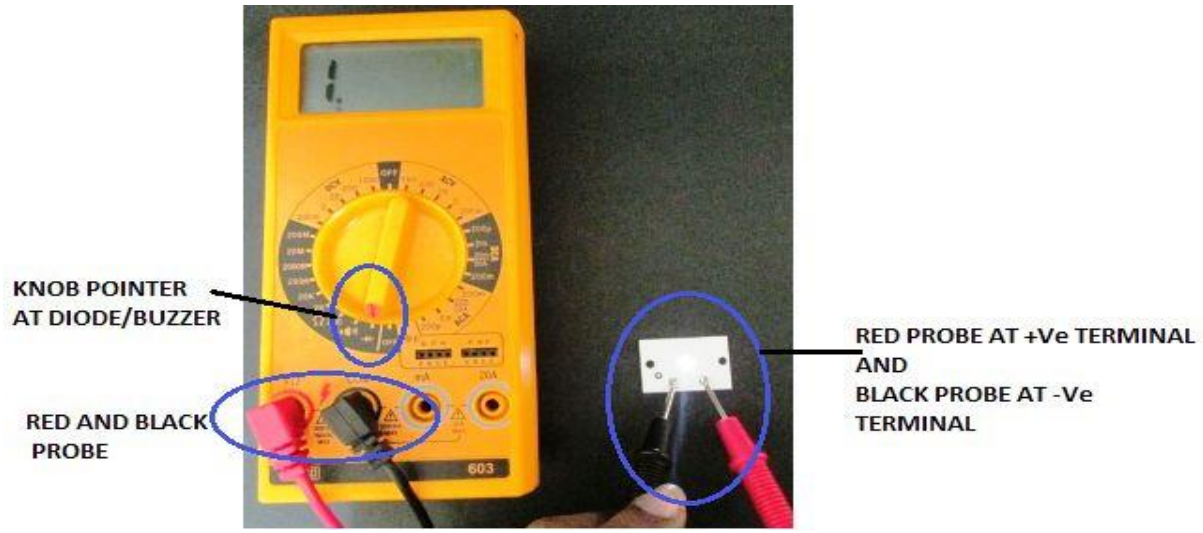


Figure 31: Testing load LED using Multimeter

8.7 Testing of Load Wire

LOAD WIRE	**Teflon coated**	
MULTIMETER SETTING	**BLACK PROBE (-)**	**COM**
	RED PROBE (+)	**VΩ**
	KNOB	*for continuity Check*
TESTING PROCEDURE	Check whether **Load Wire is connected or not** by connecting Multimeter Probes to either of the Wire sat a time *(Red probe to One End & Black probe to Other End of the wire)*	
ACCEPT COMPONENT	✓ When BEEP sound hear from Multimeter	
REJECT COMPONENT	X When there is **No Sound from the Multimeter for the Connectivity**	
IMPORTANT TIP	• Any conducting wire's continuity can be check through this procedure	

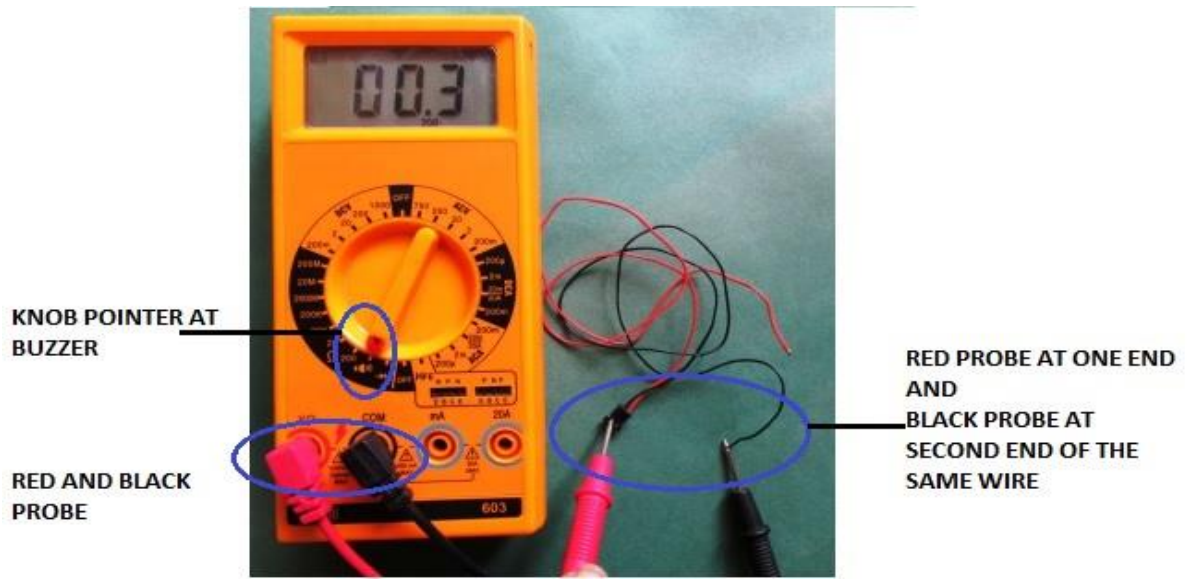


Figure 32: Testing Load Wire using Multimeter

8.8 Testing of PCB (PRINTED CIRCUIT BOARD)

(PCB Test includes 4 different tests)

PCB	**Test -1**Check whether the switch mounted over PCB is working or not
MULTIMETER SETTING	Multimeter is not required to perform this test
TESTING PROCEDURE	Press the switch for multiple times and listen the tic-tic sound from it.
ACCEPT COMPONENT	✓ When switch press functioning smoothly and generates tic-tic sound
REJECT COMPONENT	X when switch is getting stuck while pressing and generates no sound
PRECAUTION	• Do not perform PCB test at dusty place, a small particle of dust can malfunction the switch and PCB

PCB	**Test -2**Check whether the DC socket mounted over PCB is working or not
MULTIMETER SETTING	Multimeter is not required to perform this test
TESTING PROCEDURE	Connect solar panel's connector pin with DC socket ,which is mounted over PCB andkeep the panel in sunlight, The indicator LED will emit light (green light)
ACCEPT COMPONENT	✓ When indicator LED emit light (GREEN LIGHT)
REJECT COMPONENT	XWhen indicator LED emits no light
PRECAUTION	• In this test emission of light is important not the color of emitted light from indicator LED but for understanding purpose when we will connect the solar panel first with DC socket and place the panel in sunlight, then the indicator LED will emit GREEN color

PCB	**Test -3** Check whether **PCB Indicator is Glowing or not (once Red & then Green)**	
MULTIMETER SETTING	**BLACK PROBE (-)**	**COM**
	RED PROBE(+)	**VΩ**
	KNOB	**Buzzer OR Diode**
TESTING PROCEDURE	**First Step:** Connect solar panel's connector pin with DC socket which is mounted over PCB and keep the panel in sunlight, The indicator LED will emit GREEN light, **Second Step:** Now connect battery with PCB, The same indicator LED will now emit RED Light.	
ACCEPT COMPONENT	✓ Only when both RED and GREEN light **Glows**	
REJECT COMPONENT	X When either or, both the Red & Green Indicator **Not Glowing**	
PRECAUTION	• Test indicator LED by keeping PCB on flat insulating surface	

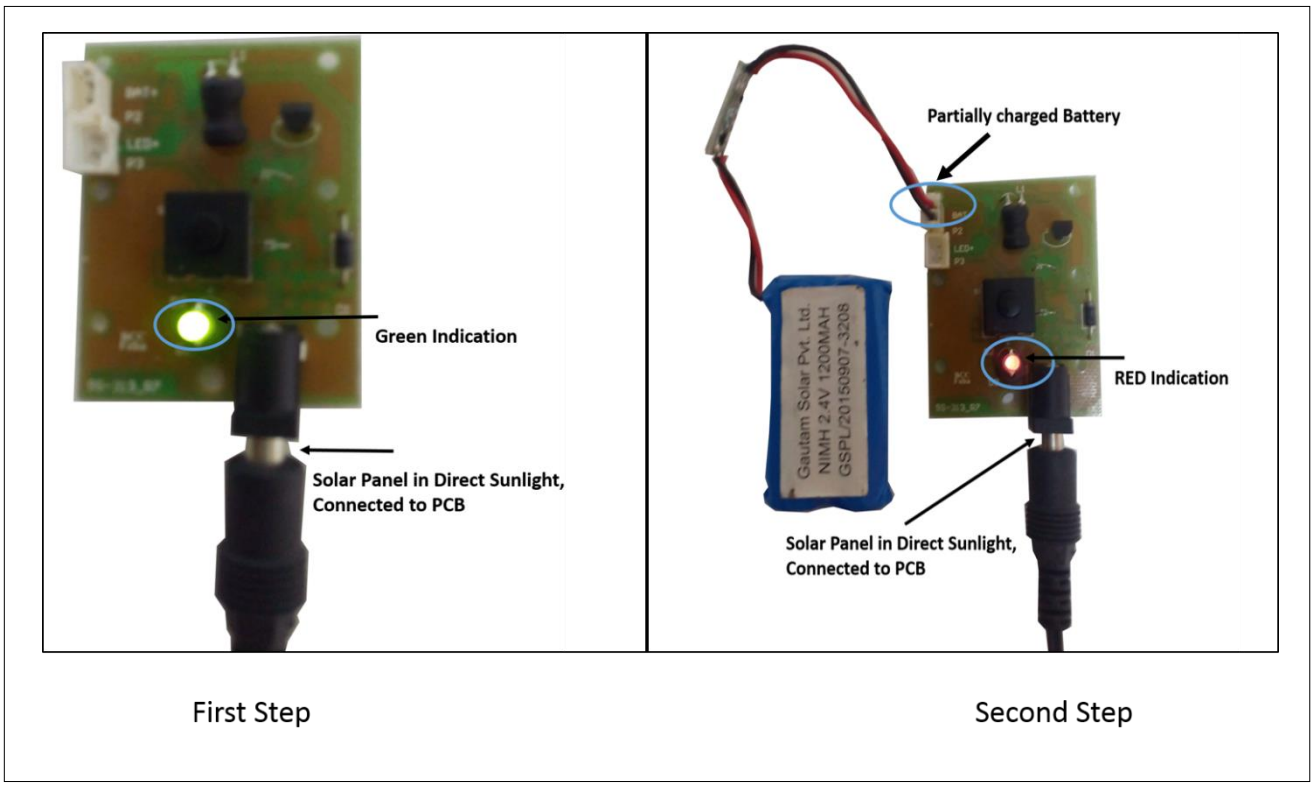


Figure 33: Testing of Green and Red Indicator

PCB	**Test-4**Measure the Operating Voltage of LED for both Low (one click switching-on the lamp from off state) & High (two click switching-on the lamp from off state) Intensity of Light	
MULTIMETER SETTING	**BLACK PROBE(-)**	**COM**
	RED PROBE(+)	**VΩ**
	KNOB	**DCV-20**
TESTING PROCEDURE	Measure the **Operating Voltage of LED** for both **Low (one click switching-on the lamp from off state) & High (two click switching-on the lamp from off state) Intensity of Light** by connecting Multimeter to the Load Connector Terminals on the PCB*(Red probe to +ve & Black probe to –ve Terminal)*	
ACCEPT COMPONENT	✓ **Operating Voltage** should come≥ **2.7V at Low mode and ≥ 2.9V at high Mode**	
REJECT COMPONENT	X Before rejecting the PCB, once again check battery voltage, solder joints and Connectors for any loose connection, if even measuring voltage comes less than 2.7 V at Low mode and less than 2.9V at high mode, then reject the PCB	
IMPORTANT TIP	• Operating voltage can be check at LOAD LED's terminal	

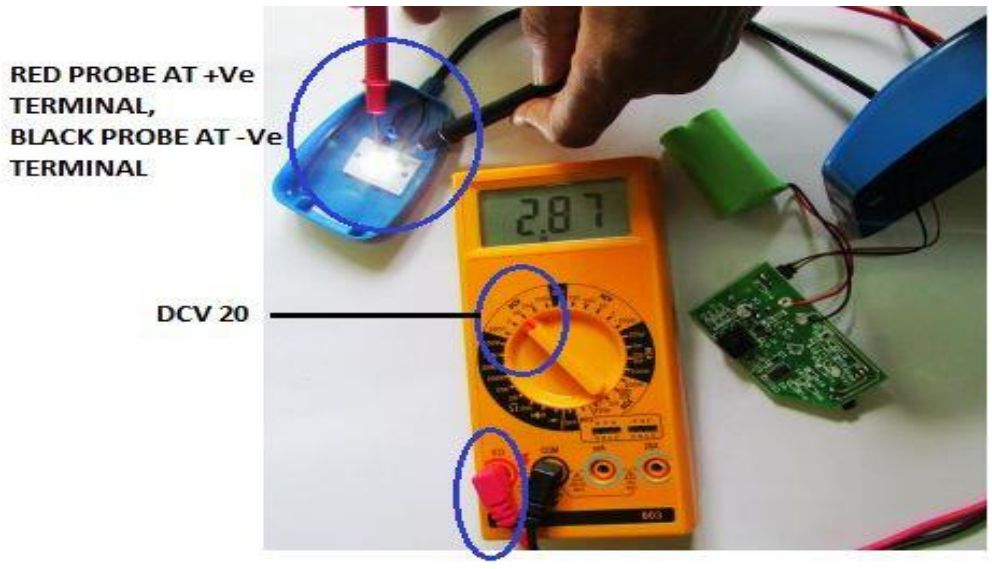


Figure 34: Testing of Operating Voltage of LED using Multimeter

8.9 Final lamp Testing

PCB	**Test -3** Final Lamp Testing
TESTING PROCEDURE	Connect all the Technical Components (Battery, PCB, LED, Load Wire and Solar Panel) of the Lamp & Check whether the Lamp is functioning properly in both Low & High Intensity Modes or not, before final screwing the Lamp body Check whether **PCB Indicator is Glowing or not (once Red & then Green)** by connecting Multimeter Probes to the Terminals of Indicator (Red probe to either of the Outermost Terminals at a time & Black probe to Middle Terminal)
ACCEPT COMPONENT	✓ When overall Technical components of the lamp is functions properly
REJECT COMPONENT	X If it is not Functioning/LED is not glowing in either or, both Low & High Intensity Modes, also in case the LED Glows with very Low Intensity even after proper connection ,Press the Switch on the PCB multiple times to check & eliminate if in case it malfunctions Reject the PCB if the Switch is not functioning properly
PRECAUTION	▪ Always Keep PCB over an insulating surface ▪ Do not put pressure on PCB ▪ Avoid moisturize place ▪ Do not perform test with wet hands

Figure 35: Overall testing of PCB Low Mode

Figure 36: Overall testing of PCB High Mode

Things to know

Explaining importance of OV, UV and DC-DC conversion:

- OV (overvoltage) is the maximum voltage above which the battery cannot be charged. And even if we try to force charge the battery beyond that, there is a chance of it to get blasted.

- UV (under voltage) is the cut off voltage, below which, the battery gets cut off.

- A DC-to-DC converter is an electronic circuit which converts a source of direct current (DC) from one voltage level to another. The voltage of our battery is 2.4V. But our LED works at a voltage of 3.2V.which is called operating voltage of LED, So the PCB we are using, step up the 2.4DC voltage of our battery to 3.2V DC, required for the LED.

MODULE – 9 Assembly of SoUL kit

9.1 Introduction

This module describes all the components/parts used to assemble Solar Urja Lamp and the procedure to assemble in a step by step manner. Vendor A is considered while assembling the lamp

Lamp Parts in the sequence of Assembling process:-

1) Base
2) Base Cover
3) Goose Neck
4) LED Cap
5) LED Face
6) Load Wire
7) LED Strip
8) PCB
9) Battery
10) 3 Screws – “For Control PCB”
11) 2 Screws – “For Enclosure”
12) 2 Identical Lamp Code Stickers (Stick one inside 4 & other outside 2)
13) 2 Identical Project Logo Stickers (Stick one outside 2 & other outside 4)
14) 1 Screw – “For LED PCB”
15) 1 Screw – “For LED Reflector”
16) White Sticker to Seal the Lamp after checking proper Lamp Functioning & Charging (Stick at joining point of 1 & 2)
17) Solar Panel
18) Operations Manual
19) Packaging box

General Precautions:-

1) Before inserting wire into Gooseneck, make sure that the Glue used to affix got dried at the junction points.
2) Don’t let the Glue drop at any part of the Lamp, otherwise it might not be accepted by the child while Distribution.
3) Do proper Soldering by utilizing small but sufficient amount of Soldering Metal Wire.
4) Don’t touch the Soldering Iron for longer duration to the LED Strip.
5) Be careful while tightening the Screws; don’t put extreme pressure while screwing else it can damage the Lamp Body.
6) Take at most care while tagging the Lamp Code Sticker; make sure they are identical or, of same number.

9.2 Soldering

Soldering is the process of using a filler material (solder) to join pieces of metal together. Soldering occurs at relatively low temperatures (around 400 degrees Fahrenheit) as compared to brazing and welding, which actually melt and fuse the materials themselves at higher temperatures. In soldering the filler material becomes liquid, coats the pieces it is

brought into contact with, and is then allowed to cool. As the solder cools it hardens, and the two materials are joined. Soldering is a quick way to join many types of materials, from copper pipe to stained glass. It creates an electrically conductive strong bond between components that can be re-heated (de-soldered) if you should ever want to disconnect two items joined together. It's great for joining electrical components and wires and is used in just about everything electronic.

How to solder:

- Hold the soldering iron like a pen, near the base of the handle. Remember to never touch the hot element or tip.
- Touch the soldering iron onto the joint to be made. Make sure it touches both the component lead and the track. Hold the tip there for a few seconds and feed a little solder onto the joint.
- Apply the solder to the joint, not the iron.
- Remove the solder, then the iron, while keeping the joint still. Allow the joint a few seconds to cool before you move the circuit board.
- Inspect the joint closely. It should look shiny and have a 'volcano' shape. If not, you will need to reheat it and feed in a little more solder. This time ensure that both the lead and track are heated fully before applying solder.

Figure 38: Usage of Solder gun

Few safety precautions:

- Never touches the element or tips of the soldering iron. They are very hot (about 400°C) and will give you a nasty burn
- Always return the soldering iron to its stand when not in use
- Never put it down on your workbench, even for a moment
- Work in a well-ventilated area
- Wash your hands after using solder. Solder contains lead which is a poisonous metal
- The smoke formed as you melt solder is mostly from the flux and quite irritating. Avoid breathing it by keeping you head to the side of, not above, your work.

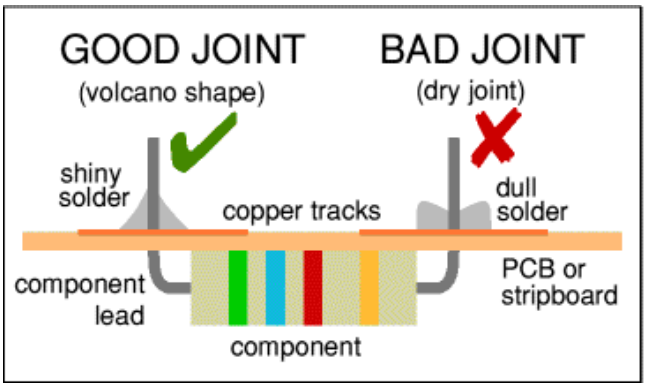
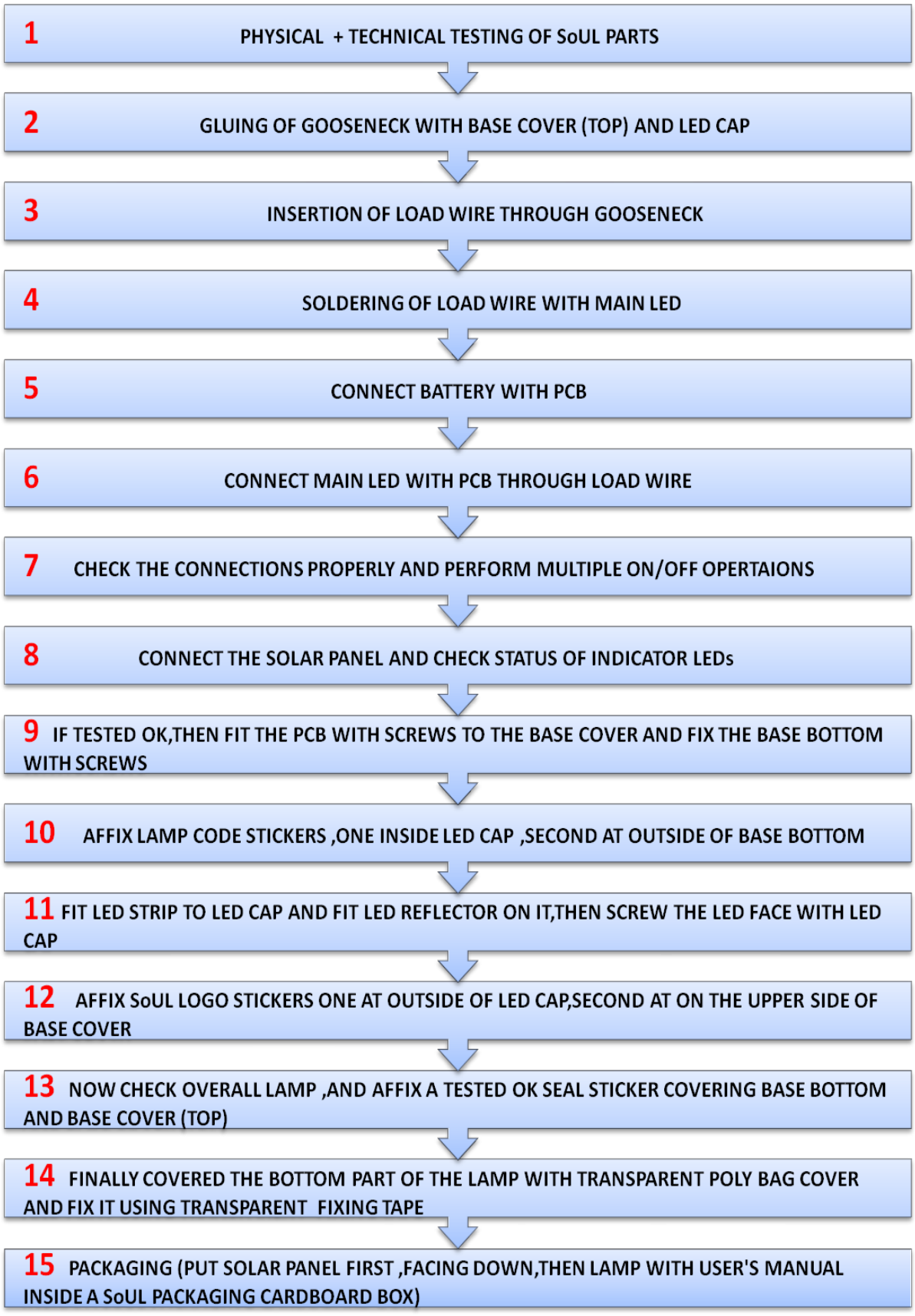


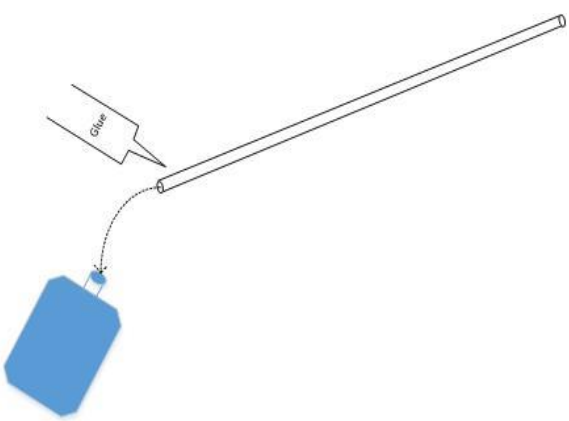
Figure 39: Solder joint (Source- http://www.vcampus.co/)

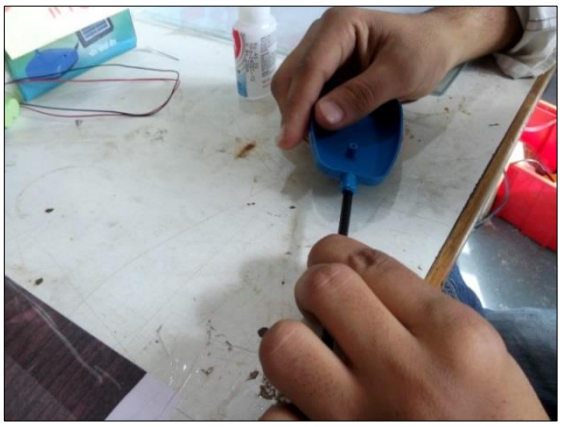
Step by step assembly of SoUL (Using Vendor A's SoUL kit)



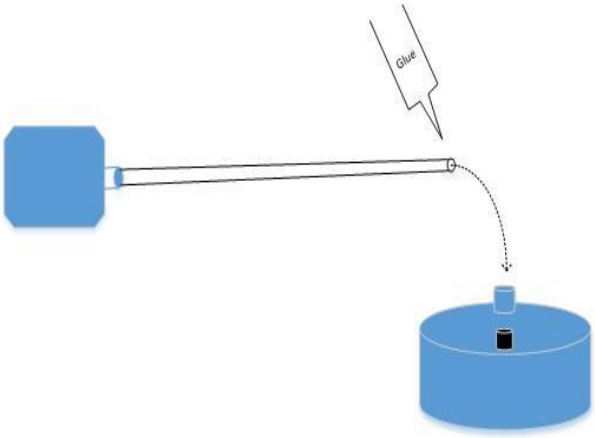
9.3 Assembly Procedure of SoUL Kit (Vendor A's kit)

1. Fix the LED CAP casing to the Gooseneck using Tuff Bond (Glue)

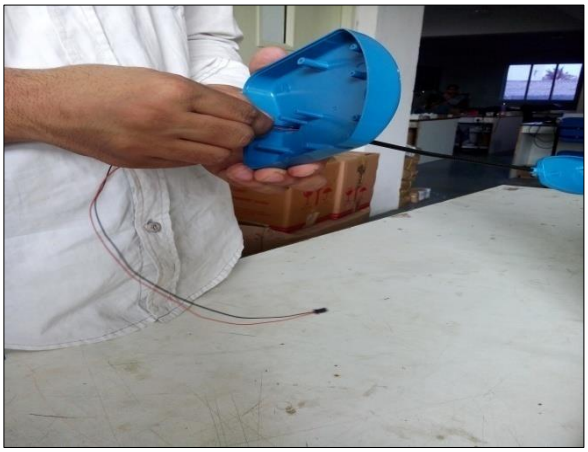


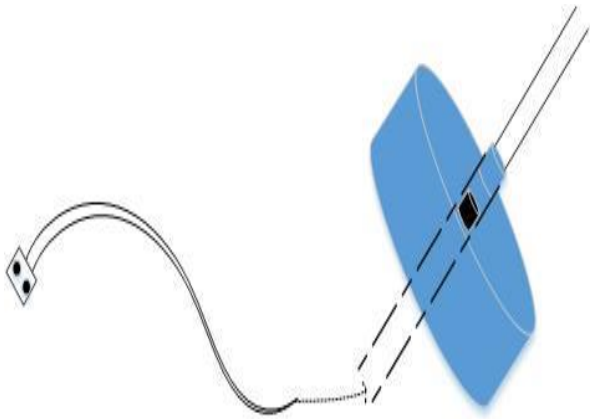


2. Fix the BASE COVER (TOP) casing to the Gooseneck using Tuff Bond

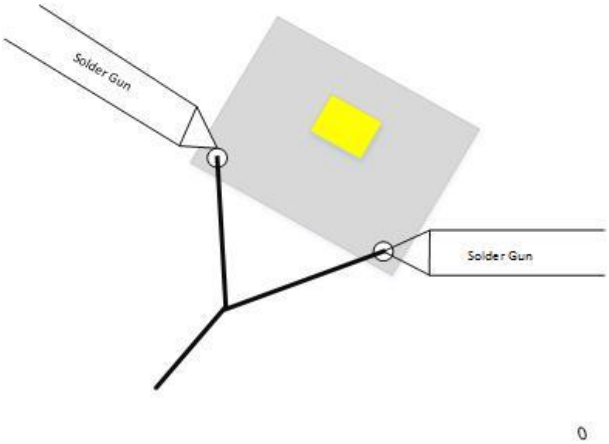


3. Insert the LOAD WIRE (LED Connector) into the gooseneck from the opening inside the Bottom Blue

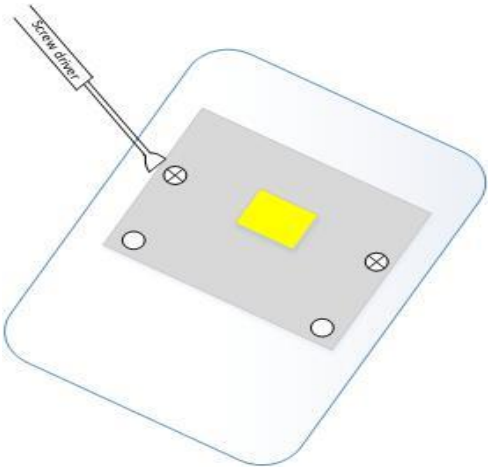


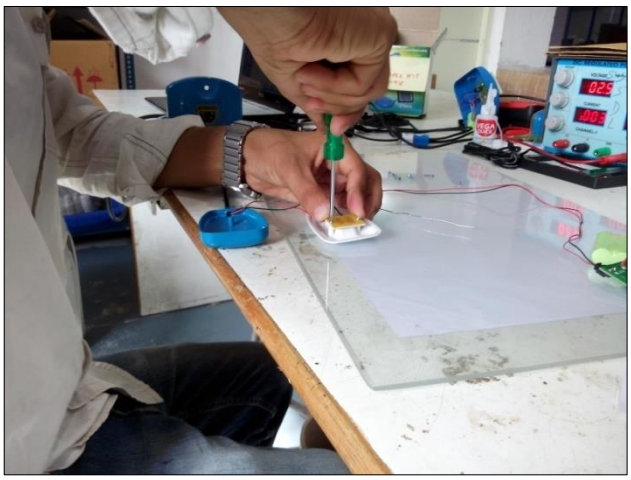


4. Solder the LED Connector inserted in the gooseneck to the LED PCB at the Top Blue

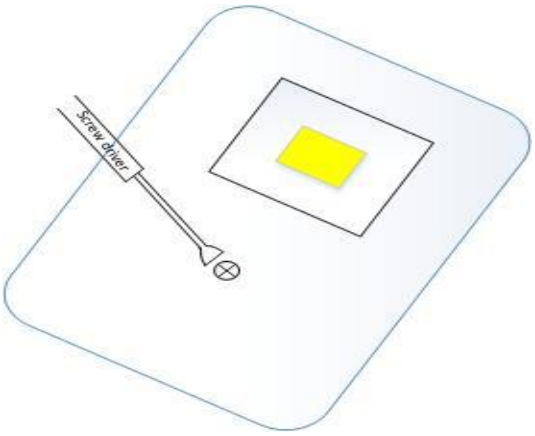


5. Fix the LED PCB with White Reflector using 2 x 6.5 PH screws

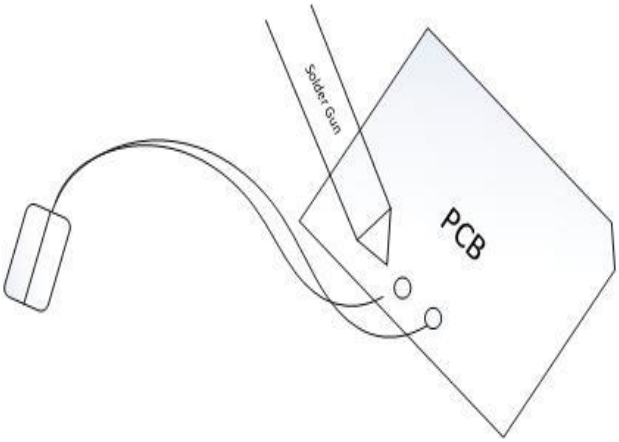


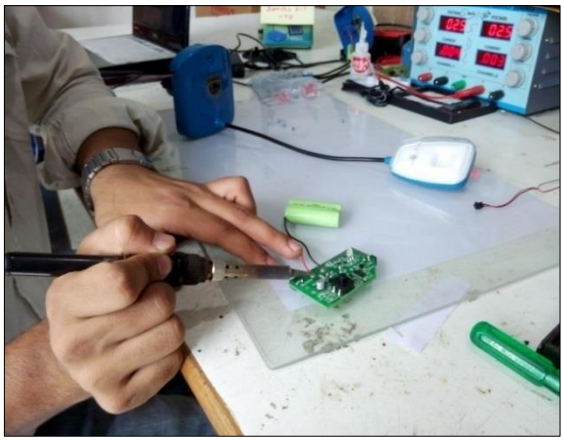


6. Fix the Top lens by attaching the White Reflector & transparent Glass to the Top Blue using 2 x 9.5 PH screw



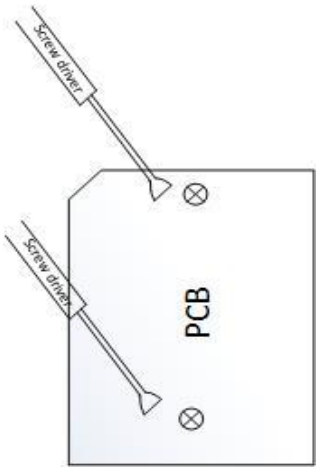
7. Solder the 2.4V battery with Driver PCB

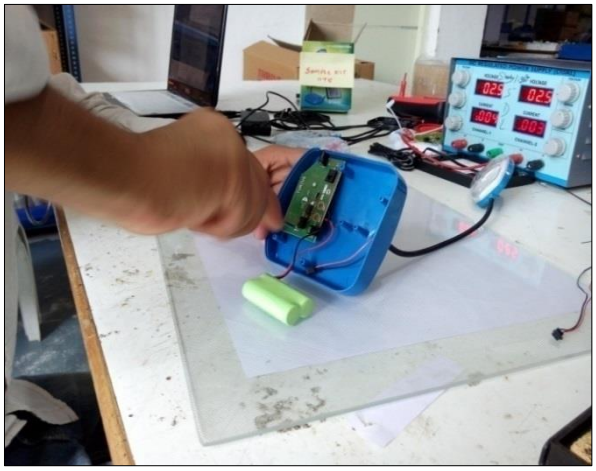




8. Properly align the Driver PCB with the Bottom Blue thereby checking the position of
   a. Switch,
   b. Bi-color LED and
   c. DC Socket

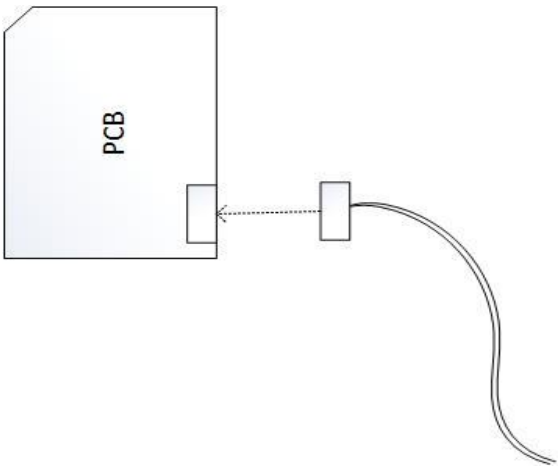
9. Fix the Driver PCB with the Bottom Blue using 2 x 6.5 PH screws

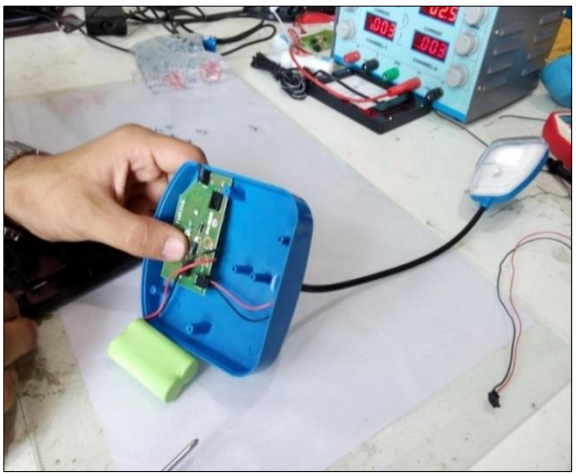




10. Check the Switch mobility by continuously pressing it 10-15 times

11. Connect the LED connector to its socket on the Driver PCB





12. Position the battery on the Bottom Black and align it with the Bottom Blue

13. Fix them using 2 x 13 CSK screws

MODULE – 10 Instructions Manual

10.1 Introduction

This module discusses about the final testing and packaging of solar Urja lamp. Instruction manual and vendor wise technical specification are provided in this module

10.2 Final Testing and Packaging

After having smooth assembling a SoUL is ready for the final test before putting into the packaging box

Do the following checks before packaging

- Switch **ON/OFF** the lamp for multiple times, check switch is working properly or not and,
- Load LED is glowing in Low mode/High mode
- Check gooseneck joints with the LED cap and Base bottom is proper or not
- Attached solar panel and check for LED indicator, it is showing **RED color** or not (for charging status)
- Check for screws, are the SoUL parts got properly fixed or not
- Check for stickers, whether they are at fix locations or not

Packaging

- After having satisfactory checks, do the following procedure for packaging:
- For packaging of SoUL use a cardboard box having the dimensions **120mmx110mmx140mm**
- Put a solar panel inside a SoUL box facing the bottom of the box
- Gently fold the lamp from gooseneck and put it inside the box over the solar panel
- Put it inside from the base bottom side
- Keep an instruction manual inside the box and then`
- Finally pack the box putting a seal sticker outside of the box
- Now it is ready to deliver to the Beneficiary

10.3 Instruction Manual

Important points

- Keep the light on a table on its base. Position the light so that the light beam is directed at the center of the book or paper and illuminates the page uniformly
- Do not keep light ON all night long. TURN IT OFF when it is not needed to save the battery power.
- Charge the light using the solar panel for at least 5 to 6 sunny hours for the first time before use
- Gently insert the connector at the end of the wire from the solar panel into the socket in the light base. Make sure the light switch is turned OFF during charging
- When charging keep the solar panel (glass surface), directly facing the sun as much as possible thru ought the day. Do not let shadows fall on the panel

- While charging the light, keep the light indoors in shade and away from water
- When sunlight falls on the solar panel, the RED indicator light on the light base turns on to show that he pin is connected and the light is charging when the light is fully charged, the GREEN indicator light turns on. The light can be charged fully in at least 2 bright sunny days
- After charging, unplug the solar panel from the light and safely store the solar panel in its box. Keep the wire wound up and hold it together with a rubber band
- Charge the light daily so that there is sufficient charge for any cloudy/rainy day
- Even when the GREEN indicator is not glowing, the battery might have enough charge for hours of use
- Wipe the panel clean and blow dust from the connector pin periodically
- If the light is kept in discharged condition for long time (more than 3 months), the battery may fail to recharge again and may need to be replaced
- Do not drop it in water or keep it in the rain. However, there is no harm if rain falls on the solar panel
- The LED light is diffused for the safety of student's eyes, but do not look at it directly

Following information should be mention over a SoUL packaging box

LAMP VENDORS					
		Vendor A	**Vendor B**	**Vendor C**	**Vendor D**
SOLAR PANEL	Rated Power	1.0 Watt	1.0 Watt	1.0 Watt	1.0 Watt
BATTERY	Voltage	2.4V	2.4V	2.4V	2.4V
	Capacity	1200mAh	1200mAh	1200mAh	1200mAh
	Type	Rechargeable Ni-MH	Rechargeable-MH	Rechargeable Ni-MH	Rechargeable Ni-MH
MAIN LED	POWER	0.5 Watt	0.5 Watt	0.5 Watt	0.5 Watt
MODES OF WORKING	HALF MODE	8 Hours Backup	8 Hours Backup	8 Hours Backup	8 Hours Backup
	FULL MODE	5 Hours Backup	5 Hours Backup	5 Hours Backup	5 Hours Backup
Weight	Net weight	130 gems	130 gms	130 gms	130 gms
	Gross weight	170 gms	170 gms	170 gms	170 gm
Packaging Box Dimensions		120mmx110mmx 140mm	140mmx110m mx140mm	130mmx130mmx 140mm	140mmx110mmx1 40mm

Abbreviation

DC	Direct Current
AC	Alternating current
LED	Light Emitting Diode
PCB	Printed circuit board
Soul	Solar Urja Lamp
A & D	Assembly and distribution
PV	Photo Voltaic
V	Volt
A	Ampere
mV	Milli Volt
mA	Milli Ampere
Wh	Watt Hour
KW	Kilo Watt
KWh	Kilo Watt Hour
Ah	Ampere Hour
SOC	State of Charge
DOD	Depth of Discharge
C-rating	Charging Rate
VOM	Volt-Ohm Multimeter
RMS	Root Mean Square
Ni-MH	Nickel Metal Hydride
Voc	Open Circuit Current
Vmp	Max Peak Voltage
Isc	Short Circuit Current
Imp	Max. Peak Current
Com	Common
VΩ	Voltage Ohm
DCV	Direct current Voltage
OV	Over Voltage
IIT-B	Indian Institute of Technology Bombay
NGO	Non-Government Organization
IP	Institute Partner
NCEF	National Clean Energy Fund
MNRE	Ministry of New and Renewable Energy
DIS	Distribution Information Sheet

References

Books

1. "Solar photovoltaic Technology and systems, A manual for technicians, Trainers and Engineers", 2013, by Prof. Chetan Singh Solanki, IIT-Bombay
2. "How solar Home lighting System works", 2013 by Andre Wirz, SaraObama solar learning center, Africa

Web Resources

- http://www.energy.gov/energysources/solar.htm
  - *Solar Energy Basics – National Renewable Energy Laboratory*
- http://www.nrel.gov/learning/re_solar.html
  - *Solar Energy Research and Development – Department of Energy*
- http://www.energy.gov/hub
  - *How do Photovoltaic Work? – NASA*
- http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells
- www.millionsoul.iitb.ac.in
- www.batteryuniversity.com
- www.eia.gov/kids
- www.electronics.howstuffsworks.com
- www.ledinside.com
- www.hp.com

Appendix C: Management Training Manual

The management training manual used in Million SoUL project is presented here. The same can be updated and used for NaSSoLiM.

EXECUTIVE SUMMARY

Training and development play an important role in the effectiveness of organizations and to the experience of people in work. Training has implications for productivity, health and safety at work and personal development. All organizations need to train and develop their staff. Most organizations are cognizant of this requirement and invest effort and other resources in training and development.
Preparation of this guidebook is intended to help Institutional Partner (here referred as NGOs – non-governmental organizations) in management of inventory and A&D center, planning, reporting and communication, execution and monitoring activities of Million SoUL (Solar Urja Lamp) Project (MSP); has been a lengthy one involving many people along the way.

The primary aim of this manual is to help local NGOs (non-governmental organizations) achieve the greatest possible impact through the best organizational and management practices. Local NGOs are being involved to bring about, or support processes to bring about, major positive change in the lives of the beneficiaries or service users they have been formed to serve.

This manual is designed to help local NGOs in the making, both new and experienced, by outlining some basic standard of best management practices. However, the primary target audience is NGO's working executives (i.e. project in-charge, supervisors and data entry operators) at assembly & distribution center or directly at community premises.

The manual is designed to be accessible and comprehendible to NGOs regardless of the number of staff they employ or as per their organizational spread. Larger, more complex organizations employing experienced and technically skilled personnel may find that they already use many of the procedures and processes suggested.

The manual can be used as a step by step guideline for planning and monitoring of project activities that makes best use of its people and financial resources to design, deliver and improve the overall performance of project.

Table of Contents

CHAPTER 1: INTRODUCTION TO MANAGEMENT TRAINING

1) Importance of Management Training Programs for an Organization

Executives handle more than a handful of responsibilities; they are also expected to oversee the functions of their subordinates. Organizations have high expectations from their executives. Not only are they expected to excel in their jobs, but the efficiency and efficacy is core part of their job portfolios.

Management training is not only essential to groom regular employees in becoming good executives, but it is also intended to enhance and improve the skills of existing executives so that they can learn new practices which will enable them to be more effective in performing their functions. Every organization, whether small or medium-sized, will greatly benefit from providing appropriate training to their employees. And although this will entail certain costs for the organization, this is one investment that will ultimately produce greater returns in the long run.

2) Why Executives Need Training?

The way executives work together and exchange expertise is critical to their personal success as well as the success of their organization. Management skills required by the employees are mostly consistent with successful project implementation.

Future executives cannot rely solely on their technical expertise to show their value. Their value addition to the organization should not only be limited to their theoretical knowledge, but also their willingness to play effectively a variety of roles within the organization on a regular basis.

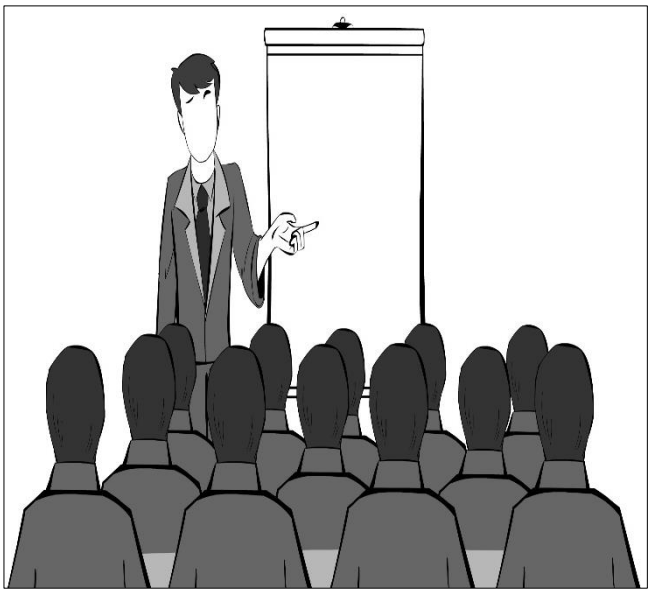


Figure1: Management training orientation (Source: www.clipartzebraz.com)

This is also true of the relationships that executives, managers, consultants and others have with outside contractors, government departments, and other stakeholders where they can only influence, not control. These management/leadership skills need to be reinforced from time to time. It is an investment in personal development that provides both immediate and long-term benefits for the organization.

These, then, are the critical management roles needed for an effective Executive, Manager, and Leader:

1. Specialized Professional - Relates technical or complex information to the job, but within the strategic scope of the project.

2. Facilitator - Manages discussions effectively; ensures that all parties are in agreement and have a clear understanding of the agreed-upon future steps before proceeding; keeps the focus on moving the work/project forward.

3. Problem Solver - Effectively analyzes the overall situation/project; proactively identifies problems and proposes solutions.

4. Coach - Motivates and works effectively with others while helping them gain expertise and knowledge; creates an environment where coaching and feedback is important.

5. Administrator - Manages time, deadlines, and budgets simultaneously; provides a variety of written summaries for projects; has a clear understanding of the policies and procedures involved in utilizing resources.

6. Influencer - Receives recommendations favorably. Is persuasive; presents options and trade-offs and focuses on win-win outcomes.

7. Strategist – Focuses on the "big picture"; has a clear understanding of project strategies and needs as well as objectives and concerns.

8. Partner - Brings a high level of trust and commitment to working relationships; has an, objective sense of whether expectations are being met; values open communication as a fundamental building block for all constituent relationships.

3) Need of Hand Holding:

Hand-holding is a management principle where one party carefully monitors the progress of other party and guides them step-by-step towards the completion of the task.

"Hand-holding" is providing very close support, showing a client, for example, exactly what to do, step by step as opposed to giving them general guidelines and letting them make the decisions.

4) Management Training Outline:

A) Training Agenda

Morning (9:00 am – 10:00 am)

- Welcome
- Ice breaking exercise (Management Exercise)
- Introductions to management training
- Project overview
- Organizational structure (General idea of staff roles and responsibilities)

Tea Break (10:00 am – 10:30 am)

Morning (10:30 am – 12:30)

- Managing A&D Center

- Inventory management
- Worker's scheduling and planning

Lunch Break (12:30 pm – 1:30 pm)
Afternoon (1:30 pm - 4:30 pm)

- Managing promotion and campaigning
- Managing Payments & Incentives
- Managing A&D completion
- Managing SoUL (Solar Urja Lamp) Repair Center (SRC) Setup

Tea Break (3:00 pm – 3:30 pm)
Afternoon (3:30 pm - 5:30 pm)

- Managing workforce supervision
- Managing workforce selection
- Managing training & development
- Conclude on a positive note - thank NGO staff for attending management training
- Dismissal

B) <u>Orientation</u>:-

a) Project Overview

India has one of the largest young populations in the world, with 350 million children under 14 years of age. School education is thus essential for the future of the country. 7.8 Crore (78 million) households in India still use kerosene as their primary source of lighting today. Thus, most of the young students going to school either do not have access to alternate light source or have an erratic supply of electricity, both of which affect their study during later hours of the day.

The light level required for study purposes is about 150 Lux at the reading area. Thus, to provide light for 4 hours every evening, solely for study purposes, requires only 0.7 kWh of electricity per year! A 0.5 Watt LED provides up to 250 Lux of light. A solar powered lamp with LED light can thus provide up to 150 Lux of light at the table in low intensity, and up to 250 Lux of light in high intensity mode, using a 1 Watt solar panel to charge the battery of the lamp, at a cost of Rs.400 – Rs.600 per lamp.

Figure2: Thrive Lamp

A sustainable adoption of solar energy products has not yet happened in India due to a clear mismatch between the requirements on the field and the scope of past solar lamp programs. Solar lamps are typically required in remote, rural areas at a low cost and with easy availability in the local market, with access to timely and low cost after sales service. However, currently lamps are produced in large urban cities

which result in a high cost of lamp due to higher overheads, their minimal availability at local level due to lack of distribution channels, and time consuming and expensive after-sales service since they are based in cities or large towns. Hence, to directly and completely address the requirements, the solar lamp program must be able to involve local people in all aspects of assembly, distribution and after sales service at the local level. This will ensure that the lamps are of low cost, sufficiently available in the local market ensuring market penetration into remote areas, with timely and low cost after sales service using trained manpower available at the local level.

Further, a countrywide large-scale solar lamp program must address, simultaneously, the issues of Scale, Speed and Skill. Million Solar Urja Lamp (SoUL) Project (MSP) is an Indian Institute of Technology - Bombay (IITB) initiative in collaboration with Ministry of New and Renewable Resources (MNRE), which focuses on the 'localization' of solar energy. The solar study lamps provided under this program are locally assembled, distributed and repaired & maintained, thus localization of solar energy. In order to achieve scale, the model is designed to be replicated in parallel in multiple blocks, across districts and states. To achieve speed, the assembly and distribution for any block is designed to be completed in stipulated period. In order to target skill development, rural people are trained in the assembling, distribution, repair and maintenance of SoULs in their local areas.

b) Project Objectives and Concepts

The objective of the Million SoUL (Solar Urja Lamp) Project (MSP) is to provide high-quality affordable clean light for study purpose to 1 million (10 Lakhs) school students enrolled in rural areas between classes 5 to 12, in select rural areas of India in the fastest possible way.

The specific goals are:

1) Provide high quality, affordable clean light for study purposes to school students in rural India, in the fastest possible way,
2) Involving local people in assembly, testing, campaigning, distribution, repair & maintenance of SoUL.
3) Ensure that the SoUL is in working condition throughout the warranty period.

In this model, the assembly of lamps, their distribution, use, repair and maintenance are all carried out by trained local people, thus ensuring low costs, better availability and long life of the lamps through local repair and maintenance. Further, in order to make a discernible impact, every school student in a particular region (a block as a unit of intervention in the program) gets an opportunity to own the lamp. On an average, a block in India has 17,600 school children studying in 5th to 12th standard. The project endeavors to reach out to at least 75% of school children in each block, thereby saturating the block with solar lamps. This allows for better logistics management, lower costs, and sustainable job creation. Further, in the initial phase, the project targeted blocks with less geographical or social constraints. This is essential to demonstrate the large-scale implementation in quick time.

c) Specification of Solar Lamp

The solar lamp is a standard 1-Watt solar panel powered study lamp with 0.5 Watt LED and Ni-MH battery, and a flexible gooseneck to provide adjustable lighting. The lamp has 18 - 19 different components (depending on the supplier) including the PCB, panel, wires, battery pack, plastic casings, screws, packaging box and product code stickers.

d) Financial Model

The expenses budgeted for the project are Rs.500 per lamp, towards: the cost of procurement and delivery cost of the components or SoUL kits, overhead costs of coordination, costs of local assembly and distribution, and costs of free repair and maintenance during the warranty period. The sources of funding for this project are the government and other funding agencies, along with the contribution of Rs. 120 per lamp by the student beneficiaries themselves.

e) Operations Model

The typical sequence of operational activities, after the selection of the NGOs, is as follows (see Fig. 3):

i. The blocks and the corresponding local assembly-cum-distribution (A&D) center is located,
ii. Local people are recruited by the NGO, who are then trained to assemble and distribute the lamp at the center,
iii. Components are sourced by the Million SoUL Project (MSP) office and supplied directly by the supplier to the assembly center, where they are assembled into lamps by the trained manpower,
iv. Campaigning and distribution of lamps is carried out at every school and every village in the block, and
v. At the end of the distribution, repair and maintenance centers are established at multiple locations in a block, and monitored by the local centers until the end of the warranty period. During the assembly and distribution phase of the project, periodic updates of the inventory, assembly and distribution is shared with the MSP office, along with detailed records of the student beneficiaries and their payments.

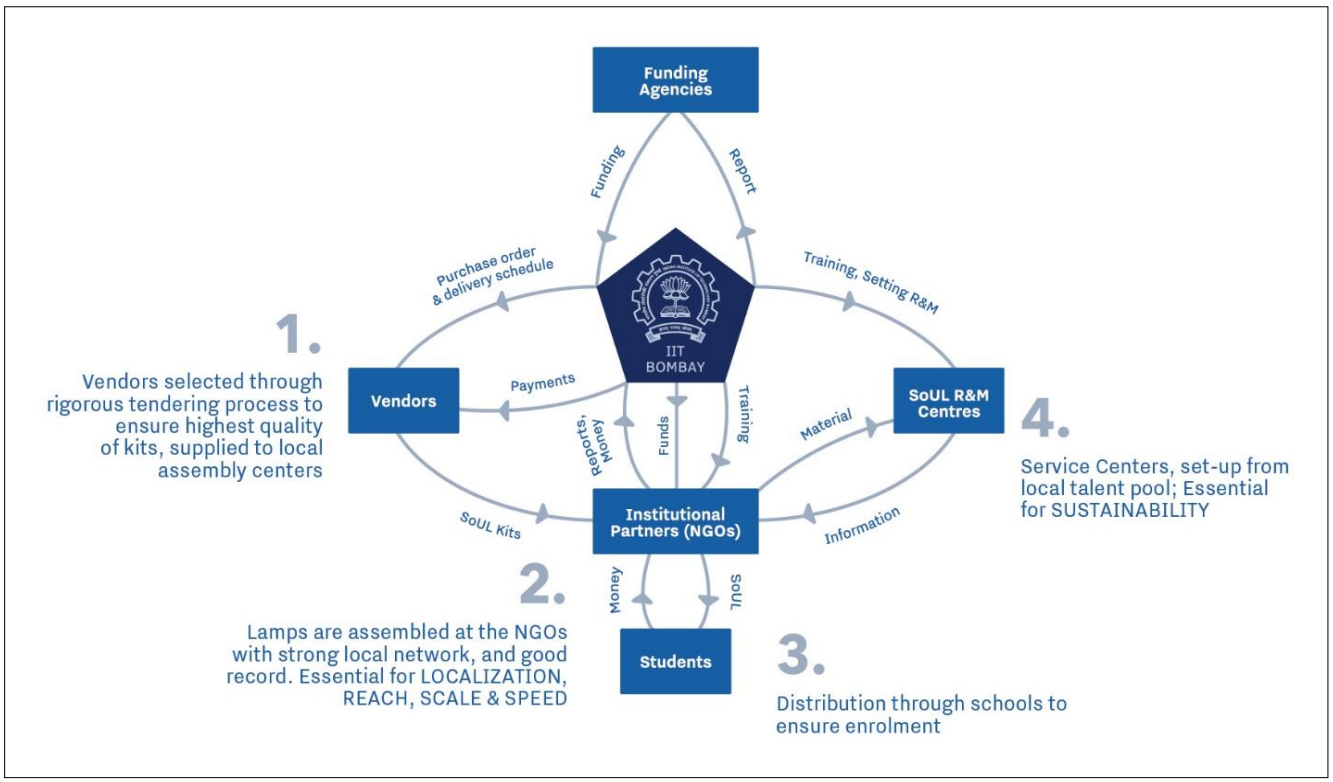


Figure3: Operational flow chart

CHAPTER 2: ORGANIZATIONAL STRUCTURE

1) Million SoUL (Solar Urja Lamp) Project (MSP) – IITB

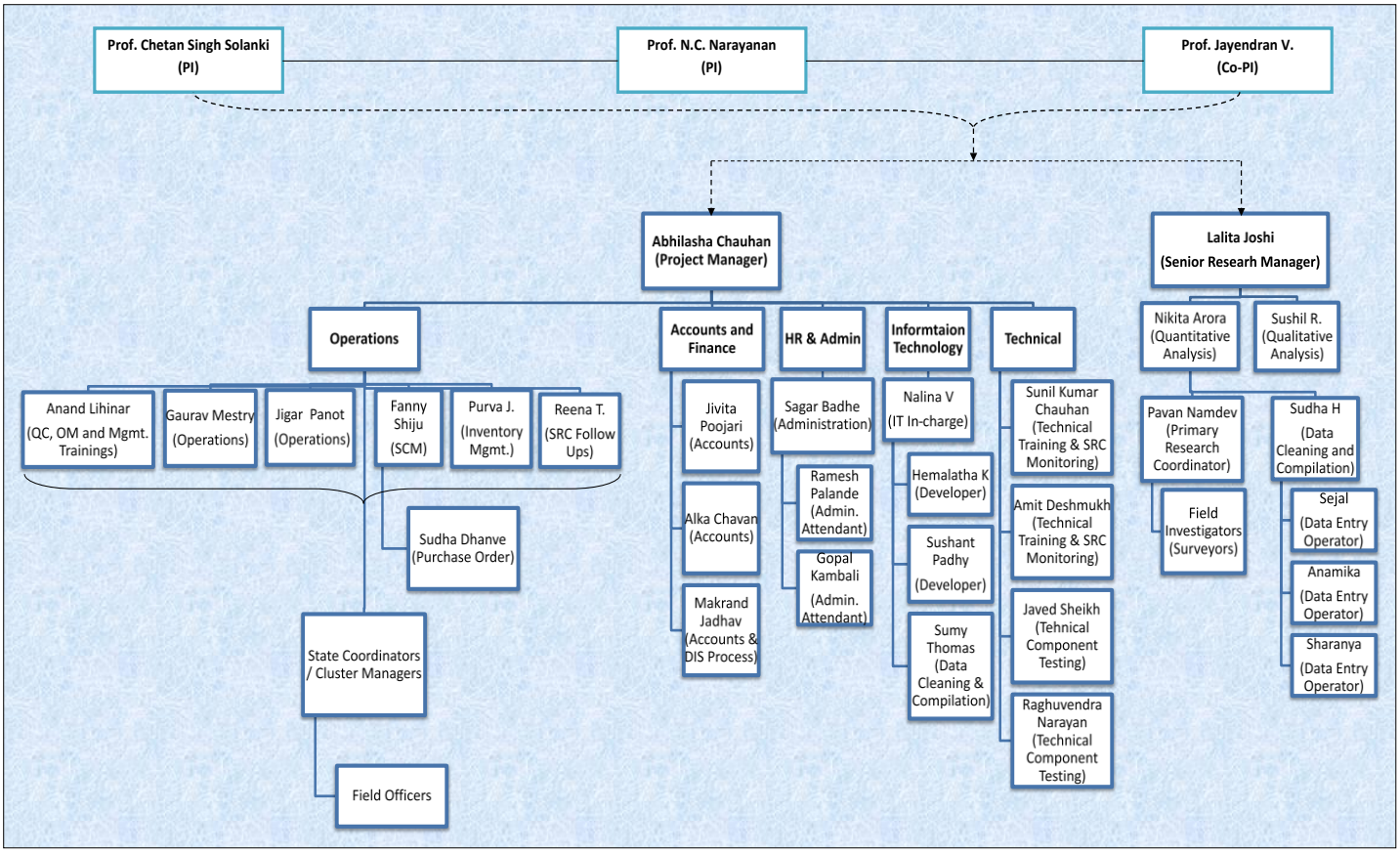


Figure4: Organizational Structure – MSP - IITB

Million SoUL (Solar Urja Lamp) Project (MSP) - IITB Field Staff Description:

1. <u>State Coordinator / Cluster Manager's Job Description</u>

Summary of Position

The state coordinator/cluster manager is a representative of IITB, appointed as a state coordinator / cluster manager for monitoring overall activities of SoUL project for specific state / cluster where SoUL project is started. He is the key person for all the stakeholders and he is responsible for SoUL related matters for entire state / cluster.

Duties & Responsibilities

a) Assembly and Distribution related task

- Coordination with IITB, IPs, Vendors and other district partners
- Coordination with IPs of their respective block/clusters (starting from pre-training)
- Visits to proposed A & D centers (along with IP personnel)
- Coordination with IITB to arrange the training for A&D and SRCs
- Hand holding of IPs after training

- Meetings with IPs for strategy making & planning for effective implementation
- Follow-up with IPs for meeting targets (i.e. assembly and distribution progress) and identifying constraint and work towards resolving them (with the support from the team).
- Managing and monitoring of IP & IITB Field Officer (if available)
- Reporting to SoUL Team
- Regular field visits to coordinate with IP & IITB Field Officer (if available), on the basis of priority like blocks with issues or new IITB Field Officer (if deputed)
- Coordination/Monitoring with SoUL Team for Operation & Research work
- Visiting Govt. offices, as & when required.
- Planning and organizing fort nightly or monthly meetings of all respective IITB Field Officer (if available)
- Meetings with IPs as and when required
- Review of IPs and Field Officers performance
- Active participation in A&D closing up activities

b) SRC related task

- Ensure that field officers coordinate with IP & Operation team (IITB) for spare parts demand & supply plan of SRCs
- Ensure that field officers coordinate with IP for SRCM's monthly honorarium
- Ensure that field officers coordinate with IP & SoUL IT team (IITB) for regular data flow in soft copy as well as hard copy
- Area wise SRC Monitoring:- Monitoring of SRCs by IPs, Monitoring of IPs by IITB Field Officers, Monitoring of IITB Field Officers, for overall SRC related activities
- Coordination with IPs through IITB Field Officer for bi-monthly SRC Awareness programs (for example Announcement through Loudspeakers, Pamphlets, Wall Painting, Street play etc.) as well as Lamp Repair & Maintenance Camp in Tier-2 & Tier-3 level villages
- Coordination with IPs through IITB Field Officer for monthly Lamp Repair & Maintenance Refresher Training of SRC Managers as well as monthly Operations Refresher Hand-holding to IP's SRC In-charge & Data Entry Operator
- Coordination with IPs & 3 SRC domains (Operations, Campaigning & Lamp Repairing, Sustainability) of SRC team through IITB Field Officer for various tasks that would be assigned simultaneously and/or one-after-another
- Identification of loop holes & possible solutions
- Coordination with IP for completing tasks
- Informing Seniors (IITB) about problems
- Random visits to ALL the SRCs for monitoring
- SRC operations for new product availability at the SRCs by Vendors with the help of IPs

2. Field Officer's Job Description

Summary of Position

The field officer is a representative of IITB, appointed as a field person for specific block or district for monitoring the activities of project at the grass root level. His roles and responsibilities are determined as per IITB guidelines. He will act as a key communicator between Institutional Partner and IITB. He consults with IIT-B's state coordinator/cluster manager for all major and minor issues related to SoUL project operations. Field Officer monitor and supervise all the field level activities. Field officers are not involved directly for executing the project activities. He works as an intermediary between IITB and NGO.

Duties & Responsibilities

· Ensure that project in-charge at the NGO level is following his roles and responsibilities through proper monitoring and coordination

2) Institutional Partner (i.e. NGO)

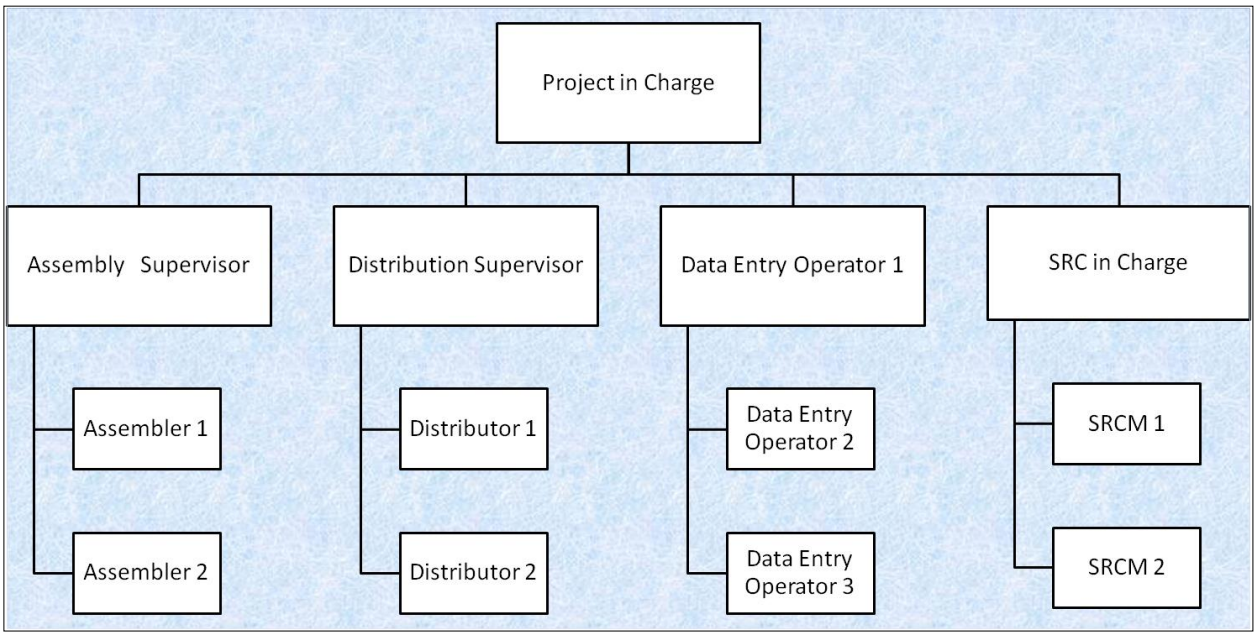


Figure5: Organizational Structure – IP (i.e.

A) NGO Staff Description

1. <u>Project In-Charge's Job Description</u>

Summary of Position

The Project in-charge is a representative of Institutional Partner (i.e. NGO), appointed as a project in-charge for a specific assembly & distribution center, block or district for monitoring and executing the SoUL project activities. He performs the roles and responsibilities as per IITB guidelines. He acts as a key communicator between Institutional Partner and IITB. He consults with IITB's state coordinator/cluster manager/field officer for all major and minor issues related to SoUL project operations. Project in-charge monitors, supervises and executes of all project activities at the IP level. Project in-charge is the key answerable person for project related matters to IITB.

Duties & Responsibilities

a) Broad level responsibilities

- Overall monitoring, supervision and execution of project activities
- As a part of photo documentation take photographs of all the field level activities

b) Assembly and Distribution related task

- Coordination with IITB, Vendors and other district partners
- Coordination with IITB and other staff of IP for respective blocks/clusters (starting from pre-training)
- Coordination with IITB to arrange the training for A&D and SRCs
- Attend Management training / Hand holding / Technical training
- Meetings with state coordinator/cluster manager/field officer for strategy making & planning for effective project implementation
- Daily, weekly and monthly assembly and distribution planning with the help of respective supervisors
- Follow-up with SRC in-charge, A&D supervisors & data entry operator for meeting targets (i.e. promotion and campaigning, assembly and distribution progress) and identifying constraint and work towards resolving them (with the support from the IITB team).
- Managing and monitoring staff of IP
- Regular field visits to monitor the progress of project
- Coordination with SoUL Team for Operation & Research work
- Visiting Govt. offices, as & when required.
- Planning and organizing fort nightly or monthly meetings of all respective staff of IP
- Meetings with state coordinator/cluster manager/field officer as and when required
- Review of assemblers, distributors and supervisors performance
- Handle laptop and toolkits provided by IITB with care
- Active involvement in A&D closing up activities

c) SRC related task

- Coordination with SoUL Operation team (IITB) through Field Officer for spare parts demand & supply plan of SRCs
- Coordination with SoUL Account team (IITB) through Field Officer for SRCM's monthly honorarium
- Coordination with SoUL IT team (IITB) through Field Officer for regular data flow in soft copy as well as hard copy
- Cluster/block wise SRC Monitoring
- Coordination with Field Officer/Cluster Manager for bi-monthly SRC Awareness programs (for example Announcement through Loudspeakers, Pamphlets, Wall Painting, Street play etc.) as well as Lamp Repair & Maintenance Camp in Tier-2 & Tier-3 level villages

- Coordination with IITB through Field Officer/Cluster Manager for monthly Lamp Repair & Maintenance Refresher Training of SRC Managers as well as monthly Operations Refresher Hand-holding to IP's SRC In-charge & Data Entry Operator
- Coordination with IITB's SRC team & 3 SRC domains (Operations, Campaigning & Lamp Repairing, Sustainability) through IITB Field Officer for various tasks that would be assigned simultaneously and/or one-after-another
- Identification of loop holes & possible solutions
- Coordination with IITB for completing tasks
- Informing IITB Seniors about problems
- Regular visits to ALL the SRCs for monitoring
- SRC operations for new product availability at the SRCs by Vendors with the help of IPs

d) Research Activities

a. Data Collection:

- Secondary data at block and district level (school related information etc.)
- Village profile: data collection
- Qualitative data: PRA (mapping, FGDs, key informant interviews etc.)

b. Household Impact Surveys

- Coordinate with Field Investigators when HH impact survey is planned (convey dates, inform village personnel, make arrangements for stay and food etc.)
- Facilitate and supervise data collection process

2. Assembly Supervisor's Job Description

Summary of Position

The Assembly Supervisor is a representative of Institutional Partner (i.e. NGO), appointed for supervising, monitoring and executing the assembly related activities in a specific assembly & distribution center. He performs the roles and responsibilities as per IITB guidelines. He consults with project in-charge for all major and minor issues related to assembly operations. Assembly Supervisor is directly involved in various activities like supervision, execution of assembly work which includes the material handling, issuing, storage, packaging etc.

Duties & Responsibilities

a) Consignment/Supply Chain Related Tasks

- Check with Operation team (IIT Bombay) about the arrival of consignment (date and time)
- Present at the site at the time of arrival of consignment
- Take photos or video shooting (specifically if there is a damage to the components when the boxes are opened)
- Supervise the material receiving process and proper counting of boxes (exact number of boxes - A & B type mentioned on LR copy)
- Verify the Tax Invoice & Delivery Challan (DC) for actual quantity received and put original copy of same in file for future evidence and verification.
- Report all damages (including damage to cardboard boxes) and shortages (# Boxes) on all copies of the delivering carrier's shipment bill (i.e. LR, Invoice &

DC) and have the delivery person sign his/her name and date on all shipment bill copies.

- Supervise & update the Goods Received Note (GRN) in physical inventory book. This goods received note includes count of:
  - Total / actual boxes and/or material (if applicable) received by IP against the quantity delivered by vendor
  - Upload the scan copy of Loading Receipt (LR) on million soul website

b) Assembly related tasks –

- Daily, weekly and monthly assembly planning with the help of Project in charge
- Issuing material to assemblers for assembly purpose
- Supervise the counting and testing process of components during the assembly to ensure quality
- Receive assembled lamps from assemblers at the end of the day
- Maintaining defectives as per instructions
- Update the Inventory Books (GRN/Assembly/Missing, Excess & Defective/Free Kit – A&D Records) as per instructions and handover the same books to data entry operator for online record update
- Maintain records pertaining to material / kits issued to workers (like Issue of Material to Assemblers, Issue of Lamps to Distributors, Receipt of DIS & Money from Distributors, etc.)

<u>Important Note</u> - Ask IITB, before dispatching defectives to vendor:

Do the following tasks:

- Send defective components report along with sign & seal of IP (scan copy) to IITB (Operation Team), once consignment-wise lamps are assembled.
- Once defective components report (soft copy) is sent to IITB, ensure whether received the undertaking letter for a logistic company from IITB and after that dispatch the defective components to the vendor by courier service

3. <u>Distribution Supervisor's Job Description</u>

Summary of Position

The distribution supervisor is a representative of Institutional Partner (i.e. NGO), appointed for monitoring and executing the distribution and campaigning related activities in a specific assembly & distribution center. He performs the roles and responsibilities as per IITB guidelines. He consults with Project in-charge for all major and minor issues related to distribution and campaigning operations. Distribution Supervisor will do the monitoring, supervision and execution of distribution and campaigning related activities of the project. Distribution Supervisor will be directly involved in various activities like supervision, execution of campaigning and distribution.

Duties & Responsibilities

a) Campaigning activities

- Monitoring and creating campaigning strategies for cluster / block level distribution with the help of Project in charge.

- If needed training to distributors and other project staff with the help of state coordinator/cluster manager/field officer regarding campaigning and distribution
- Regular visit, when distributors do the campaigning and project promotion in the schools and villages

b) Distribution related tasks –

- Daily, weekly and monthly distribution planning with the help of Project in charge
- Follow up with distributors for DIS (hard copies) and lamp money
- Update the "Daily Distribution Records" book as per instructions and handover the same book to data entry operator for online update
- Visit the field when distribution is in process

c) Distribution Information Sheet (Hard Copies)

- Check if the DIS Sheets are properly filled by the distributors with teacher/principal signature along with the school seal
- Supervise and handover the DIS (hard copies) to data entry operator for online update
- Dispatch DIS sheets (hard copy of IITB) through courier/speed post to IITB as per milestone

4. <u>Data Entry Operator's Job Description</u>

Summary of Position

The Data Entry Operator is a representative of Institutional Partner (i.e. NGO), appointed to enter the data of student beneficiaries and other project related data for a specific assembly & distribution center. He performs the roles and responsibilities as per IITB guidelines. He consults with Project in-charge, assembly & distribution supervisor and SRC in-charge for all major and minor issues related to data entry work. Data Entry Operator will do the monitoring, supervision and execution of entire data entry work of the project. The primary responsibility of the Data Entry Operator is office and administrative support.

Duties & Responsibilities

- Supervise and execute the daily activities of data entry work.
- Training new data entry operators on related methods and procedures.
- Resolving complex or complicated inaccuracies, missing data or data unable to be verified.

Online Update – Maintain following records in online format provided by IITB

- GRN Records
- Daily Assembly Records
- Daily Missing / Excess & Defective Records
- Daily Distribution Records
- DIS Entry
- SRC Data Entry

Offline Update – Maintain following records in hard copy format (booklets) provided by IITB

- GRN Records
- Daily Assembly Records
- Daily Missing / Excess & Defective Records
- Daily Distribution Records
- Free Kit Records
- DIS Entry
- SRC Data Entry
- Maintain records pertaining to material / kits issued to workers (like Issue of Material to Assemblers, Issue of Lamps to Distributors, Receipt of DIS & Money from Distributors, etc.)

5. SoUL (Solar Urja Lamp) Repair Center (SRC) In-Charge's Job Description

Summary of Position

The SRC in-charge is a representative of Institutional Partner (i.e. NGO), appointed for monitoring and executing the repair & maintenance of the SoUL related operations and activities for a specific assembly & distribution center /cluster / block. He performs the roles and responsibilities as per IITB guidelines. He consults with Project in-charge for all major and minor issues related to SRC operations. SRC in-charge monitor, supervise and execute SRC related activities. SRC in-charge will be involved directly for executing the SRC related activities.

Duties & Responsibilities

a) Repair and Maintenance related tasks

- As per IITB guidelines, monitor the SRCMs for each & every Repair & Maintenance activities.
- Surprise checks to random SRCs, to make sure the quality is not compromised
- As a part of photo documentation, take photographs of SRC Centers in case of unusual things spotted, mismanagement etc.
- Any irregularities found in the process of Repair & Maintenance from any side, may be from the IP side or, the SRC side, it should be immediately reported to IIT Bombay's field officer/cluster manager/state coordinator so that appropriate action can be taken immediately against the respective person.
- Test Faulty Components properly (to cross-verify the proposed Faulty Components are really Defective) after receiving from the SRCMs and dispatching to the respective vendor for future replacement.
- Regular monitoring and guidance to respective staff for updating the inventory data (Count Check list of received, missing, defective, replacement of spare parts) in SRC logbooks & through online mode.

Inventory / Supply Chain Related Tasks (SRC):

a. Receiving of Spare Parts:-

- Regular follow-up with operation team (IITB) about arranging Spare Components as per the Demand. Make sure the next demand for Spare Components should be raised when only 50% quantity is left-out.
- Send the inventory report showing the status (received spare, no. of spares given to each SRC Center, details of defectives received, inventory (good components) left at each SRC center before the receiving of next spare components.
- Check with operation team (IITB) about the arrival of spare parts (date and time).
- During the count check of spare components, physical presence is mandatory at assembly center and close monitoring needs to be done for avoiding any mishandling of actual inventory.
- Send a scan copy of the stamped & signed count checklist of Spare components through mail to IITB within 24 Hrs after received of Spare Parts and put original copy of same in a file for future evidence and verification.
- Click photos / Video shooting (specifically if there is damage to the components when the boxes are opened) of activities from spare parts arrival to counting of components.

b. Defective Components Dispatch:-

- Handover defective components and respective data to Data Entry Operator to update through online mode that was collected from SRCMs and cross check with the logbooks for assuring the accuracy level.
- Before dispatching defectives to vendor send a scan copy of defective components report along with sign & seal of IP to IITB through mail to issue Undertaking Letter
- After receiving scan copy of Defective components report, IITB will Issue Undertaking Letter for dispatching the defective components to the respective vendor
- Keep photo copy of defective component report in separate file for future evidence and verification.
- Put original copy of defective component report in defective component box for vendor reference.
- Handover the Undertaking Letter to logistic company for their reference.
- Dispatch the defective components to respective vendor by having coordination with field officer or IITB (Operation Team)
- Intimate Logistic details of the defective components to IITB (Operation Team)

CHAPTER 3: MANAGING A&D CENTER

1) Introduction:

Taking into the consideration of increasing phases of Million SoUL Project and the previous phase learning, outcome and operational difficulties proved that managing localized A&D center is not easy task and requires proper planning and coordination between all stakeholders to avoid errors in day to day operational activities. It is, hence, important to identify the objectives for planning and managing A&D center more effectively and efficiently. Some are as follows:-

- ✓ Easy information flow (between all stakeholders)
- ✓ Reduce defectives (during assembly, storage and transport)
- ✓ Effortless material handling
- ✓ Well defined operational measures
- ✓ Clear roles & responsibilities to avoid communication errors

A&D center is the place where all project related operations are taking place such as receiving, dispatching, storage, assembly, distribution and record keeping of solar lamps and other important operations. A&D Center is a location with adequate facilities where volume shipments are received from a vendor.

The A&D center is a pivot in the physical assembly and distribution process. An A&D center is a location where inputs (incoming factory shipment – unassembled kits) are converted into outputs (outward shipments in terms of demand of the lamps by the students). This conversion takes place by assembling various components in to solar lamp in a time effective manner and with minimal discrepancies. In short, an A&D center is at the heart of all the assembly and distribution process.

It includes - receiving, dispatching, storage, assembly, distribution and record keeping. The Assembly and Distribution Supervisor generally reports to project in-charge. Through the NGO, the Assembly and Distribution Supervisor indirectly reports to IITB, however its main functionality is handled by NGO.

A&D center is the key place for multiple operational activities and it coordinates with NGO and IITB. That is because of the following.

- In order to run the assembly and distribution operations smoothly the A&D center (i.e. NGO) administration must complete understanding of all SoUL related operations to run the project effectively and should complete various activities within schedule time.
- In order to provide the required solar lamps to the beneficiaries the project in-charge has to plan the materials, manpower and other resources etc.

2) Advantages of Own A&D Center:-

It is generally less expensive and more ¬ efficient.

- ✓ A&D center should be strategically located and ¬ easily accessible, that will help to save time, money and other resources.
- ✓ Fixed costs of an A&D center are distributed among ¬ many users.
- ✓ The cost of A&D center can be easily and exactly ¬ ascertained, and the user pays only for the space and services he uses.

3) A&D Center Location

The following considerations determine the location of an A&D center:

- Block / town service area and cost of distribution from the A&D center to the block / town area.
- Satisfaction of transport requirements and facilities available in the form of roads and vehicles.
- Transportation rates prevailing in the area and distribution cost per SoUL kit.
- Availability of electricity, water, sewerage disposal and their cost.
- Assemblers, distributors, supervisors, data entry operators, project in charge availability and their cost.
- A&D center requirements and constraints, including commitments, if any, made to assemblers, distributors (including other staff of NGO) and others about a particular location which may influence a decision.
- Attitudes of local residents and government toward establishment of the A&D center.
- Potential for later expansion.
- Cost of land for the A&D center and other costs.
- Possibility of change in the use of the facility at a later date if the NGO so desires, and lease or sale of the land and building.

4) A&D Center Characteristics

- It protects the material against ground moisture, rain, objectionable odors, insects, rodents, birds, poultry, cattle, thieves, wind, fire, etc.
- It provides the necessary facilities for manual and mechanical operations, inspection, disinfection, cleaning, reconditioning, packaging, etc. of the SoUL kits.
- It is an economic unit, close to the block / village with adequate covered platforms and connected by well-connected roads.
- It offers the necessary amenities, such as water for drinking, electricity and fire-fighting etc.
- As far as possible, it is located away from grain mandis, grocery or shopping centers, grain fields, garbage dumping grounds, sewerage tanks and disposal plants, dairies, poultry farms, tanneries, factories, because their close proximity is detrimental to healthy storage facilities.
- Within a given general areas chosen for an A&D center, the choice of a particular site depends on access, availability of transportation to and out of the location, are its proximity to major beneficiaries.

- The location is not cut off from any part of the total service area by a river or other geographic barriers.

5) Storage Capacity of A&D Center

The term capacity of an A&D center refers to the overall cubic content of the storage area of that building, as well as the length, width, and height. The volume content of a storage area of that building is affected by a number of factors. Some of these are enumerated below:-

- Type of material to be handled;
- Handling system to be used;
- Stock layout arrangements;
- Land requirements;
- Office area required.

Setting up a fixed A&D center at a given location becomes a constraint on A&D center operations for number of months. The internal layout may be changed with a relative ease. But it is difficult to change the overall size of the A&D center. Through the A&D center size may be expanded at a later date or extra place may be leased, the resulting available space may not be ideal. In general, poor planning of the A&D center leads to either higher material handling costs in the A&D center with lower desired capacity or unnecessary space cost if larger space than what is require is desired.

6) Storage in A&D Center

One of the fundamental features of A&D center is systematic storage and safeguarding of material. In order to ensure that the quality remains the same and is well preserved, the following steps are taken:

- The A&D center is separated into different sections for storage of material according to their nature like unassembled kits (i.e. components), defectives, and assembled (finished) kits.
- Different stacking methods are adopted, depending on the size of the packages and the duration of storage.
- Assembled kits are stored in a separate section, generally close to the doors, and unassembled kits which are likely to remain in storage for a long time are stored a little away.
- Gangways and operational spaces between stacks are left for necessary disinfestations operations, re-stacking, turn-over, etc.
- The components / kits are periodically inspected to check that there has been no damage during storage.
- If there is defective / damaged components found during the assembly process and that the components are not capable further storage, the assembly supervisor can take action to have them delivered to respective vendor.
- If the material requires cleaning to bring them up to an acceptable standard by beneficiaries, this must be done by the assembly supervisor.

7) Functions of A&D Center

The functions of A&D center are as follows.

a) Receive the:- material ¬

Receive the unassembled kits / components from vendor. This receiving is to be done from vendor directly by coordinating with IITB. Count for proper quantity as per the document.

b) Store the material properly: - Provide ¬

The right and adequate storage and safeguard the material properly. Ensure that the materials do not suffer from damage, pilferage or deterioration.

c) Mixing of material: -

The SoUL kits are received from vendors are often requiring mixing and assembling together to satisfy need of final beneficiaries.

d) Deliver the SoUL kits to right place: - Fulfilling¬

The block target of final beneficiaries is decided as per the number of students enrolled in the current academic year. Taking this into account, A&D center issue the SoUL kits as per prior intimation from distributors on the basis of school campaigning and promotion.

e) Keep the records ¬ perfectly in discipline: -

To maintain proper records and update receipt and issue of materials (unassembled kits to assemblers for assembling the SoUL kits and assembled SoUL kits to distributors for distribution)

f) Packaging and waiting for order: - Often A&D Center¬

Person has to make package for delivery till the final order is received from final beneficiary. The SoUL kits are then loaded carefully in the transport vehicle to present to the students in appropriate condition.

g) Maintaining good cleaning: - Keeping the A&D center clean and neat ¬ and is good order so that the handling, preservation, stocking, receipt and issue can be done satisfactorily.

h) Keep proper control: - Keeping a ¬ vigil on the discrepancies, abnormal consumptions, accumulation of material, pilferage, theft etc. by implementing controlling measures.

i) Arranging transport: - For ¬ distributing the assembled kits to the beneficiaries it is essential to plan and arrange proper vehicle. This needs to be done for keeping economy and quality. The placing the product upside down etc as per need is very much required to maintain the lamp quality.

8) A&D Center Operations

The essential processing of materials in an A&D center involves following operations:

a) Receiving Material:

An A&D center accepts the material delivered by a transporter / vendor and then accepts the responsibility for this material.

b) Dispatching Material:

An A&D center dispatches the defective components to vendor after completion of specified inspection and other formalities.

c) Sorting Material:

The materials are sorted out for appropriate storage area in the A&D center.

d) Storing Material:

The materials are kept aside where they can be found later, when needed.

e) Assembling the lamps:

The unassembled kits are received from vendors are often requiring mixing and assembling together to satisfy need of final beneficiaries.

f) Distributing the lamps:

The consolidated order is packaged suitably and directed to the right transport vehicle. The SoUL kits are then loaded carefully in the transport vehicle to present to the students in proper condition.

g) Record Keeping:

Maintain and update the records of each and every operation in appropriate format.

9) A&D Center Safety

The hazards for the material stored in an A&D center are of the following nature:

- Theft and housebreaking
- Fire
- Floods
- Riots and civil commotion
- Moisture, insects and rodents

An A&D center is constructed on a site away from colonies which may be prone to anti-social elements. The selected site is also away from low-lying areas, rivers etc., so that the inundation might be avoided floods. The structure is designed in such a manner that the plinth is at least one metre above the ground level. The platform of the verandah and plinth of the A&D center are constructed in such a way that it is rodent-proof. It generally has a compound wall with sufficient height, and only one gate for entry and exit to ensure better and closer watch on incoming and outgoing persons and vehicles.

An A&D center is also located away from dumping grounds, garbage pits, etc., to ensure that insects which normally breed in such places, do not damage the material in A&D center.

Internal Safety

The owners of materials, their agents and other dealing with the A&D center are screened so that entry is permitted to only such persons who are interested in conducting ethical business practices and do not indulge in pilferage or other adverse activities of sabotage, etc. Sufficient surveillance measures are taken to ensure the same.

10) Material Handling

The handling of material is a manual activity which has been performed carefully. The construction of the great pyramids and other historical monuments all over the world called for the handling of various types of materials in various forms and methods. Material handling has now become an important and specialized function of all industrial activity. It is as important as, costs and the production process.

A modern manufacturing plant works on assembly line principles. In an automobile plant, the chassis moves along the assembly line where different workers attach different parts in turn tighten a bolt or make certain adjustments. Finally, the finished car emerges at the end of the process. A similar procedure is followed for other assembly line production processes. Before it reaches the ultimate customer, the product has to pass through a series of handling processes – from the procurement of raw materials to the sale of the final article.

The manufacturing establishment first receives the raw material or spare parts which go into the making of the product. They are conveyed to the place where they are stored. Then they are taken to the preliminary fabrication or manufacture or the first production process. Thereafter, they are again sent to the storage before they are moved into the various stages of manufacturing operations.

Once the machine and processing operations are finished, the semi-manufactured or finished product moves to final inspection and packaging. When all the manufacturing operations are completed, it is again sent into storage to await transportation to consumers.

Material handling is an essential production function. Organizations do not pay adequate attention to this function. On an average, fifteen to twenty percent of the cost of a product is incurred on material handling. Over and above this tangible cost of material handling and of labor and machinery costs, they are the hidden costs of material handling which arise from the damage of raw materials to the finished products, delay in transportation, deterioration in the quality of the product, waste of productive labor time and loss of production. This total material handling cost must be minimized by designing a proper system.

Material handling is undertaken at every stage of logistics activity, and is an integral part of the other elements of logistics function. Material is handled during the production process, in transport, A&D center, during packing and when goods are returned by the customer (i.e. beneficiaries) for one reason or the other. This would insure cost reduction in the operation of the overall material handling function and increase productivity.

Material handling involves the following point

a) Receiving or dispatching of material involving unloading, loading;
b) Flow of material within the A&D center;

c) Inspection of unassembled kits / components and finished kits at A&D center;
d) Sampling of components, intermediate assembled kits and finished kits at nominated stages;
e) Verification and documentation.

Each of the above functions has been discussed in more detail in the following paragraphs.

Receipt and dispatch

The receipt of unassembled kits / spare parts or the dispatch of defectives, at the A&D center, or field storage facility may be considered a part of the transportation function.

Receipt

a) Receipt of trucks, shipments, etc., in a nominated area or location.
b) Unloading of individual truck or shipments.
c) Storage of the material (whether unassembled kits / spare parts).
d) Inspection of the material received.
e) Documentation for receipts of material.
f) Documentation for the storage of material.
g) Communication to all concerned about the receipt of the material.

Dispatch

a) Documentation and generation of reports for dispatching defective components.
b) Inspect and verify if components actually defective.
c) Receipt of undertaking letter for dispatching defective components.
d) Coordination with courier service provider for dispatching defective components.
e) Storage of adequate material to ensure uninterrupted assembly/distribution/repair & maintenance activities.
f) Documentation of dispatches and storage.
g) Communication of information about dispatches to all concerned.

CHAPTER 4: INVENTORY MANAGEMENT

1) Introduction –

Primarily, the first and most important step to commence in inventory management is to acquire accurate data in terms of facts and figures. Next, a set of rules and regulations is set up to protect and guard the information efficiently. Such information may become a crux factor in the improvement of internal operations, strategies and output.

These will include good practices like making accurate entries on every material receipts into the computer, setting up a replacement strategy on all items in the assembly center and be ready with specific guidelines on the control of defectives as well as excess inventory. Such effective inventory management habits will provide superior competitive advantage and will save cost, time and resources.

2) Benefits of Good Inventory Management -

a) Improves the accuracy of inventory orders –

Proper inventory management helps you figure out exactly how much inventory you need to have on-hand. This will help prevent material shortages and allow you to keep just enough material without having too much in the assembly center.

b) Leads to a more organized assembly center –

A good inventory management practice supports an organized assembly center. If your assembly center is not organized, you will have a hard time managing your inventory. Proper storage pattern will help to get material easily accessible in assembly center. This, in turn, helps speed up the assembly and distribution processes and ultimately keeps beneficiaries satisfy and happy.

c) Helps save time and money -

Inventory management can have real time and monetary benefits. By keeping track of material you have on-hand or ordered, you save yourself the effort of having to do an inventory recount to ensure your records are accurate.

d) Increases efficiency and productivity -

Inventory management practices, such as regular inspection, monitoring and keeping records in record book and Google spreadsheets, can help drastically improve your efficiency and productivity. This policy will help eliminate manual processes so your staff can focus on other – more important – areas of the project activities.

e) Meet demand and improve the speed of supply -

Inventory management helps you meet demand by allowing you to have the right material on-hand as soon as your beneficiaries need them.

3) Ways to improve assembly center efficiency and inventory management

a) Good inventory management starts with upkeep

Inspect your operation regularly and review your assembly center – just because it was well-organized when you initially started, doesn't mean that it meets your current standards. Have a daily checklist for the assembly supervisor, and hold him or her responsible for the upkeep of the assembly center.

b) Good storage pattern

Assembled kits are stored in a separate section, generally close to the doors, and unassembled kits which are likely to remain in storage for a long time are stored a little away, you'll eliminate a lot of unnecessary labor time, and your staff will think you are super considerate.

c) Internal Safety

The owners of materials, their agents and other dealing with the A&D center are screened so that entry is permitted to only such persons who are interested in the ethical business practices and do not indulge in pilferage or other adverse activities of sabotage, etc. sufficient surveillance measures are taken to ensure that the staff working in the A&D center do not indulge in pilferage, thefts, etc. Give your employees some kind of an identifier (like ID cards, special t-shirts, etc.) that can distinguish those working in the assembly center and those who are not.

d) Room for receiving

A lot of inventory errors can happen at receiving if assembly supervisor don't have enough space to work. Avoid giving him a small office at the end of the assembly center. Eliminating receiving errors will relieve you from all kinds of ugly issues later in the like missing components, kits etc.

e) Label every defective component

Put labels on 'defective components' to make it easier for pickers to choose the right inventory. It's all about reducing errors in the process – some simple preventative measures will save you from having to put out fires in the future.

f) Quality control

Take precautions, measures before taking any action while performing operations. This is called quality control, and adds another layer of responsibility. Therefore, inspect thoroughly each and every technical component for assuring quality level. This thorough inspection will help to avoid future spare parts buying cost and lamp defective rate.

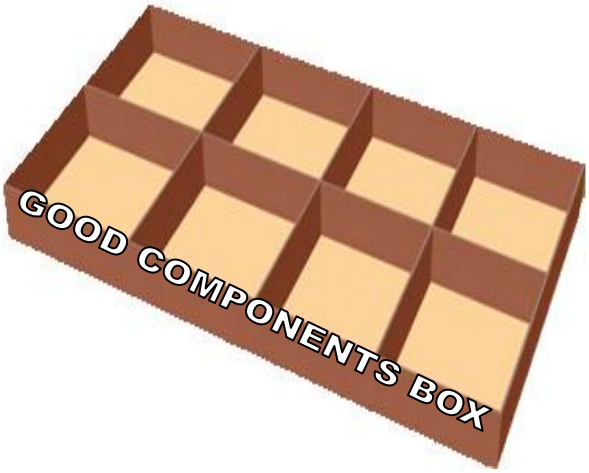
g) Finish right, start tight

Give your assembly center the chance to finish day assembly and distribution processes and clean up before they clock out. By the end of the day, your

assembly center will be organized and your inventory will be right where it belongs, instead of just lying around waiting for the next day to start in confusion. You can probably imagine how much faster your staff will clean up at the end of their work day so they can clock out and get home, as compared to how sluggishly they'll get it done in the morning.

Before leaving your A&D center, any remaining or excess Good components keep in separate box for using it in next day assembly work. This practice will help to protect any physical damages and provide safety to all components.

*Figure6: **Good** components maintenance box used in assembly and distribution center, below is an illustration:*



h) Don't let your assembly center become a dirty

You know how in libraries / bookstores / movie rentals / shoe stores / any place that houses a large inventory of product for rent or sale, everything is neatly categorized and the sections are clearly labeled so as to assist customers in finding what they're looking for? Yeah. That's super convenient. Make signs and labels to direct your staff through your assembly center and help them find the inventory fast and easy, and, ideally, without having to continually bother supervisors by asking for directions.

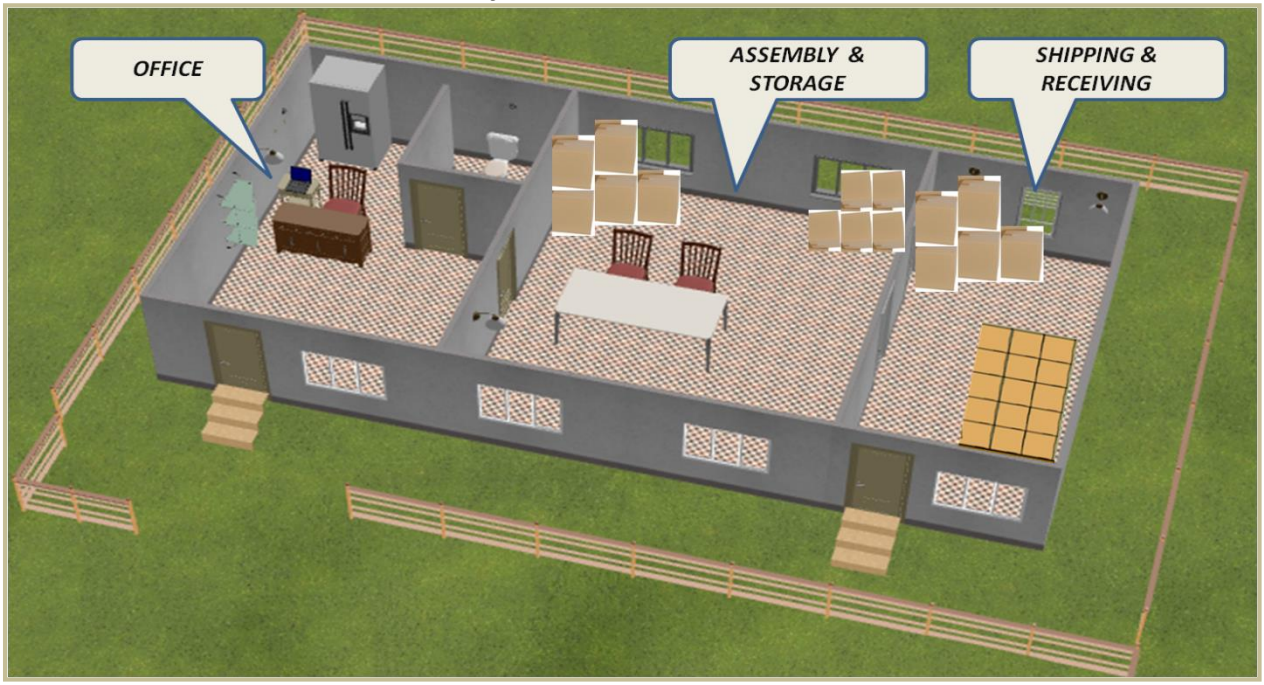
4) How to Create Inventory Location Names in A&D Center

Location names exist so you know where to put material, and where material is put. Sounds simple, but walk into any company and you'll find lots of items stored in locations that aren't clearly labeled, or don't have a well thought out, commonly understood name. A location name doesn't need to be too complicated or cryptic. In many enterprises, the people working there day to day will already have common terms they use to describe various locations. If that's the case, then build on the common understanding where necessary. If you have lots of locations, large rooms, or large storage areas, then this guide will help you organize your thinking on how to name locations.

Key Considerations

- ✓ Location names should be unique. No two locations should ever have the same name.
- ✓ EVERY physical space in your assembly center should have a location name. Even if you don't currently store anything in that space.
- ✓ Where practical, EVERY location should be labeled.
- ✓ The location labels should contain the full name of the location, and if possible, have arrows that point to the location
- ✓ If you have more than one "room" consider using room names
- ✓ Room names should be abbreviated (usually to a single letter) and contained in the full location names.
- ✓ Within a room, location names should ascend from top to bottom and from left to right

Figure7: A good location naming scheme using our assembly and distribution center, below is an illustration of the facility:



Why are we doing this?

If you store your items in a small area or one room, you don't need to do this activity. But if you have a large storage area, or more than one room, you're going to benefit by breaking down your space into manageable smaller chunk.

Some of the benefits are obvious:

- ✓ You can find locations faster
- ✓ There's no confusion about what a place is called

5) What are defective components?

Defective components means those components which are imperfect, faulty, doesn't work properly or not qualifying testing standards.

A) Reasons of defective components

a) Parts assembled with the incorrect direction.
b) Incorrect components used due to incorrect or missing instructions.
c) Faulty components used without proper testing by the assemblers to reach their day assembly target.
d) Parts damaged due to excessive material handling.

B) Defect Management Process

Defect management process includes the following steps –

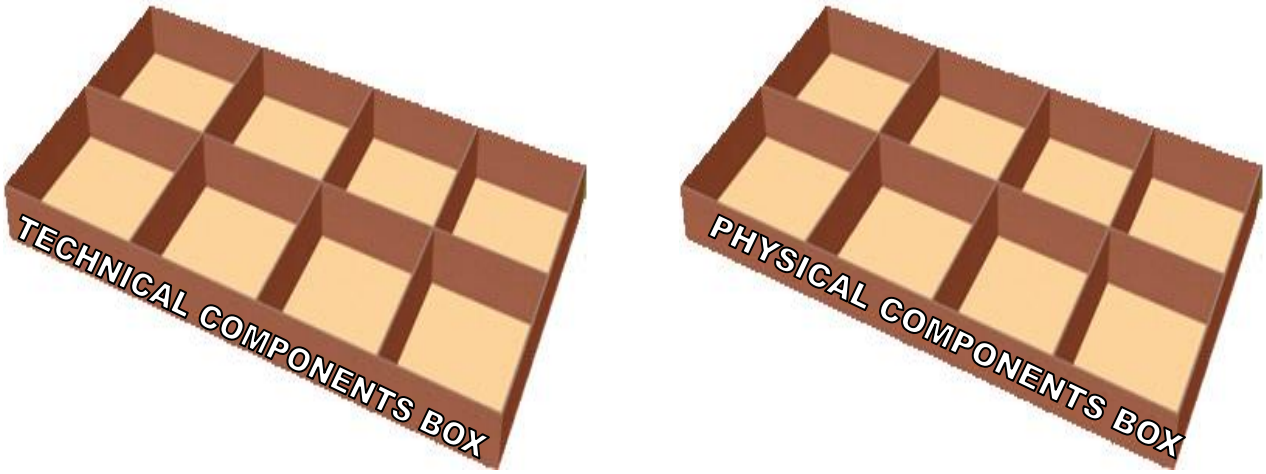
a) **Identification**

This step involves the finding of defective components. As per the guidelines, Assemblers should do the thorough inspection and testing of components before starting the process of lamp assembling.

b) Categorization

When a defect is reported, it is typically assigned to a designated team member to confirm that the defect is actually a defect. Once it is confirmed, then defective components are maintained in specific boxes (i.e. technical and physical components maintenance box) and accordingly records are maintained by assembly supervisor.

*Figure8: Technical and physical **defective** components maintenance boxes used in assembly and distribution center, below is an illustration:*



c) Assignment

Once a defect has been detected**,** it is then assigned to assembler to repair, if possible.

d) Re-use

Once a defective component has been resolved and verified by assembly supervisor, then the defective component will be considered as good component and it will be re-use for assembling the lamp.

CHAPTER 5: WORKER'S SCHEDULING AND PLANNING

1) Introduction

Planning (how to do a job) is the fore thinking of a detailed program to achieve the final output (i.e. receive, dispatch, storage, assembly, distribution, repair & maintenance and record keeping of SoUL lamps).

Scheduling (when to do the job) is an important tool for any operation, where it can have a major impact on the output of a process. The purpose of scheduling is to minimize the time and costs, by telling an assembly facility what to make, when, with which resource, and on which tools. Scheduling aims to maximize the efficiency of the operation and reduce costs.
Well-planned, properly scheduled, and effectively communicated job accomplish more work, more efficiently, and at a lower cost.

2) Scheduling represent:

- Time (duration) estimates for all the tasks
- Start and finish dates for the tasks
- Names of staff assigned to complete the tasks
- Sequence of tasks

3) Purpose

The project in charge will use this proposed schedule scheme for planning, executing and controlling project tasks. Hence it will help to track and monitor the progress of the project.

The project schedule defines timelines for key deliverables and sets expectations for project progress and completion.

4) Who is involved?

1. Project in-charge
2. Assembly supervisor
3. Distribution supervisor
4. Data Entry Operator

5) A&D Phase Completion Period

IP should complete the assembly, distribution and DIS entry work, within One Hundred and Ten (110) days from the start date of the project.

6) Tasks and their requirements:

The following flow chart depicts the tasks and requirements:

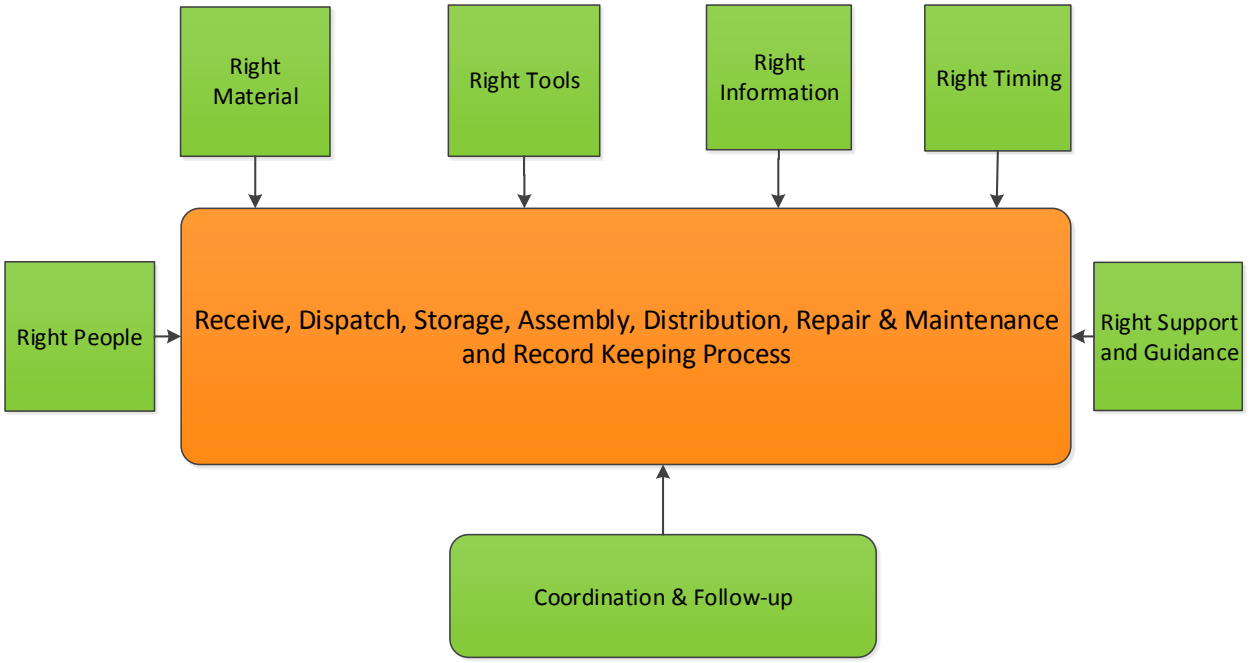


Figure9: Tasks and their requirements

Coordination encompasses the logistical efforts of bringing together all the necessary resources so the work is ready to be scheduled.

7) Key project tasks:

Following tasks are important and should be completed within assigned time.

- Assembly
- Distribution
- DIS entries (including other records)

8) Assembly, Distribution & Data Entry Planning:

Assembly, Distribution & Data entry planning can be completed in two ways. One way is based on the total days, and second way is based on the assemblers and distributors.

Based on days:

Table1: Assembly, distribution & data entry planning – based on total days

Assembly, Distribution & Data Entry Planning	
Based on total days	
Target	**10000**
Days	**90**
Per day assembly and distribution	111
Assuming 40 lamps/day	40
# Assemblers	3
# Distributors	3
Assuming 30 entries in 1 hr (i.e. 30*8 working hrs)	240

# Data Entry Operators	1
Expected assembly, distribution & data entry in 110 days	
in 30 days	3333
in 60 days	6667
in 90 days	10000
in 110 days	12222

Explanation:
Suppose a block has targeted of 10000 units then it could be completed within 90 days. To complete it within 90 days, we required 111 lamps should be assembled and distributed per day. Considering 3 assemblers and 3 distributors, each one will complete 40 lamps of assembly and distribution per day. So, if we consider 3 assemblers and 3 distributors per day, then they can complete 120 lamps. Even though we require only 111 lamps to be assembled and distributed per day, but a target of 120 lamps can be achieved easily. One data entry operator per hour will complete 30 records of entries so within 8hrs (working hours in a day) he will be able to complete 240 records.

As per above scenario, within one month (30 days), 3,333 lamps can be assembled and distributed. So in a time span of four months (110 days), one can achieve a target of 12,222 lamps.

Based on Assemblers & Distributors:

Table2: Assembly, distribution & data entry planning – based on # assemblers & distributors

Assembly, Distribution & Data Entry Planning	
Based on # assemblers & distributors	
Target	**10000**
Days	63
Per day assembly and distribution	160
Assuming 40 lamps/day	40
# Assemblers	4
# Distributors	4
Assuming 30 entries in 1 hr (i.e. 30*8 working hrs)	240
# Data Entry Operators	1
Expected assembly, distribution & data entry in 110 days	
in 30 days	4800
in 60 days	9600
in 90 days	14400
in 110 days	17600

Explanation:
Suppose a block has targeted of 10,000 units, and we have 4 assemblers and 4 distributors. If each assembler and distributor completes 40 lamps of assembly and distribution per day, then the total assembly and distribution count will reach 160 per

day. One data entry operator per hour will complete 30 records of entries so within 8hrs (working hours in a day) he will be able to complete 240 records.

As per above scenario, within one month (30 days), 4,800 lamps can be assembled and distributed. So, in the time span of four months (110 days) one can achieve a target of 17,600 lamps**.**

CHAPTER 6: MANAGING PROMOTION AND CAMPAIGNING

1) Preliminary Assessment – From Planning Perspective

A) Collection of Secondary Data & Planning Report:

Before starting project in a particular block, it is of prime importance to collect secondary data & planning report in order to determine the enrolled students between the 5^{th} to 12^{th} standard and also the requirement of SoUL in that area. This process should be accomplished in participatory and comprehensive manner.

The objective of this approach is not only to facilitate participatory decision making in the promotion and campaigning process, but also to improve further decisions to meet the beneficiary needs and to overcome the operation and maintenance challenges.

Under this process, information pertaining to the list of villages and gram panchayats, list of schools with address and DISE code, school-wise student enrollment data, school working days calendar, block maps with village clusters clearly marked, etc. is collected by the IP's.

B) Cluster Mapping:

Cluster mapping serves as a tool to provide a visual representation of the information in a particular geographical context. It is based on a stakeholder's perception with the focus on a certain location where the requirement and demand of SoUL. Cluster mapping is a process of categorizing the block locations in several small parts which allow you to concentrate on specific region.

Cluster mapping allows you to define your cluster boundaries according to the presence of number of schools, enrolled students and density of population.

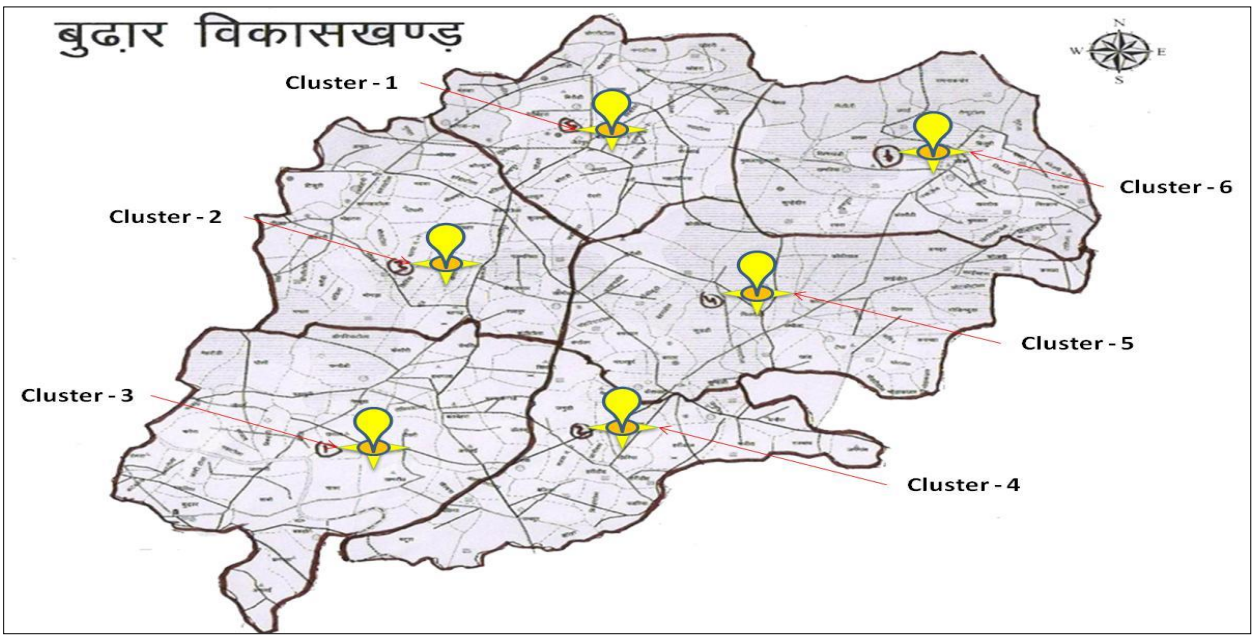


Figure10: Cluster mapping with in block, below is an illustration:

2) Demand Creation - Introduction:

Various solar programs have failed in the past because they were supply driven. It is of prime importance to understand that people will only relate to solar products and related technologies properly which is really required by them (demand driven). Furthermore, communities will only accept alternative energy solutions when they understand them and see its benefits. Demand for solar products is only created when end-users have motivation, opportunity and ability to invest in it and which suits their needs and aspirations.

Often, the solar products of supply-driven projects are poorly used and maintained and financially unsustainable to support the repair and maintenance services, because the needs of the local people were not considered. In order to create demand for solar products, it is necessary to identify what the community members actually require, as well as to identify what aspects of solar products will be of most interest to them. When these drivers are identified, they will be used to convince the community to demand the adoption of solar products.

Awareness Raising for Demand Creation:

It is a systematic activity carried out by the institutional partner across the community/project area together with the assemblers, distributors to explore and promote the SoUL project at field level by observing, asking, listening, looking and demonstrating the SoUL to the local community. This activity is normally conducted during the initial phase of the project.

By applying awareness raising tools you can support demand drivers for SoUL within a community. Awareness raising tools aim on the one hand; at making people aware of a certain benefits of SoUL lamp, and at the other hand, it aims at integrating

different stakeholders about positive changes in education and associated benefits to the students. Awareness raising, e.g. with different media campaigns, also helps to reach those stakeholders that are often forgotten (e.g. radio campaigns, videos, posters and pamphlets, or internet and email).

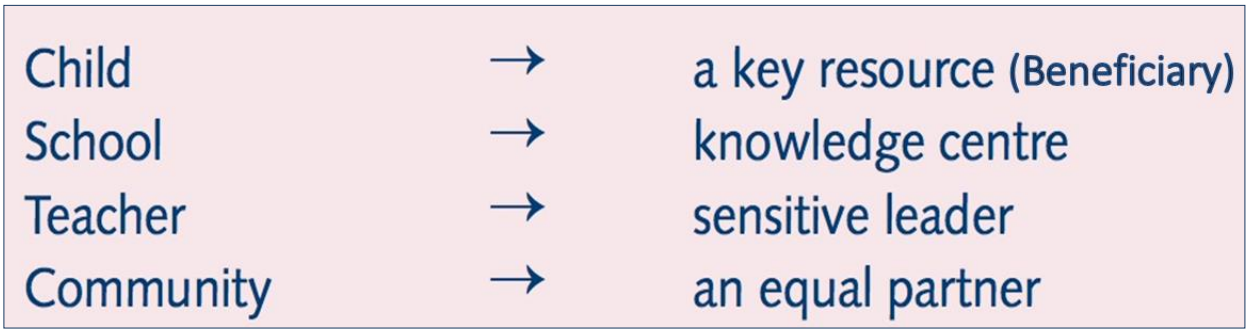
To raise awareness for SoUL, it is important to promote its visibility and credibility within a community or society. It is also of prime importance to inform and educate people in order to "elevate their level of knowledge" about the different options regarding solar products. The intention is to influence their attitudes, behaviors and beliefs towards the achievement of clean light through solar lamp in their community. The ultimate goal of a solar lamp awareness raising program is to achieve such a degree of understanding and motivation that the members of the community can participate in the decision making process at a more informed level and that they participate in the realization of the decisions taken.

Effective awareness raising will employ a variety of different communication approaches, techniques and tools to ensure that the central message is received and understood by a heterogeneous audience. Awareness raising demand time and financing and therefore require adequate support in planning, promoting and performing these activities. Such support will include funds, monitoring and networking.

A) School Campaigns:

Schools present an opportunity to reach thousands of students on secured platform to promote and demonstrate the effectiveness of the solar lamps. They provide unique opportunity for raising awareness as it brings large number of students from different backgrounds together for learning purposes and usually have systems for production and dissemination of educational material. Schools can also provide an entry point to the community as a whole.

Figure11: The idea: Main actors involved and their roles in a solar lamp promotion and campaign.



Empowering Young People as Promoters:

Empowering young people as promoters in the field of solar technology is a way of assuring that a project or program has a greater effect and more long lasting impact

on the communities. When trying to find solutions to electricity problem and ways to improve access to clean light in any given community, it is essential that youth become involved, so they themselves can work together in an organized fashion to identify appropriate solutions to the problems, and then take 'ownership' of the measures to apply those solutions. There are many tools that can be applied in order to involve youth in community based action. This can help raise their self-esteem and also encourage other young people to take similar actions.

Why Involve Youth?

Young people need opportunities to develop skills, and when adequately directed can easily and effectively support organizational work without a lot of experience. Solar programs should try to involve young people as promoters because they have a lot are tremendously creative and can devote their time and energy in innovations. In this media age, young people have access to tremendous amounts of information that can sometimes be overwhelming (using internet based social networks, for example), but they really do not know what to do with all of it. Hence, this access to internet can be used in to channel their energies towards dissemination of solar technology in the rural areas.

Making the Change:

Young people are prepared to take risks while experimenting with unconventional structures. They are a section of society which will be able to assure sustainability. Indeed, young people are often more sensitive and intuitive than many adults, which can give them an instinctive and intuitive sense of what will work or not and in which direction a program should be directed. 'One way to make sure change lasts is to work with young people, because they will take what they learn into the future. Each of us, no matter what age we are, can adopt the attitude of a young person to always be willing to learn and try out new things'.

B) Advocacy - Influencing Leaders:

"Advocacy is the action of delivering an argument to gain commitment from political and social leaders and to prepare a society for a particular issue". Advocacy involves the selection and organization of information to create a convincing argument, and its delivery through various interpersonal and media channels (e. g. public speaking, project visits, requests, engaging celebrities, radio and newspaper). Here, we will focus on one of the essentials of advocacy: influencing and involving important leaders, because political support together with support from community leaders and religious leaders can give a solar-related project or campaign a powerful boost.

Advocacy as a Tool to Involve Leaders on All Levels:

Creating awareness and gaining the commitment of decision-makers for a social cause is very important to influence policies and practices that affect the lives of people – particularly the underprivileged. Therefore, the goal of advocacy is to make the issue in concern a political priority and to achieve change in policy and practice.

To gain the commitment of leaders, advocacy work consists of a set of tools including meetings with the relevant decision makers, public speaking and involving the media to reach the general public.

In the first instance, advocacy may be carried out by key people in state and national agencies, as well as special ambassadors, but is gradually taken over by people in regional and local leadership positions, local NGOs and by the print (e.g. posters and pamphlets) and electronic media.

Why Should You Try to Influence Leaders?

'Strategic networks and involvement of political, religious and local leaders are basic requirements for a successful project, because leaders can play a role by openly supporting the solar project in the media. They emphasizing the solar technology related project in meetings with other leaders, or by addressing communities directly'. The involvement of leaders will increase public attention to the solar lamp project and it will also influence social norms directly. Community norms and values can change through the support of leading community figures for certain measures. There is a need to involve those leaders who are especially regarded as credible, trustworthy and popular among the public.

C) Creating Information Material:

Creating appropriate and specific information materials for solar program is of key importance and a way to assure a strong and sustained impact and behavioral change in a given community or area. Effective information materials can create curiosity and interest on the subject matter. Awareness raising materials is an important way to reach a lot of people.

Why Is It Important to Develop Information Materials?

Basically used to enrich a horizontal learning process within the group or community, information materials are a way of sharing useful information in appropriate and interesting forms and on a timely basis to those people and groups who can make the best use of it. Information materials can raise awareness regarding the existence, nature, extent and severity of problems early on in the learning process and, at a later stage, can provide useful and necessary information on technical options and solutions, as well as recommendations on the appropriate use, operation, repair and maintenance.

If not provided to the targeted audience at the right time, external information can short-circuit the learning process of the group and hinder the expected program results. As different people understand different things, to have access to sequential and orderly information is important. Whereas some information materials (e.g. poster and pamphlets) might be designed for general consumption of a wide community audience, other materials with more detailed technical information might be directed to a specific group (e.g. students, parents or teachers) or even

individuals with specific responsibilities (e.g. SRC Managers responsible for repair and maintenance). In this way, the people who receive the information might apply it directly or, in turn, disseminate and transmit it to others, outlining steps to teach and train others.

Who Should Be Involved in Creating Information Materials?

Creating effective information materials is generally a multidisciplinary team process, as it requires diverse skills and experience, including a clear grasp of both social and technical issues. In addition, such an undertaking also requires one person who can manage and maintain the broad vision of both text and graphic materials, and how to merge them. Much of the process in developing materials has to do with coordinating the different persons and perspectives involved in the process (writer(s), designer, artist, and printer). And, of course, indirectly, the community (the users of the information) must be at the center of the process — it is their need, their implicit and explicit demand for relevant information, which must be generated by a participatory learner-centered development process.

Characteristics of Information Materials

Once an initial problem identification and information needs-assessment has been carried out, planning the production of material required for the program can begin to take place. Both the written and visual language of the material should be carefully crafted to reflect the context of the users. For graphic purposes, it is critical to carefully consider the local culture and regional characteristics of where the material is going to be used, including dress codes/styles.

Depending on the target audience, be it for adults or children, key communication elements — such as colloquial vs. technical language — should be identified. In areas where people do not necessarily know how to read and write, it will be necessary to prepare information and training materials that are suitable for the language and cultural context, relying a lot more on clear illustrations. Peoples´ levels of visual literacy can also vary, often depending on their previous exposure to visual communication media. For those less accustomed to looking at visual images, make sure that they will be able to read the images well. But in order to be able to apply and impact of the materials, it might also be useful to develop the information not limited to a very specific area by identifying images and “types” that are sufficiently universal to be used in a number of similar areas — i.e. rural, urban, indigenous, etc.

Another consideration has to do with accompanying the material with a section or guidelines on how to use it — suggested target audience, how/when/where to display or distribute, etc. A distinction should initially be made if the information will be geared toward more technical people, like for example; people who would have clear spelled-out responsibilities related to the assembly, distribution, operations, repair and maintenance services of solar lamps. Although, not commonly taken into

consideration, it might be useful to make some sort of provision for the maintenance and monitoring of the useful life of the materials. For example, a simple feedback form (possibly with an email or internet address) can facilitate feedback for long-term evaluation and budgeting purposes.
For budgetary purposes, also consider the print run (amount of printed material, including formats, colors, quality of printing, etc.). Will the material be for sale, distributed freely, easily reproduced at a local level? If involved in a local program, screen/stencil printing might be a way to get local people involved, with a view that the materials could at least be designed with the potential of going to scale.

With Variations, a Typical Materials Development Process Will Have The Following Stages:

1. Developing the concept, timeline and budget for the whole project
2. Identifying the writer(s) for the text and artist(s) and/or graphic designers for the drawings, illustrations or other graphics
3. Deciding on the format and digitalizing first concept with text (getting the messages right) and graphics
4. Sharing drafts with your work group
5. Field-testing the materials to find out how potential users interpret the messages and visuals
6. Incorporating group's and users' feedback into the final draft including graphic design
7. Having the revised proofs, final print and distribution

D) Different Materials, Different Media:

Posters, pamphlets, stickers and banners: with striking visual images and provocative one-way messages, these materials can be publicly displayed indoors or outdoors to wide audiences. Factsheets, booklets, newsletter, guidelines and manuals: although time-consuming to produce and distribute, using the written word and pictures helps to communicate in a long-lasting form.

Mass media — newspapers, radio, videos and TV and internet: make use of the mass media to publicize information, opinions and concerns to a larger audience and to influence people in power and decision-making positions. Mass media reaches very large audiences and is an efficient means to widely publish. Today, the internet is used in participatory processes and it helps to link participants from different regions or countries, share information or distribute educational material.

Media Campaigns as a Tool to Influence Both the Public Opinion and Policy Makers

As the media are part of the lives of many people, they can give a basis for public discussion and the reconsidering of norms. Case studies show that the media can have an immense educating impact on the public opinion and behavior. Also, the

media can influence the decision makers indirectly, when the public gets aware of a topic and applies pressure. The media play also an important role in advocacy work.

Summarized, the media are useful for the following reasons:

- Change public attitudes and behavior
- Inform the public about your issue and proposed solutions
- Recruit allies among the public and decision-makers
- Raise money for your cause
- Get your issue onto the political public agenda
- Make your issue visible and credible in policy debate
- Influence decision makers and opinion leaders

E) How to Plan a Media Campaign

The following six steps are the main ones for developing a media campaign in general. The questions posed will guide you through your planning:

Step 1: Define Your Audience: Whom do you want to reach with your message? Can you reach this audience within available resources? Do you know enough about your audience to select effective messages and channels of communication?

Step 2: Set Clear Objectives: What is your overall goal? Do your plans fit with other activities and plans in the community? Have you identified your objectives?

Step 3: Define Channels and Vehicles for Communication: Which channel is the best to use for your targets?

- Raise awareness/ spread information: accessible media with broad reach (radio/ posters and pamphlets)
- Change attitudes: channels with emotional impact (television, radio)
- Model specific skills: television works best because of sound, sight, and motion
- Change public opinion: look for news coverage via editorials, news interviews
- Complex message: print presentations

Step 4: Identify Effective Messages: Have you chosen a message for your audience that has the right message content (or theme)? Does the message have the right tone (light or heavy) and the right appeal (rational or emotional)? Would using humor or fear be appropriate and effective? Any message you choose should pass the 'What?' 'So What?' 'Now What?' Test:

- 'What?' refers to the basic information being conveyed
- 'So What?' addresses the reasons or benefits for action
- 'Now What?' clearly defines some desirable and productive action

Step 5: Implement Your Campaign: What work needs to be done? Have you made a timeline? When and how long will you run your campaign, and with what intensity? When will you contact the media channels you have selected, obtain the messages you selected in the format required? Have you set out a work plan that defines required tasks, the people responsible and the timing?

Step 6: Evaluate Your Campaign: Does your campaign track coverage (process indicators)? Does it generate additional media coverage? Can you see changes in

knowledge or attitudes (outcome indicators)? Are there any letters or phone calls with questions on the topic?

F) Media Campaigns - Posters and Pamphlets / Radio / Video / Internet and Email

The media (television, radio, print media, internet and email) play a significant part in spreading information on solar lamp program and in awareness raising. They enable to influence and change public opinion and behavior on an issue. This can lead to public pressure on the local policy actors, and can indirectly influence decision makers as well. Furthermore, the media can play a role as an advocacy tool.

1. Posters and Pamphlets

Here, we will focus on print media, especially on posters and pamphlets. Being placed and handed out at public places and prepared with an eye catching and strong visualization, they are an efficient tool to raise awareness of solar lamp program and to focus discussions about it.

Why to Choose Posters and Pamphlets as Medium to Reach Your Targets?

- Posters and pamphlets are an efficient tool to influence the public opinion because they can reach wide and specific audiences (students, parent and teachers), and they are accessible to people who are otherwise isolated by illiteracy or poverty.
- The involvement of the public will increase the decision makers' attention to the solar lamp program and it will also influence social norms directly. According to this, posters and pamphlets can have a direct effect on the public attitude and behavior.
- An eye-catching poster or pamphlet with strong visualization does not necessarily need words on it. They can hence also reach illiterates or deaf.
- Posters or pamphlets can contain an address of a website or an email-address where people can find more information or ask questions about the solar lamp campaign or any other ways of communication.
- A series of posters can help making the solar lamp campaign familiar and heighten the educational impact. Different audiences can be attracted within the series, which leads to a wider circulation of solar lamp program knowledge in society.
- Posters and pamphlets can also give written information in areas where there are few illiterates. This enables to emphasize main messages and to give educational information.

Things to Consider Before Applying Posters and Pamphlets

- Find out if posters and pamphlets are the right media to reach your targets. If you cannot express your message in pictures, radio might be better in some areas for reaching illiterates. Posters usually work best with short slogans that emphasize the main message.

- If the posters and pamphlets are part of an overall media campaign, it could be beneficial to use a corporate slogan or figure that is recognizable within all kinds of used media. Make sure you use identical information in all media.
- Most material uses drawings and symbols. The correct understanding of those depends on existing cultural conventions. This can become a problem when producers of material are from a different cultural background than the target audience. Avoid this by employing a local artist.
- The flyer/ poster should be designed to have maximum impact on your audience. It should be eye-catching while avoiding being sensational.
- If you produce educational material, the content should include a simple presentation of the facts relating to your issue, and a clear statement of what you want your audience to do.
- Posters and pamphlets are usually a one-way medium and most people cannot ask for further information. To avoid this, the public can be involved in their production (e.g. in workshops) to make them a two-way medium.
- Consider how the posters and pamphlets will be reproduced (e.g. photocopying, printing). It is important to know how many colors can be used and if there are photographs, images or logos that you must include.
- Make sure people will know who is talking to them: Include contact details like phone numbers and web addresses.
- How you distribute the pamphlets or where you place the posters will depend on your target audience and the resources you have available. If you have very limited resources, you may decide to target the distribution very specifically to key audiences. Make sure you are allowed to place posters and hand out pamphlets in your target area.
- Posters and pamphlets should be a part of a wider communication process that encompasses other awareness raising instruments.
- Posters and pamphlets are printed on paper and being littered after their use. This means that there will be a lot of waste produced by choosing posters and pamphlets as media.

Design Principles and Ideas for Posters and Pamphlets

Posters and pamphlets can be used as part of your public campaigning to raise public awareness among large numbers of people. They should be tailored, with particular messages and approaches, depending on who your intended target audience is. The following ideas and tips help you to get an idea of how to produce posters and pamphlets:

- The main message needs to be seen on the first sight: Use big letters, symbols or figures and few backgrounds.
- For texts it is important to answer the questions Who? What? When? Where? Why? and How? at the beginning.
- Keep the information given short and interesting.
- Emphasize benefits of your issue.
- Do not put too much information on it, just key points.

- If you want to use a slogan, make it short and memorable.
- Use uniformity in layout and logos in campaign material.
- Posters in a participatory setting should be open for interpretation, in order to invoke discussion and lead to creative thinking.
- Promotional/ awareness posters are clear to the viewer at a glance and usually have one main slogan and few details. They say a lot with just one picture or slogan and should be very eye-catching and memorable.
- Visualizing the result of behavior change can help encourage the adoption of this behavior change. A good example is a poster where a solar lamp is used for study purpose to demonstrate how much kerosene could be saved each month.
- Cartoon figures are often used to target students.
- Often, educational posters have a lot of information and interesting details meant for a closer look. They can be used at schools as teaching material, but usually they are not very useful for raising awareness because on the streets people might not stop and do not necessarily look at them for long.

Figure12: A pamphlet for creating awareness – IIT Bombay; below is an illustration:

2. Radio

Here we will focus on why and how to develop an appealing radio campaign, which reaches a wider audience than any other medium. Also, radio campaigns are a cheap method to spread information about solar lamp related projects widely.

Main Stakeholders and Target Groups

As the central aim is to spread information and raise awareness of solar lamp program and so change people's attitudes, your target group are people in rural areas who have no or few information about the topic. Radio reaches a very wide audience.

The main actors of a radio campaign can come from the local level: You can just call the local radio station and ask if they are interested in your topic. The station might help you, as well as local govt. administration, to get a recorder and make up an interesting broadcast.

It is also possible to reach nationwide radio stations: you can try to involve local decision makers to support the application and then ask directly at the stations if they want to broadcast your campaign.

Why to Choose a Radio Campaign?

Radio Campaigns are an efficient tool to influence the public opinion because radio reaches a wider audience than any other medium, and is accessible to people who are otherwise isolated by geography, conflict, illiteracy or poverty. The involvement of the public will increase the decision makers' attention to the solar lamp project and it will also influence social norms directly. According to this, radio campaigns can have a direct effect on the public attitude and behavior.


Figure13 & 14: Radio - a medium that can be used almost anywhere nowadays. (Source: www.thehindu.com & www.airddfamily.blogspot.in)

Radio also has the power to motivate people by building on oral traditions like songs, which help to get to the peoples heart. In addition, radio listening can be a group activity, which encourages the discussion of educational issues after the broadcast.

Community radio stations can play a significant role in increasing participation and opinion sharing, improving and diversifying knowledge and skills and in catering to health and cultural needs.

Things to Consider before Applying Radio Campaigns

- Find out if the radio is the right media to reach your targets. Many rural communities now have access to radio, and some read national newspapers on a daily basis.
- Populations may be more easily influenced through television, while professional audiences may respond to articles in key publications and periodicals.
- If the radio campaign is part of an overall media campaign, it could be beneficial to use a corporate slogan that is recognizable within all kinds of used media. Make sure you use identical information in all media.
- Radio campaigns are a cheap method to spread information, but they should be deliberate, in particular they need to be basic and memorable for anyone with any education.
- For making a broadcast you will need a recorder. It is also possible to borrow one at a radio station. Maybe you can also make the broadcast there.
- Radio campaigns should be a part of a wider communication process that encompasses other awareness raising instruments.
- Radio is a one-way medium and most people cannot listen again to a show or ask for information to be repeated. To avoid this, telephone calls or letters with questions on the campaign should be enabled to make it a two-way medium.
- Many people lack access to radios, electricity or the batteries to power them. Therefore, radio campaigns need to be appealing and burning themselves into one's memory at the first listening.
- Check religious background of the specific area before planning the radio campaign. The campaign can lean on religious issues but should definitely not break with any religious rites.
- The title and opening line of a presentation are important, since they will determine whether you attract the attention of listeners.

Ideas for Radio Campaigns

There are lots of ways to create a radio campaign: Short on-off programs can be broadcast to highlight or explain particular issues, whereas series of programs give a longer period for the introduction of a set of ideas. Below, you can find few different ideas how to make an appealing radio campaign for your issue.

a) **Participation, Local and Community Radio:** Individual radio programs can be made with the direct involvement of poorer people, through interviews, phone-in programs, letters, or recordings of outside events. Involving members of the audience in broadcasting itself, building up local content, and enhancing the relevance of programs is not just good developmental practice — it can make for better radio as well. Most people are able to speak on radio expressively after

only minimal instruction, so community radio provides a means to voice local concerns, as well as a way to reach people with messages.


Figure15 & 16: Radio is a medium that allows for almost anybody's participation. (Source: www.youthkiawaaz.com & www.ruralindiaonline.org)

b) Radio Spots with Traditional Songs: Radio has the power to motivate people by building on oral traditions. To carry a message a radio-spot can, for example, rely on traditional songs as well as a composition of solar lamp messages, like 'SoUL is our Goal'

3. Video

Here, we will focus on why and how to prepare video material for solar lamp project's promotion and awareness. As a participatory and visual medium, video can both give locals a voice and convey complex ideas in comprehensible formats. Due to this, it enables to teach specific solar lamp related skills.

Main Stakeholders & Target Groups

Your target group is a specific audience, watching or producing the video. They can be living either in rural areas or in urban ones. Make sure you address the right audience by considering the particular cultural background. For producing a video, the main actors can vary, but you will need the equipment and probably professional support. Also, the locals and local decision makers can participate in the production, as you can handle over the camera. It is also important to keep in mind the cultural sensitivity during preparing a video.

Have a look at the different ideas of producing a video further down, to see which kind of video needs which actors to take part.


Figure17 & 18: Video is a participatory medium.
(Source: www.indiantribalheritage.org & www.videovolunteers.org)

Why to Choose Video as Medium to Reach Your Targets?

- Once you have the equipment, it is easy to produce or show a video.
- Video can overcome literacy problems.
- Increasingly, people are already accustomed to moving images, and video is as a result seen as less of an external medium.
- As a visual medium, video can convey complex ideas in comprehensible formats.
- By handing over the camera, people are free to record what they regard as important. Video is a good tool for pushing public participation.
- Students, parents and teachers participation can be brought forward
- Tapes and smart cards can be used repeatedly, if needed. Especially for this reason, it is valuable as a training tool. Due to the vision and emotional impact, it enables to teach specific skills.
- A short, high-quality video, video news release or film clip produced by a communication professional will attract coverage particularly from the broadcast media. The videos can be screened during “Open Days” or at special events organized for solar lamp project workshop or event.

Things to Consider before Applying Video Campaigns

- Find out if video is the right media to reach your targets. It is not as widely spread as the radio and might not be common in all rural areas. Make sure people do not feel short taken by producing or showing video material.
- If the video is part of an overall media campaign, it could be beneficial to use a corporate slogan that is recognizable within all kinds of used media. Make sure you use identical information in all media.
- Equipment costs — especially for productions of a high quality — can mount rapidly. It is usually advisable to seek expert advice over what to buy, although in many countries there will be a limited range to choose from.
- Videos should be a part of a wider communication process that encompasses other awareness raising instruments.

- Equipment can break, especially in extreme conditions.
- Video needs careful planning, and can be time-consuming.
- It requires electricity: rechargeable batteries only last for a few hours each.
- Use of video almost always requires an input from experts in the field. Results from applications of video without this expertise can be disappointing. It is helpful to ask experienced people and get some tips before starting.
- It is important to consider the cultural background of the specific audience when producing a video, to make sure the message is going to be noted.
- Many people are excluded from watching videos at home because they do not have the equipment, so it is important to show them at public places.

Ideas for Producing and Showing a Video

There are lots of ways to create a video and many different types of them: educating videos, training videos, participatory videos, research videos and quality videos. Below you can find a short description of each of those to get an idea what a video for solar lamp project could be like:

a. Educating Videos:

For solar lamp project the most important sort of a video is an educating video. As a visual medium, videos are good to teach specific skills like how to assemble and distribute the lamps. It is easy for the audience to get the point and imitate the shown contents. The video has to be appealing, so it is good to present the key points in a (funny) story, so that it is not boring to watch the video.

b. Training Videos:

When non-professional personnel make a video, this activity is generally recognized as participatory video. Before pushing the record button, filmmaking aspirants attend training seminars on production techniques, with good facilitation, so that filming will be more than just an individual experience. Regular and competent training provides guidance for the whole process of producing a video.

c. Participatory Videos:

Participatory video refers to a particular way of using the camera that emphasizes the participatory character of a video activity. The filming is used as way of identifying and discussing central issues in a community and the underlying social processes. The video films produced are shared with the community, thus initiating community led learning. Participatory video is a very effective means of advocating social processes and can help coordinate community action. Quality and outreach with this video approach, however, are less important. Participatory video is more about team activity than creating a product. To increase the impact of the participatory video process, it should be well embedded in the overall communication strategy.

d. Research Videos:

Video is also used in research activities. The camera can be used to gather information through, for example, interviews or filming particular school campaigning practices. It can also be used for reflexive research. The use of video for research is often part of other forms of video making.

e. Quality Videos:

Some video activities are clearly product driven, in that the producers strive for the highest quality film as an end product. This is particularly important when public relations are involved. The outcome of the video activity should be a professional

film. A video produced as part of an awareness campaign, with the intention to broadcast it on national television networks, needs to be of broadcast quality. This requires a film crew of local and/or external professionals. Inevitably, this means comparably high production costs. The result could be a stand-alone film, with loose links to the main focus of a project but appropriate for universal use.

f. Showing/Publishing a Video:

Videos can be published and shown in many different ways: They can be watched or shown in households, at public places like a town hall, or be published on internet pages of private persons, NGOs or video pages like YouTube. Videos can also be used as training material at school, university or in specific courses.

4. Internet and Email

Here, we will focus on why and how to use internet and email, which enables people to have access to information on solar lamp project from all over the world. Through networking, for and email people having access to computers can take part in actual solar lamp project related discussions and activities easily.

Main Stakeholders and Target Groups

The target groups of your work are mainly people who already know something about the topic and search for more information. They might be little or well informed and from any location, so you need to consider different levels of knowledge.

If you cannot do it yourself, you will need someone for helping you with creating a homepage. Sometimes there are courses on creating website, otherwise you can ask at organizations like other NGOs or IITB if they might help you or know someone specialized.

You can plan internet and email campaigns on the local level, but most of the information given will be accessible all over the world.

Why Choose Internet and Email as Media to Reach Your Targets?

Internet and email are in fact different tools that are used in an integrated way. The internet contains website, fora and files, where you get information, do research and download. It can also be used for online discussions in fora, and often you can register for an email newsletter for a specific page or campaign. Email is mostly being used for advertising (e.g. for an activity) or for networking, especially in groups. It is very useful to send files to each other.

For the following reasons it is useful to work with email and internet to spread information on solar lamp project:

- The internet is the most interactive medium you can choose. In opposition to radio, print media and television, people having access to a computer can take part in the internet. They can do research, send files to each other and click on links they are interested in. According to this, the internet is a two-way medium through fora, networking and email: People can ask questions and discuss directly
- It gives people access to sources from other states and countries, and enables exchange of information between groups

- E-mail enables networks to function more efficiently: Key figures can download information and send it as printed copies to other members, or pass it by word of mouth, thereby reaching the majority who are unlikely to have access to a computer
- Information and communications technology can also enable pressure groups within a government to tap into international literature and compare their government's record to their internationally recognized obligations
- Electronic networks can create forums for informal discussion specific to particular groups
- Internet gives women's groups, in particular, access to communication in a public space that would often otherwise be denied them


Figure19 & 20: The internet is an important tool to get access to information, in particular for women, who often have less access to communication.
(Source: www.newindianexpress.com & www.midliferswebbusiness.com)

Things to Consider Before Using the Internet and Email

- First, it is important to find out if the internet and email is the right media to reach your targets. Many people lack access to computers and internet, and usually you just reach people that are already aware of the topic, searching for more information.
- If the internet and email campaign is part of an overall media campaign, it could be beneficial to use a corporate slogan or name that is recognizable within all kinds of used media. Make sure you use identical information in all media.
- It is also important to understand that internet and email only support other media and should be a part of a wider communication process that encompasses other awareness raising instruments. On its own, internet and email cannot achieve that much but combined with other media as well as other awareness raising and communication tools in the solar lamp project. But, it can help to achieve your objectives very well and cheap.
- The main challenge is to create website that are accessible and attractive to a wide range of people while, at the same time, contain enough information for those who are really interested.

- Internet and email might not be the best medium to raise awareness, because it reaches less people than, for example, the radio. It is usually better for giving deepened information on a topic.
- As the internet and email are most useful combined with other media, make sure you state and write the link for the page in all other media used.
- When you send emails make sure they are not being treated as spam by their receivers.
- The realization that electronic information can empower civil society has been fully recognized by some governments who fear such developments and have tried to censor content.

Ideas for Using Internet and Email:

Several organizations run non-profit awareness campaigns on the internet. The internet can be of significant use in campaigns, but even if it is not for running the campaign itself, it can be used for networking and dissemination of information about the campaign. The following examples show several ways of how to use the internet in campaigns.

- Advertisements on the web: Consumers can be directly reached through advertisements on the web, on web pages of information providers, newspapers, newsgroups, search engines, bookstores and government homepages.
- Source of public information: Through the internet, campaigns can provide an additional source of accessible information to the public such as information on how to save electricity by using solar products. Several campaigns mention their web addresses in their conventional campaign material. It is a handy tool to use together with commercials, posters or PR activities.
- Networking: The internet can be a great tool for networks of volunteer activists, teachers or students involved in different programs and initiatives. Through the internet plans, data and results can be shared among participants. The internet can also help mobilize members of a network for certain public action at the right time.
- Resources for the solar sector: The internet is helpful in providing professionals in the solar sector with relevant and up-to-date information. This includes fora for online discussions, ordering services for literature and promotional material, database access and documented experiences from other initiatives.
- Online discussions: Campaigns could provide sites with online discussions or message boards on solar lamp project topics. Participants might post their reactions to an ongoing discussion.
- Another idea is to send email newsletters on programs and actions to inform interested people about the new development and possibilities to participate in the solar sector.
- Also there can be educating games and quizzes to address especially children

Figure21: Bringing together school students to jointly discuss solar lamp benefits— a good way to raise awareness. (Source: www.rediff.com)

CHAPTER 7: MANAGING PAYMENTS

1) Introduction:

Managing payments and incentives from both the sides i.e. Institutional Partner and IIT Bombay, in particular, have played very important role in previous phase and helped to complete project activities on timely manner such as:

- Project promotion and campaigning
- Lamp assembly and distribution
- Monthly salary of staff
- Wages to assemblers and distributors
- Monthly honorarium of SRCMs
- Closing audit of data, funds and material

The process of managing payments and incentives from both the sides i.e. Institutional Partner and IIT Bombay was more complicated and time consuming in previous phase. Due to this reason many difficulties were faced by all stakeholders. Many delays and unnecessary follow ups were done from both the sides.

Therefore, avoiding such difficulties in current phase, IIT Bombay has adopted the mechanism of milestone based payments and incentives.

2) Milestone Based Payments and Incentives:

IP and IITB should be agreed to the milestone based payments described below. IP shall, upon satisfactory completion of the milestones in the order as listed, will be eligible to receive the corresponding payments from IIT Bombay. All the payments

are subject to the verification by IITB of the report submitted by IP against the actuals and other supporting documents / records.

#	Milestone (to be reached by IP)	Month[1]	Payments from IITB to IP
1.	Submission of signed MoU, including annexures, to IITB.	--	Rs.50 x 500 lamps x *Number of blocks* Note: This advance amount will be settled against fund deposited and 3a and 3b for 500 lamps.
2.	Submission of secondary data and planning report[2]	Before the start of training	An incentive of Rs 5000 per block report will be given, if secondary data are submitted one week prior to actual date of training for that block.
3 a	Submission of Monthly Assembly and Distribution report[3] (as per performance from 21st of previous month to 20th of current month)	By 26th of each month	**Rs. 26 per lamp** distributed that month, subject to realisation of remittance as per clause 2.6
3 b	Submission of DIS forms[4] (as per performance from 21st of previous month to 20th of current month)	By 26th of each month	**Rs. 24 per lamp** distributed that month as per DIS, subject to realisation of remittance as per clause 2.6
4	Submission of Assembly and Distribution Phase Completion Report+ SRC Setup Completion Report 5	By 26th of month of the last date of assembly & distribution	**Rs. 12 per lamp** for total lamps distributed as per DIS
5.	Submission of SRC Performance Report[6] A	Once, at the end of month 7	**Rs. 5 per lamp** for total lamps distributed as per DIS
6.	Submission of SRC Performance Report[6] B	Once, at the end of month 10	**Rs. 4 per lamp** for total lamps distributed as per DIS
7.	Submission of R&M phase Completion Report[7]	Once, within 1 month from the end of the project	**Rs. 2 per lamp** for total lamps distributed as per DIS

Table3: Milestone based payments and incentives

[1] Month indicates the calendar month from the start date of Training

[2] Secondary data and planning report to contain the information as outlined in Annexure 3 of MoU, in hardcopy and softcopy format specified by IITB (Million SoUL Project).
[3] Monthly assembly and distribution report to contain the information as outlined in Annexure 3, in hardcopy and softcopy format specified by IITB from time to time (Million SoUL Project).
[4] DIS forms, provided by IITB, to be submitted in softcopy along with the original hardcopy.
[5] Submission of assembly and distribution phase completion report + SRC setup completion report to contain the information as outlined in Annexure 3 of MoU, in hardcopy and softcopy format specified by IITB (Million SoUL Project).
[6] SRC performance report to contain the information as outlined in Annexure 3 of MoU, in hardcopy and softcopy format specified by IITB (Million SoUL Project).
[7] R&M phase completion report to contain the information as outlined in Annexure 3 of MoU, in hardcopy and softcopy format specified by IITB (Million SoUL Project).

3) SRCM's Payment:

The SRC / SRC Manager's remuneration must be fixed and paid at a per month basis by the **27th of each the month**. The minimum amount earmarked for SRC / SRC Manager's remuneration must be as per Annexure 2 of MoU.

4) Lamp Distribution and Money Collection from Beneficiary:

Institutional Partner should adhere following norms while doing lamp distribution and collecting the money from beneficiaries:

1) Distribution of SoUL is carried out in the project blocks (village cluster-wise) only and by trained manpower only.
2) The target beneficiary of SoUL are the children of class 5^{th} to 12^{th}, enrolled in registered private and government schools in the project blocks.
3) Distribute the SoUL lamp only to the target beneficiaries, at the exact price of the Rs. 120/- (Rupees One Hundred and Twenty Only) per lamp.
4) Each student beneficiary to be sold one SoUL only.
5) IP should not give the SoUL for free to any of the target beneficiary, through any other government or non-government scheme.
6) IP should not sell the lamp to any entity other than the target beneficiaries, and at costs other than that detailed by IITB (Million SoUL Project).
7) The collection of Rs.120/- (Rupees One Hundred and Twenty Only) per lamp distributed to the target beneficiary and remittance of the monies or share payable to IITB therefrom is the responsibility of the IP.
8) IP should issue receipts (DIS-School copy) on behalf of IITB, to school/ students on purchase of SoUL.
9) IP should record correctly and completely the beneficiary details, in the Distribution Information Sheet (DIS) format as specified below:

Guidelines for filling beneficiary information in DIS (Hard & Soft Copy):

Million SoUL Program, IIT Bombay — IIT Bombay Copy/NGO Copy/School Copy

Distribution Information Sheet (DIS)

DIS No: MPAS Pre-printed

IP Name: Pre-printed, A&D Center Location: Pre-printed, District: Pre-printed, State: Pre-printed

Date of Distribution:	DD	MM	YYYY	Distributor Name:		Block/s (Please Circle):	Pre-printed	Pre-printed	Pre-printed
School Name:				School Code:		School Village:			

Sr. No	Lamp Code	Student's Full Name			Student's Gender (Please circle)		Class	Caste (Please circle)				Do you have electricity at home (Please circle)		Student Gram Panchayat	Student Village	Rupees paid for the lamp	Student Signature
		Student's Name	Father's Name	Surname													
1	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
2	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
3	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
4	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
5	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
6	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
7	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
8	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
9	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	
10	MPAS				M	F		Gen	OBC	SC	ST	Y	N			120	

Total Entries in this sheet:

School - Principal/Teacher's Signature & Stamp	Verified by IP - Signature & Stamp	Verified by IIT Bombay

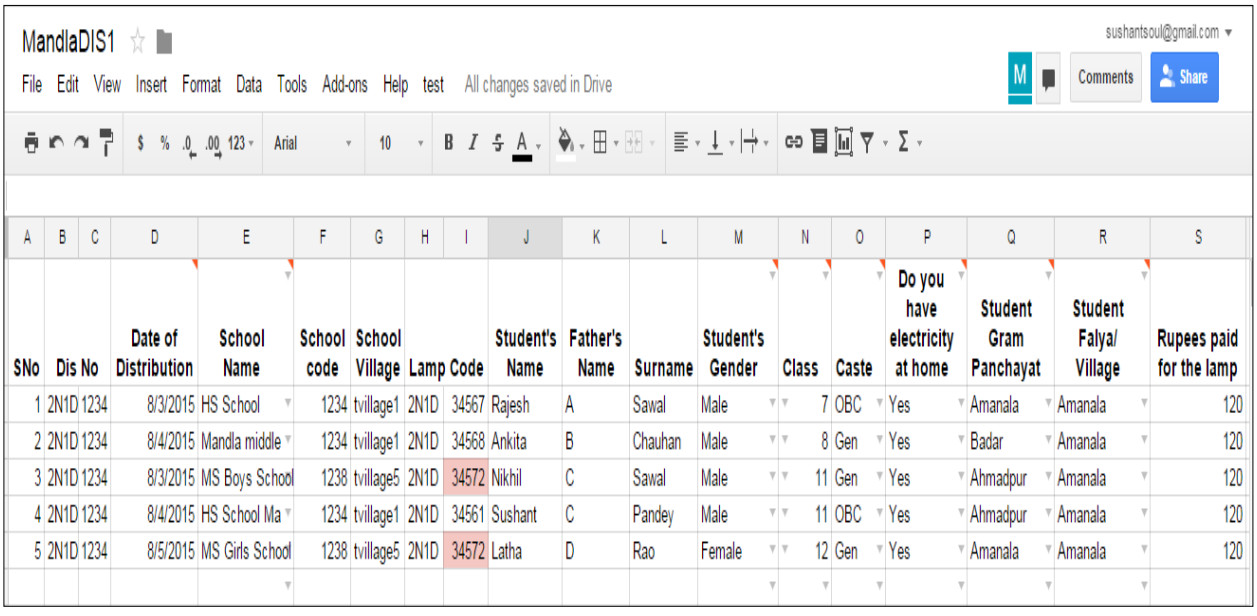
Figure22: Distribution Information Sheet (DIS) ***Hard Copy****; below is an illustration:*

Following are the instructions for the distributor when filling the DIS (**Hard Copy):**

- ✓ Distributors should carry a list of Gram panchayat and Village name of respective block. Here, distributor could carry the list of schools in his cluster as well.
- ✓ Don't change any of the preprinted field such as DIS No, IP Name, State, District, A&D Center Location, Block, and Cost.
- ✓ Fill all the records properly and don't leave any of the field as blank.
- ✓ Put date format for distribution as DD/MM/YYYY (e.g.: - 08/06/2015).
- ✓ If multiple Blocks are there in DIS then put a circle mark (□) in corresponding Block.
- ✓ Write School Name, School Code, and School Village properly.
- ✓ Lamp code consists of nine alphanumeric numbers. Out of which starting four numbers will be preprinted remain five numbers has to be written from Lamp code pasted on the Lamp.
- ✓ Student's Full name column divided into three sub parts first will be student's name, second will be Father's name and third will be Surname of the student. Please don't change the sequence of the names.
- ✓ For Gender put a circle mark (□) in M or F in the sub field of Gender column. "M" for Boy and "F" for Girl.
- ✓ For class write Numbers only like 5 , 6 , 7 and don't put "th" after Number like 5th or 6th

- ✓ For caste put a circle mark (□) on respective sub caste column given in the sheet.
- ✓ For Electricity put a circle mark (□) in Y or N sub field of Electricity column. Here, "Y" specifies YES and "N" specifies NO.
- ✓ Write proper Gram panchayat name by asking student, for any doubt refer to the Gram panchayat sheet given to the Distributor.
- ✓ Write proper village name with respective to Gram panchayat. Distributors should ask more questions to students to get the proper village name. Don't write any kind of Ward, Gali, Sahi, Palli, Nagar, etc. in Village column. Also don't write Hamlet or Faliya name in Village column, for any doubt refer to the Village sheet given to the Distributor.
- ✓ Student signature is compulsory.
- ✓ At the end Distributor should write the count of "Total Entries in this sheet" in the proper place given in the DIS sheet.
- ✓ In one sheet one school information should be there, don't mix two or more schools information in one sheet.
- ✓ Take Principal/teacher's Signature and School Stamp in proper place which is given in the sheet.
- ✓ Total three copies (IIT Bombay Copy/NGO Copy/School Copy) are there for each DIS no. Out of these three copies, distributor should give School Copy to respective school principal/teacher and handover other two copies to NGO.
- ✓ IP verification is compulsory after submission of DIS booklets/sheets by distributors.

Figure23: Distribution Information Sheet (DIS) ***Soft Copy****; below is an illustration:*


MandlaDIS1

sushantsoul@gmail.com

File Edit View Insert Format Data Tools Add-ons Help test All changes saved in Drive

Comments Share

SNo	Dis No	Date of Distribution	School Name	School code	School Village	Lamp Code	Student's Name	Father's Name	Surname	Student's Gender	Class	Caste	Do you have electricity at home	Student Gram Panchayat	Student Falya/ Village	Rupees paid for the lamp
1	2N1D 1234	8/3/2015	HS School	1234	tvillage1	2N1D 34567	Rajesh	A	Sawal	Male	7	OBC	Yes	Amanala	Amanala	120
2	2N1D 1234	8/4/2015	Mandla middle	1234	tvillage1	2N1D 34568	Ankita	B	Chauhan	Male	8	Gen	Yes	Badar	Amanala	120
3	2N1D 1234	8/3/2015	MS Boys School	1238	tvillage5	2N1D 34572	Nikhil	C	Sawal	Male	11	Gen	Yes	Ahmadpur	Amanala	120
4	2N1D 1234	8/4/2015	HS School Ma	1234	tvillage1	2N1D 34561	Sushant	C	Pandey	Male	11	OBC	Yes	Ahmadpur	Amanala	120
5	2N1D 1234	8/5/2015	MS Girls School	1238	tvillage5	2N1D 34572	Latha	D	Rao	Female	12	Gen	Yes	Amanala	Amanala	120

Following are the instructions for the Data Entry Operator when filling the DIS (**Soft Copy):**

- ✓ All fields are mandatory.
- ✓ DIS column divided into two parts, first part automatically will be filled and second part has to be filled by Data Entry Operator.

- ✓ For Date of distribution, double click on the respective cell a calendar will pop up, select the required date.
- ✓ On clicking drop down box of School name column, school name list will appear, on selecting school name, respective School Village and School Code will be automatically get filled.
- ✓ Lamp code column divided into two parts, first part automatically will be filled and second part has to be filled by Data Entry Operator.
- ✓ Full name column divided into three sub parts, first will be Student's name, second will be Father's name and third is Surname of student. Don't change the sequence.
- ✓ On clicking drop down box of Gender column, a list will come as “Male” and “Female” select “Male” for “M” and “Female” for “F” as per student Gender mentioned in the DIS hard copy.
- ✓ On clicking drop down box of Caste column, a list of Castes will be displayed, select the required caste from the list as per student caste mentioned in the DIS hard copy.
- ✓ Click on drop down box of Electricity column, a list will come as “YES” and “NO”, as per electricity information provided by student in DIS hard copy select the required.
- ✓ On clicking drop down box of Grampanchayat column, a list of Grampanchayats will be displayed, select the required Grampanchayat from list, as per student Grampanchayat mentioned in DIS hard copy.
- ✓ On clicking drop down box of Village column, a list of Villages will be displayed, select the required Village from list as per student village mentioned in DIS hard copy.
- ✓ Lamp cost will be filled automatically, so no need to fill.
- ✓ If mistakenly data entry operator enters the same lamp code two times in this sheet, then automatically it will highlight in RED COLOR and this will indicates the double entry of same lamp code. Therefore, Data entry operator should do the corrections immediately.

5) Payment to IIT Bombay:

IP should remit to IITB Rs.120/- (Rupees One Hundred and Twenty Only) per lamp, on a monthly basis, on the **25th of every month**, from the proceeds of sale of SoULs during the period from the 21st of previous month to 20th of current month. IITB reserves the right to charge interest per day for any delayed payments till such time they remain unpaid.

Such remittances should be made in the form of Demand Draft, Cheque or National Electronic Fund Transfer (NEFT) or Real Time Gross Settlement (RTGS) to the bank account provided by IITB (Million SoUL Project).

A) <u>Procedure for fund transfer against distribution of SoUL lamps to IITB</u>

Deposit the money against the Distribution of Solar Lamp (No. of Sold SoUL Lamps X Rs.120/-).

The bank details are as follows:

Beneficiary Name: Registrar IIT Bombay, Project & Consultancy Account

The bank details for depositing the amount:

Bank Name: State Bank of India
Bank Account Number: **10725729173**
Bank Branch: IIT Bombay Powai Branch
Bank Address: IIT Bombay , Adi Shankarachary Marg, Powai, Mumbai - 400076
RTGS / IFSC /NEFT No.: SBIN0001109
ECS No. / MICR NO.: 400002034
Swift Code: SBININBB519 (For Forex Transaction)

B) Guidelines - Payment to IIT Bombay

Following are the steps needs to be followed by IP:

1) In invoice, fill all the following necessary information
   a. Invoice No.: (e.g. State/IP Name/A&D Center's Location/01)
   b. Invoice date (On or after depositing)
   c. No. of lamps distributed
   d. Amount (e.g. No. of lamps X Rs. 26/-) or as per milestone
   e. NGO Bank details
   f. Authorized person signature along with NGO stamp/seal etc.
2) All particulars mentioned in Invoice needs to be filled properly and should be cross checked by IP's concern person before sending it to IITB. Otherwise IP will be responsible for the delays in the payment from IITB.
3) Payment for total distributed lamps should be credited to IITB account on **25th of every month** at Registrar IIT Bombay Account, Project & Consultancy Account.
4) Invoice should be printed on letterhead of NGO with authorized person signature and seal before sending it to IITB.
5) **Two original copies (hardcopy) of invoice against paid lamps should be reached to SoUL office, IIT Bombay on or before 26th of every month.**
6) Note that A&D and DIS invoice should be raised on same date and send together to IITB.
7) Lamp quantity and amount mentioned in invoice that should be match with each other. If it is not, then the payments from IITB to IP will get delayed.
8) Raised Invoices should be as per "Assembly & Distribution Center" wise. Please don't send the block wise invoices to IITB.
9) NGO should raise the invoices as per completion of the milestones for receiving corresponding payments
10) **Payments will be processed & cleared in fifteen (15) working days after receipt of Invoice (Hard Copy) from NGO**

11) Payment intimation email will be send by IITB to NGO (Payment details i.e. Invoice No., Date & exact payment amount
12) Payment confirmation email to 'Accounts Department' should be send by NGO after receiving payment from IITB.

Note: - To settle advance amount (Rs.50 x 500 lamps x Number of blocks) given by IITB before starting A&D activities. **Invoice of first 500 lamps distributed in each block should be raised separately per A&D center.** If there is multiple blocks under one A&D center then amount in invoice should be = Rs.50 x 500 lamps x Number of blocks under A&D center.
Refer the following invoice format for settling the advance amount given by IITB.

Format of Invoice is as follows: Sample - (if 2 or 3 blocks were coming under one A&D center)

1) Invoice format for Settlement of advance amount

Invoice : Settlement of advance amount

Invoice No:(E.g. State/IP Name/A&D Center's Location/01) Date: 22/12/15 (On or after depositing)

Sr. No.	Description	Amount in (Rs.)
1.	Distribution of 500 Nos. Solar Urja Lamps for the month of (e.g. Oct., 2015) (500 lamps X Rs. 26 X 2 or 3 block)	XXXXX
Amount in Rupees – Rupees Thirty Nine Thousand Only		
The payment should be made by wire transfer or Draft/ Cheque drawn in favor of : Name of Bank : XXXXXX Bank Account Name : XXXXX Bank A/C No. : XXXXXXXXXX IFSC : XXXXXXXXXX Contact Person : Mr. XXXXXX Contact No. : XXXXXXXXXX		

Authorized Sign

NGO Stamp/Seal

2) Invoice format for Settlement of advance amount

Invoice : Settlement of advance amount

Invoice No:(E.g. State/IP Name/A&D Center's Location/01) Date: 22/12/15 (On or after depositing)

Sr. No.	Description	Amount in (Rs.)
1.	Distribution of 500 Nos. Solar Urja Lamps for the month of (e.g. Oct., 2015) (500 lamps X Rs. 24 X 2 or 3 block)	XXXXX
Amount in Rupees – Rupees Thirty Six Thousand Only		
The payment should be made by wire transfer or Draft/ Cheque drawn in favor of : Name of Bank : XXXXXX Bank Account Name : XXXXX Bank A/C No. : XXXXXXXXXX IFSC : XXXXXXXXXXX Contact Person : Mr. XXXXXX Contact No. : XXXXXXXXXX		

Authorized Sign

NGO Stamp/Seal

3) Invoice format for submission of monthly Assembly and Distribution report

Invoice : <u>Assembly & Distribution</u>

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY (On or after depositing)

Sr. No.	Description	Amount in (Rs.)
1.	Distribution of _____ Nos. Solar Urja Lamps for the month of (e.g. Oct., 2015) (No. of lamps X Rs. 26/-)	
Amount in Rupees_____		
The payment should be made by wire transfer or Draft/ Cheque drawn in favor of : Name of Bank : (Name of NGO's Bank) Account Name : (NGO's Bank Name) Bank A/C No. : (NGO's A/c #) IFSC : Contact Person : Contact No. :		

Authorized Sign

NGO Stamp/Seal

4) Invoice format for submission of DIS forms

Invoice : <u>Distribution Information Sheet</u>

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY

Sr. No.	Description	Amount in (Rs.)
1.	DIS Count (Qty. of lamps) against Solar Urja Lamps distribution _____ Nos. for the month of (e.g. Oct., 2015) (DIS Count (Qty. of lamps) X Rs. 24/-)	
Amount in Rupees_____		
The payment should be made by wire transfer or Draft/ Cheque drawn in favor of : Name of Bank : (Name of NGO's Bank) Account Name : (NGO's Bank Name) Bank A/C No. : (NGO's A/c #) IFSC : Contact Person : Contact No. :		

Authorized Sign

NGO Stamp/Seal

5) Invoice format for submission of Assembly and Distribution phase completion report + SRC setup completion report

Invoice : <u>Assembly and Distribution phase completion report + SRC setup completion report</u>

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY

Sr. No.	Description	Amount in (Rs.)
1.	Total distribution of Solar Urja Lamps as per of DIS record _____ Nos. for the month of (e.g. Oct., 2015) (Total distributed Solar Urja Lamps X Rs.12/-)	
Amount in Rupees_____		
The payment should be made by wire transfer or Draft/ Cheque drawn in favor of : Name of Bank : (Name of NGO's Bank) Account Name : (NGO's Bank Name) Bank A/C No. : (NGO's A/c #) IFSC : Contact Person : Contact No. :		

Authorized Sign

NGO Stamp/Seal

6) Invoice format for submission of SRC performance report - A

Invoice : SRC performance report - A

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY

Sr. No.	Description	Amount in (Rs.)
1.	Total distribution of Solar Urja Lamps as per of DIS record _____ Nos. for the month of (e.g. Oct., 2015) (Total distributed Solar Urja Lamps X Rs.5/-)	
Amount in Rupees_____		

The payment should be made by wire transfer or Draft/ Cheque drawn in favor of :

Name of Bank : (Name of NGO's Bank)

Account Name : (NGO's Bank Name)

Bank A/C No. : (NGO's A/c #)

IFSC :

Contact Person :

Contact No. :

Authorized Sign

NGO Stamp/Seal

7) Invoice format for submission of SRC performance report - B

Invoice : SRC performance report - B

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY

Sr. No.	Description	Amount in (Rs.)
1.	Total distribution of Solar Urja Lamps as per of DIS record _____ Nos. for the month of (e.g. Oct., 2015) (Total distributed Solar Urja Lamps X Rs.4/-)	
Amount in Rupees_____		

The payment should be made by wire transfer or Draft/ Cheque drawn in favor of :

Name of Bank : (Name of NGO's Bank)

Account Name : (NGO's Bank Name)

Bank A/C No. : (NGO's A/c #)

IFSC :

Contact Person :

Contact No. :

Authorized Sign

NGO Stamp/Seal

8) Invoice Format for submission of R&M phase completion report

Invoice : R&M phase completion report

Invoice No: (E.g. State/IP Name/A&D Center's Location/01) Date: DD/MM/YY

Sr. No.	Description	Amount in (Rs.)
1.	Total distribution of Solar Urja Lamps as per of DIS record _____ Nos. for the month of (e.g. Oct., 2015) (Total distributed Solar Urja Lamps X Rs.2/-)	
Amount in Rupees_____		

The payment should be made by wire transfer or Draft/ Cheque drawn in favor of :

Name of Bank : (Name of NGO's Bank)

Account Name : (NGO's Bank Name)

Bank A/C No. : (NGO's A/c #)

IFSC :

Contact Person :

Contact No. :

Authorized Sign

NGO Stamp/Seal

Contact Details:

Million SoUL Project Office
Department of Energy Science and Engineering,
Next to NASA office,
Opp. Materials Management Division,
IIT Bombay, Powai, Mumbai - 400076.
Maharashtra, India
Contact No: +91 22 2576 4849/4847
www.millionsoul.iitb.ac.in

Table4: Key contact persons

Key Contact Persons:

Name	Designation	E-mail Address
Overall Coordination:		
Abhilasha Chauhan	Project Manager	abhimaanas@gmail.com
Anand Lihinar	Assistant Project Manager	srbsdivb@gmail.com
Account Department:		
Jivita Poojari	Accountant	soulfinance15@gmail.com
Alka Chavan	Accountant	soulfinance15@gmail.com
Makrand Jadhav	Accountant	soulfinance15@gmail.com

CHAPTER 8: MANAGING A&D COMPLETION

1) Introduction:

In Million SoUL Project, Assembly and Distribution centers have been established to facilitate the local assembly and distribution of the solar lamp. At the end of these activities, the assembly and distribution activities are to be closed by ensuring proper records of inventory, distribution data, financials, tools, manpower, etc.
This chapter contains procedures to facilitate closing up of the assembly and distribution activities of SoUL project. This chapter also presents the possible solutions to the issues that may arise during closing up activities of assembly and distribution. By following and implementing the instructions and guidelines mentioned in this chapter will help to improve speed, quality, efficiency and effectiveness of SoUL project closing up processes.

2) Purpose of A&D closing:

The purpose of closing up activities is to add credibility to the report submitted by IP for Assembly and Distribution phase completion to the IITB. This activity will be supervised by executives from IIT Bombay along with the IP project in-charge and supervisors to ensure the transparency level from both the sides.

The Assembly and Distribution phase completion report (In hardcopy and soft copy format) must contain the following data, summarizing A&D activities over the entire project, at each assembly center:

1. Total quantity of SoUL assembled.
2. Total quantity of SoUL distributed along with School code and DIS sheet numbers.
3. Component-wise total number of physical defectives, technical defectives and scrap.
4. Component-wise inventory count of non-defective and unused components available at the center.
5. Summary of random quality inspection by IP of assembled lamp.
6. Summary of total man-hours or man-days (gender-wise) employed.
7. Summary of total number of people (gender-wise) who participated in assembly, distribution and data entry and supervisory work.
8. List of campaigning activities carried out in, along with copies/ photos/ videos of the campaign (if not submitted earlier with the Monthly reports).
9. Summary of payments made to IITB, and Payments received from IITB.
10. Summary of DIS forms hardcopy and softcopy submitted to IITB.
11. Number of free kits used, along with the list of beneficiaries with sign (if not submitted earlier with the Monthly reports).
12. Status of toolkits, record books and laptop provided by IITB.
13. Copy of Quality Inspection Report along with penalty component, if any, as per Annexure 3, Section H.
14. Copy of documentary/ report/ video/ presentation, if any prepared by IP.
15. Summary of the duration of the actual assembly and distribution phase with broad schedule, from the date of training until the day of report submission to IITB, along with details of penalties if any, as per Annexure 3, Section H.
16. Any other, as requested by IITB at a future date.

3) Mandatory actions for IP before starting A&D closing:

Following are the mandatory actions for IP before starting A&D closing up activities and proposed visit of executives of IITB for supervising the closing up activities. These mandatory actions will help to resolve various operational issues and also help to complete closing up activities in time.

Sr. No.	Issues	Recommended Solutions
1	**Inventory (At Assembly Centre) - Quantity Received**	

	a) If, Actual quantity received by **IP** ≠ quantity delivered/dispatched by **Vendor**.	a) Check Inventory book. b) Cross check and verify with online files (A&D File). c) If data is not updated, **IP** should update the inventory data at the earliest. d) If still data doesn't match, cross check with DC & LR copy available with **IP**. e) If still discrepancies are there **IP** should inform to **FO / Cluster Manager / State Coordinator** for the same as well as consult with Operations team (IITB) for further action.
2	**Quantity Assembled**	
	a) Actual Quantity Received by **IP** ≠ Quantity Assembled + Quantity yet to assemble (will include defectives/missing).	a) If it doesn't match, **IP** should check & update Inventory book (assembly / missing / defectives), whether it is updated or not. b) **IP** should update same data through online mode. c) If still the issue is not resolved then inform **FO / Cluster Manager /State Coordinator** & consult with Operations team (IITB) for further action.
3	**Finished Lamp Inventory (Assembled but not distributed)**	
	a) Finished Lamp Inventory ≠ Status Master Records.	a) If it doesn't match, **IP should** cross check & update Inventory book. b) **IP** should update same data through online mode. c) **IP should** check Assembly Centre's hard copy records. d) **IP** should do the physical count check of finished lamps available at Assembly centre. e) **IP** should cross checks the "Lamp Issue Register/Documents" maintained at A&D Center. f) If still the issue is not resolved then inform **FO / Cluster Manager /State Coordinator** & consult with Operations team (IITB) for further action.
4	**Free Kits**	

	a) If, the number of free lamps distributed doesn't match with the data recorded in data sheet. b) Free lamp data sheet is not maintained at Assembly Centre.	a) **IP** should update the Free Kits data with the help of supervisors / data entry operator. b) **IP should** inform **FO / Cluster Manager / State Coordinator** in case of any issue and consult with Operations team (IITB) for further action.
5	**Distribution**	
	a) Total Distribution (as per DIS count) ≠ DIS data updated by IP.	a) **IP should** cross check & Update Inventory book. b) **IP** should update same data through online mode. c) **IP** should do the physical count of DIS hard copies before sending it to IITB. d) **IP** should coordinate with all distributors to collect all the DIS hard copies from distributors. c) If still issue is not resolved, then inform **FO / Cluster Manager /State Coordinator** & consult with Operations team (IITB) for further action.
6	**DIS Data**	
	a) Total number of DIS entries reached **IITB** ≠ Total Distribution.	a) **IP** should send the remaining DIS sheets to **IITB** on priority basis. b) If DIS entries < total distribution, **IP** should coordinate and collect from **Distributors** and also cross check the availability of DIS sheets on field. c) If issues are not resolved then inform **FO / Cluster Manager /State Coordinator** & consult with Operations team (IITB) for further action.
7	**Laptop + Mouse**	
	a) In case **Laptop + Mouse** are found with **IP** - missing/physically damaged.	a) **IP** has to bear the cost of **Laptop + Mouse**.
8	**Payments**	
A.	**Payments (IP to IITB)**	
	a) Payment to **IITB** (in terms of no. Of lamps) ≠ Total distribution.	a) **IP** should deposit pending money of distributed lamps in bank account of **IITB** as per milestone.

	b) Payment transferred by **IP** ≠ Payment received by **IITB**.	a) **Project in-charge** should cross verify with **Account sections** of both **IP** as well as **IITB**. b) If, issue is there, **Project in-charge** should inform **FO / Cluster Manager /State Coordinator** & consult with Account team (IITB) for further action.
B.	**Payments (IITB to IP)**	
	a) Payment transferred by **IITB** to **IP** ≠ payment received by **IP** from **IITB**.	a) **IP** should consult with Account team (IITB) for further action.
9	**Tool Kits**	
	a) If any instrument is missing from toolkit.	a) Inform immediately to **FO / Cluster Manager / State Coordinator.** b) **IP** has to bear the cost of missing instrument as per IITB guidelines.
10	**Inventory Books**	
	a) If all inventory books are not updated properly.	a) Update immediately all stock books as well as same data through online mode.

Table5: Mandatory actions for IP before starting A&D

CHAPTER 9: MANAGING SoUL (Solar Urja Lamp) REPAIR CENTER (SRC) SETUP

1) Introduction:

Sustainability of a solar lamps program not only depends on making solar lamps available, but also ensuring that all the lamps work for the duration of Million SoUL Program of IIT Bombay. The program is designed to make rural people capable of assembly, distribution and repair & maintenance of solar lamps. In previous phase, IIT Bombay has already identified the local assemblers and distributors who were involved in the lamp assembly & distribution, to act as repair center managers. IIT Bombay calls these centers as SoUL Repair Centers (SRCs) which are identified, roughly for every 3000 lamps distributed.

The idea behind setting up of SRCs, together with their repair activity they would be able to sell other solar products at commercial rates, promoting solar technology by market mechanism. These managers have enough skills to understand the working of solar technology and repair of solar lamps. New solar products can be introduced

with the additional training on those products. Vendors are encouraged to sell new products through these SRCs.

2) Objectives:

Following are the objectives behind setting up SRCs:

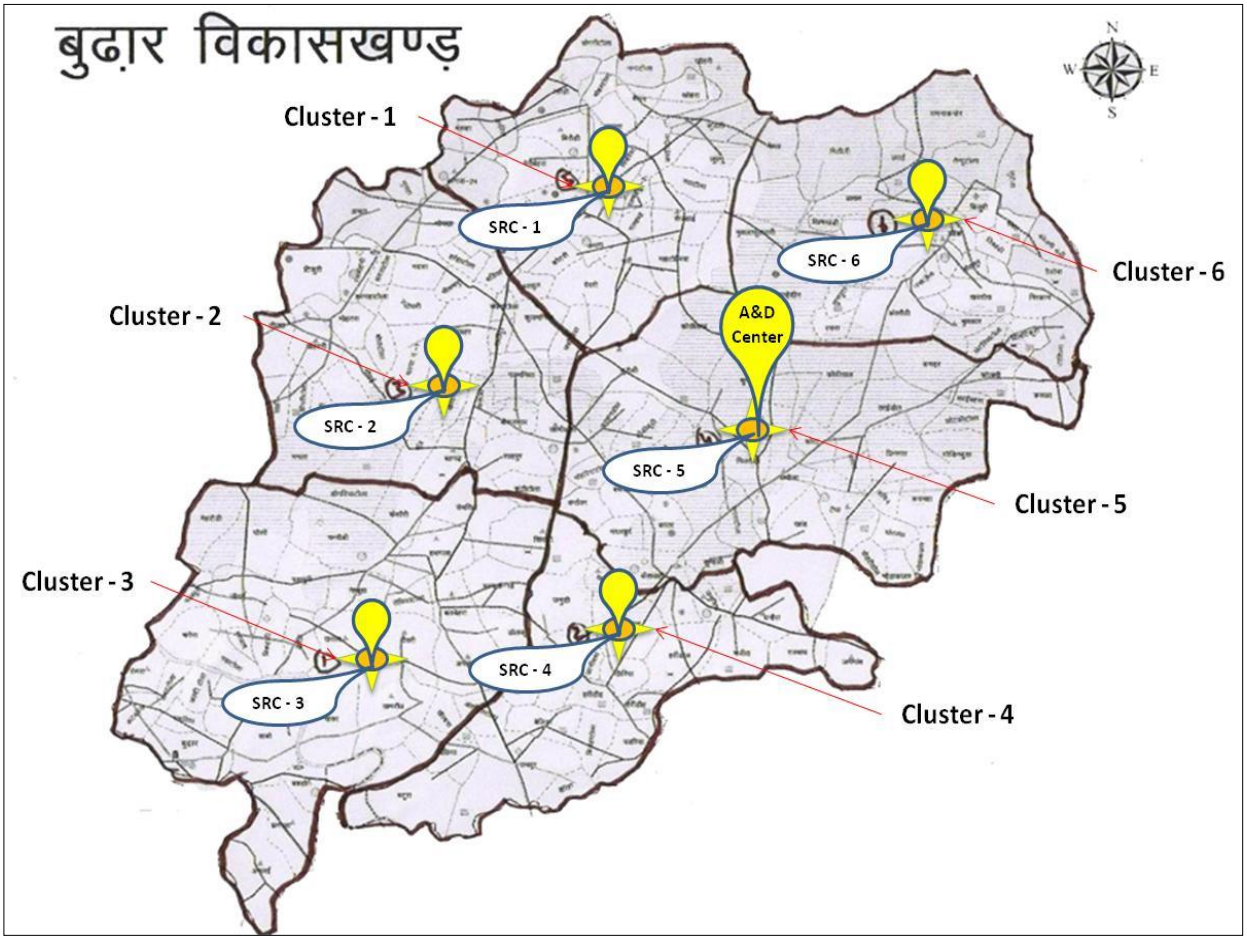
- ✓ To setup repair & maintenance (R&M) network
- ✓ To deliver free R&M service to beneficiaries
- ✓ To build a network of Solar skilled persons in remote areas for easy future implementation of Solar Technologies at the root level

3) Cluster mapping before establishing SRCs:

Cluster mapping serves as a tool to provide a visual representation of information in a particular geographical context. Cluster mapping is a process of categorizing the block locations in several small parts which allow you to concentrate on specific region.

Cluster mapping allows you to define your cluster boundaries according to the presence of number of schools, enrolled students and density of population. It is based on predefined locations and which are identified, roughly for every 3000 lamps distributed.

Figure24: Cluster mapping and proposed locations of SRCs with in block, below is an illustration:



4) SRC Planning Procedures:

IP should adopt following SRC planning procedures by counsulting with IITB:

1. Find best possible SRC locations as per lamp distribution and density of population.
2. Collection of information in advance which includes, the list of proposed SRCs Managers, maps of blocks, lamp density mapping, arrangement of spare parts, preparation and printing of SRC boards, logbooks for record keeping.
3. Cluster Formation on Google Map
4. Google Mapping to identify the best possible location of SRC in every Cluster
5. Mutual discussion between IP & IITB for proposed SRC Centers
6. Discussion on recommendations from IP as well as IITB regarding prospective SRC Managers at different areas
7. Interview of recommended prospective SRC Managers by IIT Bombay Team
8. Selection on the basis of predefined criteria for SRC Managers (viz. Eligibiliy, Interest, Basic Technical Knowledge etc.)

5) Training for SRCMs:

IP should ensure that SRC Managers attend all the compulsory trainings arranged by IIT Bombay for all the planned Clusters. Following important aspect are included in SRCMs training:

1. SRC Functionality Training
2. Lamp Technical part which comprises of Lamp R&M procedures (viz. Lamp Cleaning, Testing Old Parts, Replacing with New Parts, their Coding to identify Serviced etc.)
3. Lamp research part which comprises of Record Keeping Procedures (viz. Lamp R&M Enquiry & Process, Faulty & Spare Components Tracking, Monthly Compensation Log etc.; both at SRC & NGO level)
4. Training would be Interactive by multiple options of interacting with candidates while taking Classroom Sessions, presenting Videos from respective Vendors, Pratical Testing etc.

6) Prerequisites before establishing SRC centers:

IP should manage following prerequisites before establishing the SRC centers with the help of IITB.

1. Survey of Infrastructure & Facilities (viz. Shop, House, School, Local Premises) available with SRC Managers for the proposed SRC Centers
2. To make sure that the SRC Managers fulfills the SRC Facility Requirements depending on the SRC Checklist
3. SRC Checklist: Space/Room at least 8X8 feets, Power Supply, Floor Carpet to Restrict Static Electricity, Wooden Top-Table at least 4X2 feets, 2 Chairs, Mini Shelf/Almirah with Locking Facility, From IITB (SRC Banner, 1 R&M Toolkit, Log Books with Carbon, Component Box, Serviced Stickers, Laminated Instruction Sheets & Govt. Authorization Letters).
4. R&M Toolbox & Logbooks Details:

R&M Toolbox Items	**Quantity**
Soldering Iron	1
Soldering Iron Stand	1
Soldering Metal/Wire	10
Stripper	1
Screw Driver	2
Multimeter	1
Multimeter Battery	1
Screws of Different Type (As per vendor specification)	50
Smooth Cleaning Brush	1
Red Marker	1
Black Marker	1
Log Books – (For SRC)	**Quantity**
Lamp R&M Enquiry & Process Book	1
Lamp Deposit Receipt Book	1
Lamp Spare Components Inventory Book	1
Log Books – (For NGO)	**Quantity**
Lamp Spare Components Inventory Book	1
Monthly Compensation Book	1

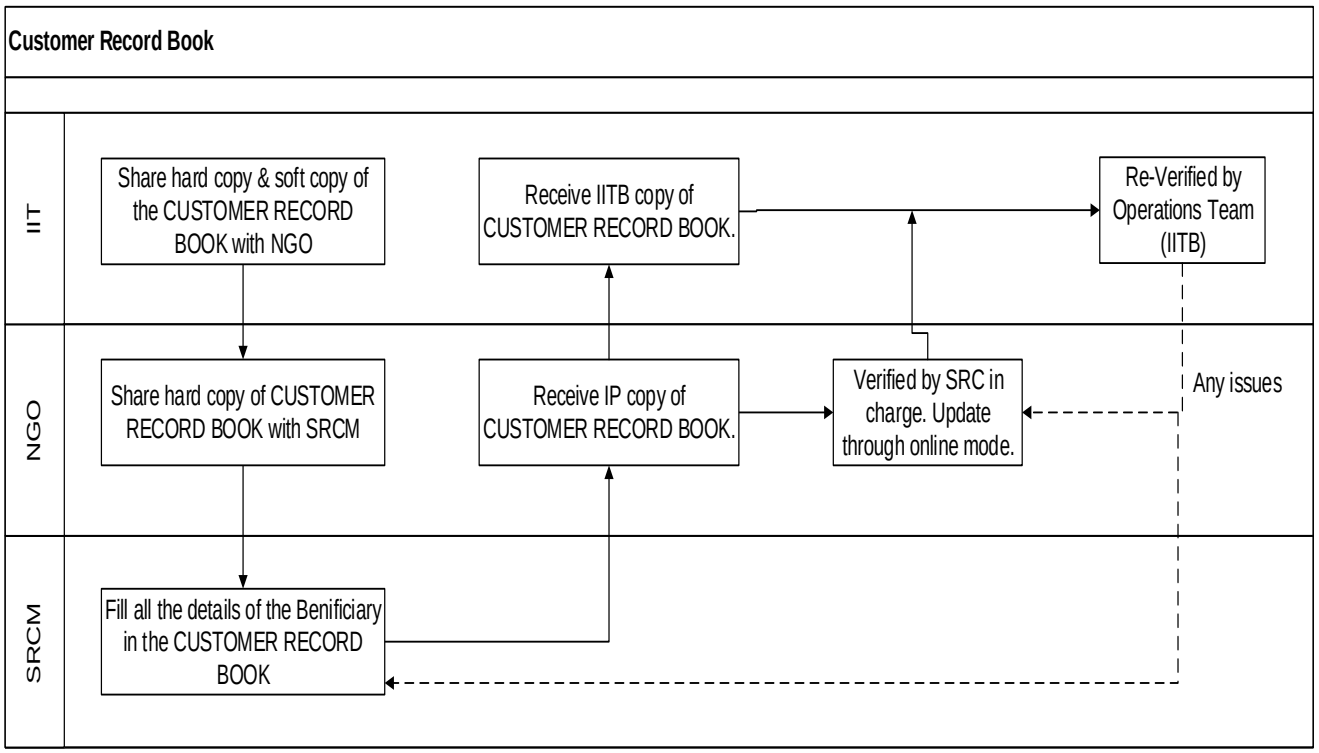
7) *Table6: R&M toolbox & logbooks details*

As per planning and after satisfying predefined parameters for establishing SRCs in respective cluster, IITB and IP will start SRCs along with SRC Mangers in respective cluster to provide free repair and maintenance services to the beneficiaries.

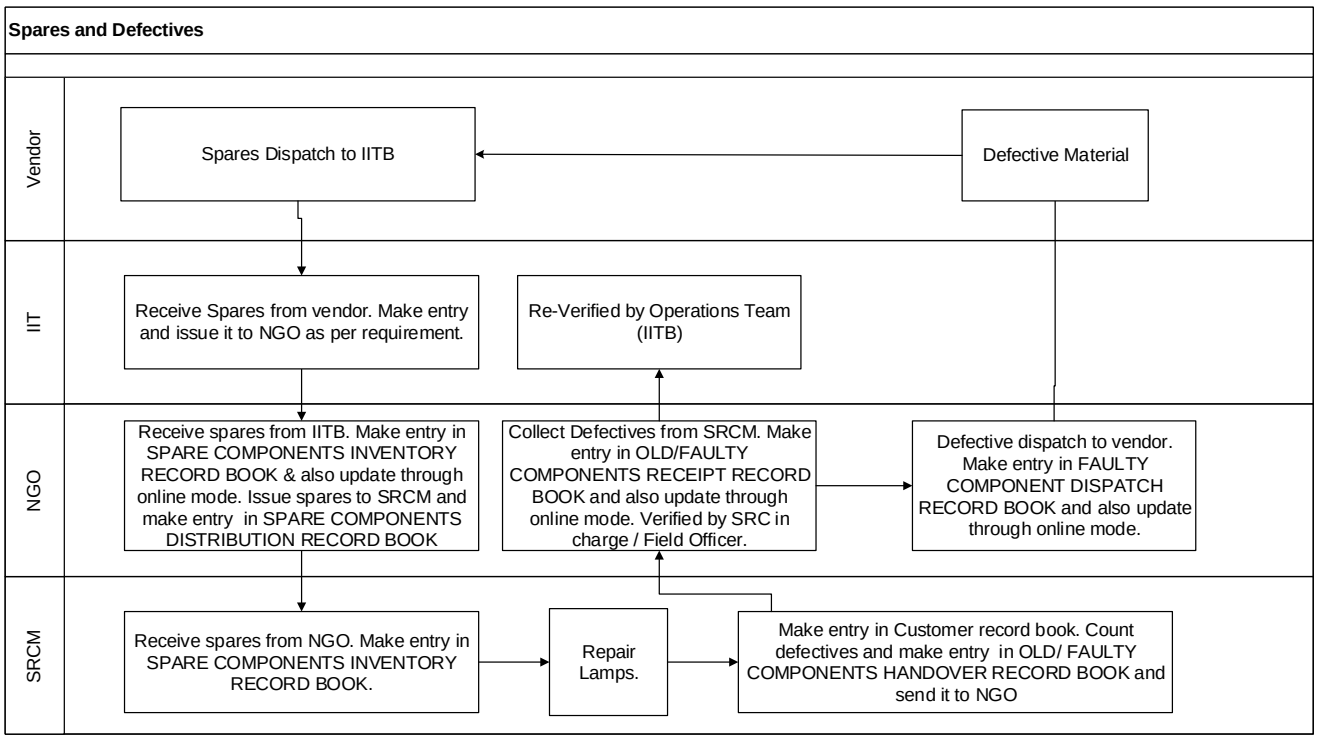
Figure25: Inauguration of New SRCs by SoUL Technical Team

8) SRC Data Monitoring Process:

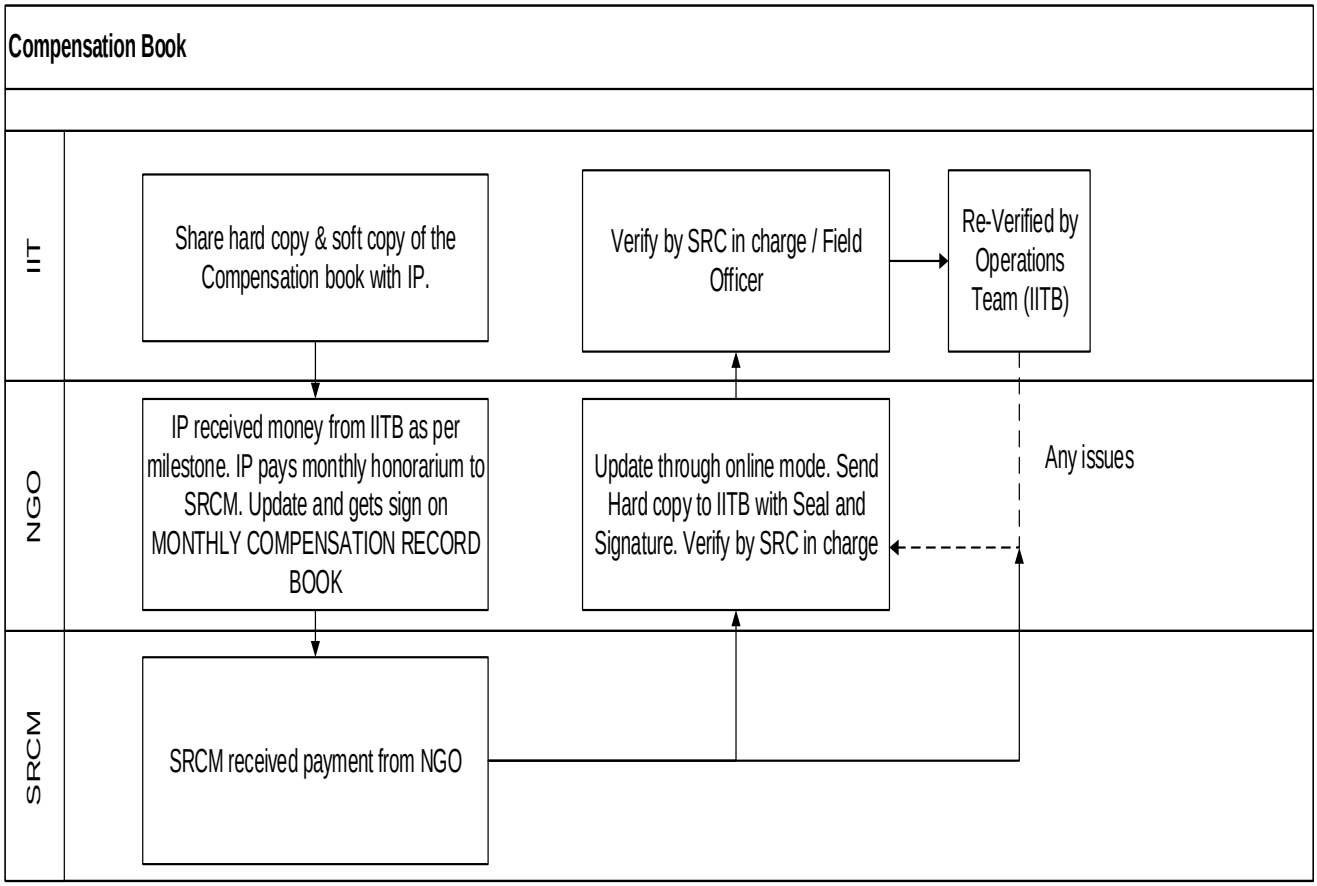
Customer Record Book Monitoring Process:



Spares and Defectives Data Flow:



Compensation Book Record Maintenance Process:



CHAPTER 10: MANAGING WORKFORCE SUPERVISION

1) Supervision - Introduction:

Supervision and support practices, as a part of workforce development, can be useful to assist with recruiting staff, retaining valuable staff, supporting and encouraging good practice, worker well-being, and engaging in reflective practice.
Possibly due to budget and time constraints, it often does not seem appropriate to consider the process of supervision, mentoring and coaching as happening distinctly, they are all closely linked. Project in-charge should be clear on exactly what the organization (i.e. IP) offers in terms of supervision and support, its purpose and goals.

Supervision and support needs will be different for different organizations but this can be easily understood by means of a needs analysis. The key is for managers to trial and evaluate different supervision and support programs to find the most appropriate model for the organization (i.e. IP). This could include promoting that there is a process in place for staff to access Employee Assistance Programs on an as needs arise basis.

2) Definitions and terminology

A) What is supervision?

Supervision serves an educative and supportive function. It is an opportunity to raise professional issues and gain further expertise. Supervision allows an individual to learn from their own experiences in working with consumers, review and debrief approaches to recovery-oriented support practices, and ensure that service delivery is following best practice standards. The supervisor must have skills to facilitate regular and systematic supervision. Supervision can be facilitated by an individual, in a group setting or in a harmony, with an additional facilitator, to suit the size and culture of the organization. Group supervision may be a more feasible option for smaller or rural organizations.

B) What is activity based supervision?

This category of supervision includes operational supervision, which may be provided by a line manager. A project in-charge /supervisor have a clear line of accountability. They are responsible for day-to-day management of workplace practices and service delivery, planning and monitoring workload, ensuring quality of work, ensuring health and safety, time management, motivating, administration and record-keeping.

C) What is managerial supervision?

This is a kind of professional supervision which is provided by a professional senior from the same discipline. Professional supervision from a manager/senior is about ensuring good governance is being followed and that the organization is working in accordance with its goals and vision.

Professional supervision could cover some/all of the following areas:

- The context of professional practice (systemic competence and role efficacy);
- The conceptualization of strategy (conceptual competence and ethical judgement);
- The competent response to expressed beneficiary need (technical skills); and,
- Critical self-awareness (personal development).

Mismanagement of staff in designated roles, where there may have been no supervision or problematic supervision, has in some cases lead to role confusion and strain, conflict of interest, staff becoming unwell, and other negative consequences.

D) What is mentoring?

Mentoring can be defined as either an informal or formal process and can be an important professional development tool for staff, including managers. Informal mentoring develops on its own between the individual staff member and desired mentor, and formal mentoring involves allocation of a mentor. Both processes can be encouraged and supported by the work place. Mentoring can be provided by someone from within the organization or an external person. This person may be engaged in the relevant field of practice or involved in a separate field. The mentor provides counsel, insight and guidance and acts as a sounding board for ideas and decisions that relate to the mentee's job. A mentor can provide advice in professional

development strategies, planning career goals, establishing contacts in the field of interest, feedback and exchange of ideas. The idea of a mentor is someone with qualities that appeal to the individual's sensibilities and professional objectives, be they skills, expertise or shared vision. The individual is 'taken under the wing' of the mentor and helped to reach their career goals and make networks. This relationship can be ongoing and a point of reference throughout that individual's career.

E) What is coaching?

Coaching is a method of improving individual or team performance through direction and instruction in order to learn a particular skill or work towards a set goal. It usually involves an external expert or coach who is bought in to work on a particular issue. This can be achieved through workshops, seminars and supervised practice.

3) Supervision and support strategies available to organizations

	Activity based Supervision	**Supervision**	**Mentoring**	**Coaching**
Focus	Meet policies and procedures	Skill & knowledge acquisition	Career development and psychological support	Learning specific issues and skills
Delivery	Clear description with job descriptions	Clear agreement – can be internal or external supervisor	Supported by the organization	Clear agreement with outside expert (i.e. IITB)
Target group	Assemblers, Distributors, Data entry operators	Project in-charge, Supervisors	Primarily on an individual level but can be done as a group	Learning and progression for individual or team around issue
Outcomes	Improvement in Performance	Service delivery that follows best practice standards, increased insight/knowledge	Guidance on developing livelihood	Improvement in specific skills required for role

Table7: Supervision and support strategies available to organizations

4) Objectives/Benefits/ Challenges of Supervision:

The main objectives of supervision programs are to:

- ✓ To provide support to staff
- ✓ To give advice
- ✓ To allow the sharing of ideas and resources
- ✓ To ensure good practice as outlined in the training manual
- ✓ To ensure that workers maintain ethical boundaries
- ✓ To facilitate professional development

- ✓ To enhance staff communication and sense of cohesiveness
- ✓ To maximize staff morale and retention
- ✓ To maintain the highest possible standards

The benefits of supervision are:

- ✓ Organizations that support continuous learning
- ✓ Staff that feels supported
- ✓ Organizations that support professional and personal growth for staff
- ✓ Improved staff communication
- ✓ Increased confidence of staff
- ✓ Reduced burnout
- ✓ Increased job satisfaction
- ✓ Quality practice
- ✓ Ongoing reflective practice

The main challenges associated with supervision are:

- ✓ The cost of supervision
- ✓ Encouraging staff to participate
- ✓ Finding appropriately experienced supervisors
- ✓ Time constraints
- ✓ Competing demands on resources

5) Practice Implications:

The findings regarding supervision and worker retention imply that certain supervisor behaviors should be increased or maintained through setting clear job expectations, training, coaching, monitoring and rewarding desired behaviors. These behaviors can be categorized as task assistance, social and emotional support and interpersonal interactions.

Task Assistance- Project in-charge / Supervisors need to:

- ✓ Provide work related advice and instruction
- ✓ Offer assistance with job related tasks
- ✓ Support training and learning activities
- ✓ Coach workers
- ✓ Provide task assistance more frequently with newer workers

Social and emotional support – Project in-charge / Supervisors need to:

- ✓ Listen to workers as they discuss job difficulties or problems
- ✓ Make supportive statements
- ✓ Recognize the emotional needs of workers feeling overwhelmed, stressed or confused
- ✓ Acknowledge and reward workers for doing a good job
- ✓ Be warm, friendly, and respectful with workers
- ✓ Clarify the workers role and job responsibilities
- ✓ Encourage for job self-sufficiency
- ✓ Encourage workers positive thinking and help seeking to manage stress

Interpersonal interaction

- ✓ Encourage coworkers to support each other
- ✓ Encourage a sense of competence in workers
- ✓ Interact with workers as professionals and encourage staff to share the organization's vision
- ✓ Project a sense of emotional closeness to workers
- ✓ Support male and female workers equally
- ✓ Provide support to workers regardless of how long they have been on the job

If managers are clear on the process of supervision and their role within the process, then this will filter down the organization to all workers. Supervision requires both a 'bottoms up' and a 'top down' approach - that is, it is the workers responsibility to approach the manager to seek access to supervision as part of staff development, just as it is the manager's responsibility to ensure staff are accessing supervision at a required minimum level (that is, it becomes part of their performance plan), and the structures are in place to support this.

6) Internal versus external supervision - Pros and Cons:

	Internal supervision	**External supervision**
Pros	- Understands the organization - 'Insider knowledge', expertise or experience specific to your area of work - Easily accessible - A person who is familiar to you and your needs - Possibly shares similar interests/ career goals - Lower costs - resources needed for supervision readily available - Easier to organize/set up - Opportunity for a staff member to increase their role/responsibility by taking on a supervisor position	- Brings new knowledge and experience to the organization - 'Outsider view' of things - Recruit from a wider pool of appropriate supervisors, and more opportunity to be selective in your final choice - Clear contracts and agreements set up - May be less subjective in supervisory process - Workers may feel more comfortable speaking honestly and openly to them - Existing staff do not need training
Cons	- Conflict of interest could arise, due to role confusion - May lack objectivity - Staff feel less comfortable disclosing/ sharing information for fear of being shamed or reprimanded - Contracts/protocols more easily overlooked - 'Match' between supervisor and worker may be less rigorous - Time needed to train supervisors may take away from time spent on	- Cost - 'Remote', i.e. contact is less frequent - Professional values may not be congruent with the organization's values - Significant orientation and induction needed

Table8: Internal versus external supervision - Pros and

	other tasks/service delivery	

7) Weekly / Monthly / Quarterly Meetings:

Weekly / Monthly / Quarterly Meetings are 1 day workshops, attended by all staff. The agenda is determined by the Project in-charge and may include guest speakers, presentations by selected staff members, and activities designed to improve skills, and explore themes related to mental health recovery.

Weekly / Monthly / Quarterly Meetings help to inspire, engage, and stimulate staff to consistently improve their practice, and help to maintain a consistent improvement philosophy.

CHAPTER 11: MANAGING WORKFORCE SELECTION

1) Hiring Needs:

A perfect hiring is essential for the growth and reach of any organization. Especially, for the large scale project like Million SoUL Program, it is recommended to hire local people who have the potential and can be relied upon to work quickly and effectively since they are aware of the demographic and psychographic factors. Moreover, a great hiring shall also increase the operational efficiency and will also expand the reach of the Institutional partner involved.

2) Recruiting:

It is essential to recruit adequate staff for project related activities as per the guidelines provided by IITB. Institutional partner should appoint one full time personnel (i.e. Project in-charge) exclusively for Million SoUL Project's management and field coordination, per assembly and distribution center apart from having an assembly and distribution supervisor, data entry operator and SRC in-charge. The said staff should have sufficient educational qualification and related work experience. Assemblers and distributors also should be hired whose domicile is in the project block and they must be recruited from multiple village clusters within the block. Every assemblers, distributors, supervisors and data entry operator must undergo training provided by IITB before being employed. Institutional partner should intimate IITB regarding any change in the staff composition, and shall also ensure that the suitable replacements are found such that the project activities and timelines are not affected.

CHAPTER 12: MANAGING TRAINING & DEVELOPMENT

1) New Staff Orientation:

An effective orientation will

- Foster an understanding of the project, its values, and its impact
- Help the new personnel understand the broader scope of the work
- Help the new personnel understand his/her role and how he/she fits into the total organization's activities
- Help the new employee achieve objectives and shorten the learning curve by deeply understanding the desired impact of the project

2) Staff Development and Training:

After the successful fresher orientation program, basic training should be provided to the staff involved in the execution of the project. The relevant training shall enable them to understand their roles and responsibilities in detail and shall imbue spirit of entrepreneurship within the local community.

3) Various types of trainings involved:

A) Management Training

B) Technical Training

A) Management Training:

Manager training and development is equally important for a large scale project. The training program can teach managers how to handle a crises and how he/she can take the brand image of the organization to the highest level possible with an improved productivity. Following are the advantages of the Management training programs:

- Effective communication
- Understanding the responsibility
- Understanding the market behavior

In the competitive age, Management training is very important because as a manager, a person shall be involved rigorously in the decision making process and shall be made accountable for every action that he/she takes.

B) Technical Training:

Technical training of the locally hired people is one of the crucial part in Million SoUL (Solar Urja Lamp) Project. Technical training is essential to impart the knowledge and skills of SoUL's testing, assembly, campaigning & distribution activities in the local people hired from the targeted block. These local people are responsible for performing the tasks such as counting the components, physical tests, technical test, assembly & distribution of SoUL under the supervision of assembly & distribution supervisors.

Technical training is conducted over the course of first 2 days, on the 1st day focus is on theoretical aspects including basic concepts of physics, electricity, SoUL components etc. and on 2nd day the focus is on practical aspects such as physical,

technical testing of SoUL components, inspection for defects and practically assembling the SoUL.

Technical training helps the potential employees to perform the unique aspects of specialized or skilled work and apply specific tools, equipments, and processes to that work. Technical training mainly focuses on skill development and application of technical concepts, procedures and processes. Technical training is also important to ensure that quality products are delivered to the end beneficiaries and that all the products are similar in functionality which is only possible when every critical step are followed while assembling the product in this case. The best way to access the technical training is in terms of number of defectives per block. If the steps, as guided, are not followed in appropriate manner, then it might lead to losses and will give a poor brand image of the organization.

APPENDIX

1) List of abbreviations

Abbreviation	***Meaning***
A&D Center	Assembly and distribution center
SRC / SRCs	SoUL (Solar Urja Lamp) Repair Centre/s
SRCM/SRCMs	SoUL (Solar Urja Lamp) Repair Centre Manager/s
NGO	Non-governmental organization
A&D	Assembly and distribution
LED	Light-emitting diode
SoUL	Solar Urja Lamp
Ni-MH battery	Nickel–metal hydride battery
PCB	Printed circuit board
Rs.	Indian Rupee
MSP	Million SoUL (Solar Urja Lamp) Project
IIT Bombay	Indian Institute of Technology Bombay
IITB	Indian Institute of Technology Bombay
PI	Principal Investigator
Co-PI	Co-Principal Investigator
QC	Quality control
SCM	Supply chain management
OM	Operation management
FO	Field officer
IP/IPs	Institutional partner/s
IT	Information technology
LR	Loading Receipt
PRA	Participatory rural appraisal
HH	House Hold
FGDs	Focus Discussion Groups
GRN	Goods Received Note
DIS	Distribution information sheet
DISE code	Unique School Identification Code
DISE	District Information System for Education
MoU	Memorandum of understanding
NEFT	National Electronic Fund Transfer
RTGS	Real Time Gross Settlement
IFSC	Indian Financial System Code
ECS	Electronic Clearing System
MICR	Magnetic Ink Character Recognition Code
A/C No.	Account number
NASA	Non-Academic Staff Association
R&M	Repair & Maintenance

2) Figures

3) Tables

4) References

- **Books**
  a. Inventory Management Explained: A focus on Forecasting, Lot Sizing, Safety Stock, and Ordering Systems by David J. Piasecki
  b. World Class Production and Inventory Management by Darry l V. Landvater

c. Manufacturing Facilities Design and Material Handling (2nd Edition) by Fred E. Meyers

- **Research Paper**
  a. Million SoUL (Solar Urja Lamp) Program: A Supply Chain Experience by Nikhil Sawal, Pranjali Yadav, Jayendran Venkateswaran, C.S. Solanki, N.C. Narayanan
- **Web Resources**
  a. www.millionsoul.iitb.ac.in.
  b. www.mckinsey.com
  c. www.pwc.in
  d. www.nelsononline.com
  e. www.nchsoftware.com
  f. Figure1: http://clipartzebraz.com//cliparts/training-clip-art/cliparti1_training-clip-art_02.jpg
  g. Figure13: http://www.thehindu.com/news/national/telangana/lack-of-tv-sets-power-cuts-mar-telecast-of-pms-speech-for-children/article6384049.ece
  h. Figure14: http://airddfamily.blogspot.in/2014_08_01_archive.html
  i. Figure15: http://www.youthkiawaaz.com/2011/07/community-radio-as-an-effective-tool-for-agricultural-development-research/
  j. Figure16: https://www.ruralindiaonline.org/categories/the-rural-in-the-urban/
  k. Figure17: http://www.indiantribalheritage.org/?p=10986
  l. Figure18: http://www.videovolunteers.org/funding-and-the-future-of-video-volunteers/
  m. Figure19: http://www.newindianexpress.com/magazine/voices/India-Can-Use-IT-to-Catch-Up-With-Developed-World-Within-Two-Decades/2014/12/06/article2557048.ece
  n. Figure20: http://www.midliferswebbusiness.com/internet-in-india.html
  o. Figure21: http://www.rediff.com/getahead/slide-show/slide-show-1-career-interview-with-chetna-sinha/20120504.htm#5

Appendix D: Concurrent Evaluation Manual

Abstract

The objective of this manual is to guide those intending to implement off-grid solar photovoltaic technology based energy program or those intending to replicate the Million SoUL Program in other regions. The manual contains steps for designing and conducting the concurrent evaluation of the program or the project and how they can be used in assessing its effectiveness. The research methodology can vary according to scope, objectives and resources available in the program; however process or steps towards conducting the evaluation remains more or less the same. This manual will guide through the various research methods that can be applied while assessing the effectiveness of a solar photovoltaic program similar to Million SoUL Program.

Executive Summary

This manual provides guideline to researchers assessing the effectiveness of a solar photovoltaic program implemented on similar lines as the Million SoUL Program of Indian Institute of Technology Bombay (IITB). The manual describes steps for conducting the concurrent evaluation and the relevant research methodologies that can be applied while conducting an impact assessment study of the program. The experience of conducting concurrent evaluation of the Million SoUL Program provided the basis for developing this manual and the insights gained from conducting research in the field was incorporated in it. The research methodology comprised of both quantitative and qualitative methods. The strengths and weaknesses of both methodologies have been discussed in this manual. Furthermore, application of both methodologies in comprehensively assessing the program has been discussed in the manual.

1. Purpose

The purpose of the manual is to present guidelines for conducting concurrent evaluation of community solar photovoltaic (PV) technology based lighting programs. A concurrent evaluation serves dual purposes: (a) strengthening of program by making mid-course corrections (b) assessing the impact of the program. For conducting concurrent evaluation, both methodologies quantitative and qualitative, can be applied in order to conduct exhaustive study of the effectiveness of the program. The practical experience of conducting concurrent evaluation of the Million SoUL Program (MSP) provided basis for developing this manual. The insights from conducting a concurrent evaluation in the Million SoUL Program were taken into account and based on that general principles were derived through which evaluation can be conducted in other solar programs have been illustrated in this manual.

The document contains steps for designing and implementing the concurrent evaluation. It details out the rationale, objectives and scope, methodology, required resources, time scale, data collection, data management, data processing, analysis and report writing. It also discusses limitations while conducting such a study.

This manual is intended to be referred by the researchers in governmental and non-governmental organizations that are implementing community based off-grid solar lighting programs. Another end user of this manual is the research team of the Million SoUL program. Proper implementation of the guidelines described in this manual aids in conducting the concurrent evaluation and thus contributes in improving efficiency and effectiveness of the program. There is variety of research methodologies that can be employed. However, this manual presents only the techniques that in general will be suitable for conducting concurrent evaluation in the solar lighting programs and have been used by the research team of the Million SoUL Program. These methodologies can be evolved according to the need and the specification of the program. The manual intends to provide the base for conducting this kind of study by other researchers.

2. Rationale and Methodology

The program model (for instance in the Million SoUL Program 'model of localization of solar energy') and the large magnitude at which it influences lives of beneficiaries demands evaluating the efficacy of it. With the purpose of impact assessment and mid-course corrections, 'concurrent evaluation' is proposed. This purpose serves other objectives such as upscaling of the model and policy recommendations related to solar energy. It can be conducted at two intervals: firstly, prior to the intervention or dissemination of the technology and secondly, 12 months after the intervention or distribution. However, as the magnitude of the Million SoUL Program was significant it was imperative to assess its efficiency and performance of the disseminated technology in order to make mid-course corrections. Therefore, instead of the regular practice of conducting second round after 12 months, the survey in the Million SoUL Program was conducted 6-9 months after the intervention.

2.1 Objectives of concurrent evaluation

The objectives of the concurrent evaluation were to:

- Evaluate the performance of the solar lighting product [in IIT-B's Million SoUL Program, solar study lamp or SoUL] that was distributed and assess the effectiveness of the after sale service
- Assess socio-economic impact of the program
- Bring transparency in the program and make mid-course corrections
- Assess scalability of the implementation model.

These objectives have a general applicability to similar kind of programs and could be developed according to the context.

2.2 Scope and methodology

The objectives of research determine the research methodology. Research methodology could be mixed methods in which there is a combination of both quantitative and qualitative methods or it could be either quantitative or qualitative methods.

The multidimensional objectives of the research study require or in this case, the concurrent evaluation requires application of mixed method approach of quantitative

and qualitative methods to study the overall efficacy and impact of the program. Mixed method approach aids in gathering comprehensive and reliable evidence as it triangulates the data; thus enhancing the credibility, validity, and confidence of the results. These methods are complementary to each other, since the quantitative study helps to understand the relation and strength between variables of interest, while the qualitative study helps to understand the reasons behind such a relation.

In the Million SoUL Program the quantitative research employs household survey methodology, while the qualitative research complements quantitative research by providing explanation to the aspects which cannot be covered quantitatively thus filling up the gaps and as mentioned earlier also triangulates the quantitative data.

3. Quantitative Method

The quantitative research is defined as the empirical investigation of the research question using scientific methods. This research is numeric in form and can be analyzed to produce hard facts. For quantitative survey, the sample size should be fairly large so that it is a representative of the population.

In an ideal scenario, two rounds of surveys should be conducted in order to evaluate differential impacts between the pre and the post intervention of the technology. The pre-intervention survey, known as the Baseline Survey, is conducted in order to collect data for variables where the impact is expected after solar technology intervention is made. For instance, kerosene consumption is a primary variable where change is expected if solar lanterns are distributed to the rural households.

The post intervention survey, referred as the Impact Assessment Survey, is conducted keeping in mind the same variables. The Impact Assessment Survey generally happens after 12 months of the Baseline Survey. The data from both the surveys is compared and evaluated for any differential impacts or changes. However, considering the research questions and the hypothesis, other surveys can be designed. For example, for evaluating the competence of the solar intervention, it is important to check the seasonal differences in the performance.

The research conducted in the Million SoUL Program tried to evaluate the program through three types of quantitative surveys. The following sub-sections present the details of three surveys.

(3.1) Baseline and the impact assessment survey at the household level;

(3.2) Load shedding survey covering three seasons at the village level;

(3.3) Survey on performance of SoUL covering three seasons with focus on charging hours and back up provided.

Even though these surveys were planned in the light of the Million SoUL Program, however they can be applied to study the impact of any solar program.

3.1 Baseline and the impact assessment survey at the household level

An aspect of research conducted about the solar technology intervention could be to assess the impact of intervention on lives of the beneficiaries. Hence, it is necessary to conduct the survey at the household level.

As aforementioned, this survey has to be conducted at the household level at two intervals or in two rounds. In both rounds, the same households are to be surveyed. The first round of the survey was planned prior to distribution of the lamps. The second round of household survey is planned after a gap of twelve months between two rounds.

3.1a Sampling

Sampling size is critical in a research study and determining an appropriate sample is somewhat dependent on how much error one is prepared to accept in a sample. It is sometimes assumed that larger the sample size better is the quality of findings. Nevertheless, sampling size is important not only in terms of implications for the analysis but also in terms of the cost, time, resources, and effort required to cover a particular sample size.

There are many methods to gather information about population. One way is to gather information about each and every stakeholder that has been benefitted by the program. However, this method could be unreasonable due to the huge cost involved and the time consumed if population is large. Hence, better way to gather information is collect information about the representative sample that reflects the characteristics of majority of population. The sampling procedure allows gathering information about small number of people and helps to draw conclusions about the whole population. Hence, it is imperative to draw the right sample through apt sampling technique so that, it is a representative sample of the entire population.

Both primary as well as secondary data can be used to draw the sample. Secondary data is defined as the data collected by someone other than the researcher for an entirely

different purpose. This data can be obtained from various records and documents; an example of this is 'Census of India' or organizational records. Primary data is the data that the researchers themselves collect keeping in mind the research question and hypothesis.

Sampling in the Million SoUL Program: The sampling method used for selecting the sample was 'stratified random sampling'. Two samples were drawn, viz. treatment sample and control sample.

Sampling plan: In the Million SoUL Program, the sampling plan comprised of two stages stratified sampling followed by random sampling. For stratified sampling, the blocks where the Million SoUL Program has been implemented were classified into clusters and then a representative block was chosen from each cluster for the survey. The clustering was based on the homogeneity of geographical and social characteristics (caste composition) of the population in each block. Thus, a sample of 20 blocks was selected out of a total of 72 blocks in which the program was implemented.

The second stage of sampling involved dividing the population into strata and arriving at their proportion and then taking a sample through random sampling. There were two strata, viz. electrification status of the house and the caste category of the household. The castes are divided into three categories, namely, Scheduled Castes (SC), Scheduled Tribes (ST) and others comprising General and Other Backward Castes (OBC). Thus, the sample (number of households to be surveyed) was arrived at by referring to Census of India, 2011 block level data which determined the proportionate percentage of electrified and non-electrified households and caste composition.

In order to select the sample households at the village level, the village wise database of the number of SoUL recipients, which included village wise number of beneficiaries and electrification status of their households, was referred. During the sample selection, it was ensured that remote and relatively small villages, i.e. villages with less than 150 households, were also included and not left out. The block level maps consisting all villages showing road network and forest villages was referred while selecting the sample villages. This helped in ensuring that the sample villages were scattered across the block.

Sample size in the Million SoUL Program: Standard sampling ratios are 50%, 30%, 10%, 1% and 0.025% (Encyclopaedia of Research Design, Volume 1). Based on this, the sample size was decided 0.75% of the population for Baseline Survey. This survey was conducted before dissemination of SoUL. In order to avoid attrition due to non purchase of the lamps by households in baseline survey, the households were asked about their preference to buy the lamp.

3.1b Data collection tool

Hypothesis on which the research is based is an essential component while studying the impact of any solar technology. The hypothesis may vary as per the topic of the research, but it is imperative that sampling, data collection tool and method to collect the data should be unbiased and based on the general norms of the sampling procedures. Research objectives and questions guide the development of survey tool for the data collection.

In the Million SoUL Program, the survey tool was structured interview schedule with mostly closed-ended (multiple choice) questions, with very few open-ended questions. Extra space was given at end of the schedule to note the interviewee's comments/suggestions and interviewer's remarks so that their opinions could be captured. The schedule for impact assessment survey had six sections illustrated in figure. Refer annexure 1 and 2 for Baseline and Impact assessment interview schedules.

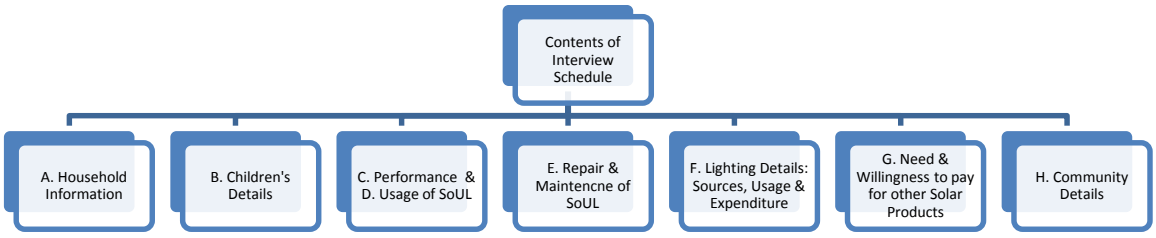


Figure 1: Sections of interview schedule

The interview schedule was translated in local languages, i.e. Hindi, Marathi, and Oriya and the data was collected by field investigators who were well-versed with these languages.

3.1c Iterative process of tool refinement

It is imperative to test the survey tool in order to check its effectiveness. The pilot testing ensures that the questions are easily understood by the respondents. For this, it is important that feedback from the experts in the respective fields should be taken into account. Conducting workshops is one of the best ways of gathering experts from various fields on one platform to seek their feedback.

In Million SoUL Program, the tool (interview schedule) was tested by giving 20 forms each to 24 IIT Bombay field officers handling program operations component in four states. They tested the tool in their respective blocks and entered the collected data in format designed for the data entry. They gave feedback on content, simplicity of language (the local language: Marathi in Maharashtra, Hindi in Madhya Pradesh & Rajasthan, Oriya in Odisha), and comprehensibility of questions from the viewpoint of the respondents as well as difficulties in data entry. After the tool testing and incorporating the feedback, a full-fledged pilot study was conducted in one block of Madhya Pradesh (Niwali in Barwani district) in September 2014. From this pilot, the pointers that emerged about the tool were mainly related to language, i.e. the need for further simplification so that questions can be understood by communities, even in the interior villages.

After the pilot study, a half-day workshop was organized in September 2014 in IIT Bombay with the objective to seek feedback on the methodology (sample, quantitative, qualitative method, tools and its contents) that was developed for conducting the concurrent evaluation. The participants of the workshop were IIT Bombay faculty from different department such as Department of Humanities and Social Sciences, Industrial Engineering and Operations Research (IEOR), and SoUL Program, Executive Committee members who are IIT Bombay faculty from various departments. Before the commencement of data collection for household survey in November 2014, feedback received by the experts was incorporated in the methodology, which pertained to sample, household survey tool, and qualitative tools. Minor gaps that emerged while analysing data for the first two surveyed blocks led to the tool undergoing the final refinement.

3.1d Data collection

Three types of models could be employed for the data collection of the household survey. One model is conventional model in which either fresh field investigators having social sciences background are trained or experienced field investigators are hired and trained for data collection. The second model is outsourcing the entire data collection activity or the survey to the professional agency and this model could be appropriate one when there is a language barrier in collecting the data. The third model is forming *academic partnership* with local colleges, train student volunteers for data collection, and supervise data collection process. The conventional model is more reliable as professionals are involved in which researchers have direct access and control on the field investigators, while academic model can be also reliable given there is scope for long term engagement with the academic institution.

In the Million SoUL Program, academic model was used for the data collection purpose in the initial three blocks, while for remaining 17 blocks field investigators were employed. The field investigators were given intensive training before conducting the household survey. Then throughout the data collection process the supervisor accompanied them to thoroughly check the filled up interview schedules and to pay surprise visits to the surveyed households for cross checking. For three implementation states of Maharashtra, Madhya Pradesh, and Rajasthan the data was collected by IIT Bombay field investigators. However, for Odisha, which is non-Hindi speaking state, due to the language barrier the data collection was outsourced to a professional consultancy company that had a prior experience of conducting surveys for the government and non-government agencies. In Odisha the surveyed blocks were three. The time taken for the first round of household survey was five months.

Academic partnership models for household survey

In the Million SoUL program data was collected by employing all the three models. Data quality, time pressure and urgency of completing the household survey in a given time frame were the decisive factors that led to an alteration in the model.

For a pilot study and three blocks of the total 20 blocks that were surveyed, data was collected by partnering with the academic institutions. For 3 blocks in Odisha, the data collection was outsourced to professional agency, while for remaining 14 blocks the experienced field investigators were hired for the data collection.

Relevance of Academic Model: In the current Indian context, it is important that the academic institutions play a key strategic role in the social development by promoting education and appropriate technology. For academic partnership the term "Academic Social Responsibility' was coined in the Million SoUL Program and there was an opportunity for the academic institutions at the local level (district) to become an active part of such a large scale program. The students [Undergraduates (2nd & 3rd year), post graduates, National Service Scheme (NSS) volunteers] from these institutions who wish to volunteer can play a critical role in data collection. The Million SoUL Program perceived the valuable contribution of the students from these institutions in data collection of the household survey. The student volunteers were trained in conducting the household survey.

Limitation of Academic Model: For the successful implementation of academic partnership model, it was realized that long-term involvement of academic institutions and extensive training is a must. The experience of implementing this model established that there is no scope for this model to operationalize in a limited time frame as it results in discrepancies in the data. Other constraints of this model are in terms of the quality, speed, and number of questionnaires that can be collected as per the sample size. On the whole this model is resource-intensiveness in terms of human and financial resources, and time. Therefore, it was realised that for implementing academic partnership model a long term association entailing more intensive involvement of the faculty and students is desired, so that the students can develop a comprehensive understanding about the program. This will ensure that their involvement in the data collection will be meaningful to them as well as to the program in terms of the data quality.

3.1e Estimated budget for the data collection of household survey

Various factors that influence the budget for conducting household survey are: sample size, length of interview schedule, nature of questions asked, time and resources available. These factors also define the number of field investigators that are required for data collection.

In the Million SoUL Program, the treatment sample to be surveyed was 12,000, while 1,200 was the control sample. Thus, total sample households to be surveyed in each round are 13,200. The total number of blocks covered across the four states was 20, so the average number of households to be surveyed per block was 915 households.

The field investigators required for conducting households survey were 15. It was expected that on an average every field investigator would fill 7 interview schedules per day. The experience of conducting the first round of household survey in the Million SoUL program demonstrated that for completing 13,200 forms, a team of 10 field investigators was required for five months. These five months include data collection as well as travel time across four states. An approximate budget is given below.

Expenditure head	**No. of Field Investigators**	**Per month per investigator**	**No. of months**	**Total Amount (in Rs.)**
Remuneration	15	Rs. 17,000	5	12,75,000
T.A. & D. A.	15	Rs. 400	5	9,00,000
Total expenditure for Round 1 (approximate)				21,75,000
Total expenditure for two Rounds (approximate)				43,50,000

3.1f Data entry, data analysis and report writing in the Million SoUL Program

The data entry operators were hired for entering the data. A format for data entry was designed in Google sheet and was stored on the Google drive. STATA, a statistical software package was used for the purpose of data management, statistical analysis and regression analysis. The methodological framework and research questions guided to prepare the cross-tabulation format. The key variables like electrification status of the household, caste category, age and gender of the student beneficiary were the base variables for cross tabulation. The comparative analysis was at the core and it included comparison between baseline and the household impact sample, across the blocks

within a state, across the states, across the vendors, and across the NGO partners (inter as well as intra).

Three types of reports were planned in the Million SoUL Program: (a) block level reports (b) state-wise report (c) overall report across the states.

3.2 Survey on seasonal functionality

For any technology to be impactful it is imperative to check its performance. In case of the solar photovoltaic technology based study lamp back-up it provides to the user was the key indicator and in this the seasonality aspect also needs to be captured in a systematic manner. Hence, in the Million SoUL Program survey on 'seasonal functionality of SoUL' was conducted.

The aim of survey on 'seasonal functionality of SoUL' is to assess the performance of SoUL in terms of lighting hours provided (i.e. back-up) in different seasons. Solar product's performance depends upon availability of sunlight (solar irradiation), which varies in different season and also varies from region to region (Gustavsson and Ellegard 2004). Under ideal sunny (day) weather conditions, a single day charging of SoUL provides light on an average of eight hours in the low mode[2] and on an average of five hours in the high mode. This assessment is conducted through data collection for one week during each season namely – summer, winter and monsoon. The data is collected on number of hours that were required for charging full battery and on lighting hours the SoUL provided in the low mode after full charge. This exercise is to be conducted for a week (7 days) i.e. collecting information on aspects mentioned (refer the questionnaire in Annexure 3) for 7 days in every season namely - summer, winter and monsoon. In this survey it is imperative that the selected households don't change during the survey and they remain the same across three seasons. Special care needs to be taken towards the training of SoUL Repair Centre (SRC) managers and the households selected for monitoring.

3.2a Sampling for seasonality exercise in the Million SoUL Program

Seasonality information is to be collected from seven selected blocks covering 70 households (10 households from each block). While selecting seven blocks for the seasonality survey it was ensured that they represent the regions in which the program is being implemented, thus spreading across the implementation area. Two to three SoUL Repair Centre (SRC) Managers, who are capable and diligent towards the data collection, were selected by IIT Bombay field officers from each of 7 blocks. Each of the selected SRC managers collected information from 4-5 households (depending upon

[2] Lighting Mode: Two modes are available in SoUL for lighting, one is high mode and other is low mode.

number of SRCs selected). SRC manager is expected to collect seasonality performance information from the selected households. The SRC managers' ease of conducting the survey was considered while selecting the households. The care is taken that the households selected is within a 1 kilometre of the shop or house of the SRC manager. The criteria for the selection of the households were:

- Households with fully functional SoUL
- Regular users of SoUL (ideally user uses the lamps for at least 3 hours daily)
- Non-migratory in nature i.e. the household should be living in the village during all the seasons throughout the year
- Households that do not have any plan to go out, specifically out of the village, for next seven days. During the study period of seven days even if house is going to be locked for a single day then such house should not be selected.

3.2b Data Collection for Seasonality exercise in the Million SoUL Program

SRC manager collected data by visiting each household for 7 days as mentioned. The information about previous day is collected by asking three questions (for the tool, refer Annexure 3):

- "How was the weather condition on the previous day?" The weather condition during charging is the point of inquiry, i.e. if the households noticed clear skies (sunny day) or cloudy day during charging hours.
- "How many hours did you charge the SoUL?" The question is aimed to ask respondents to state charging hours i.e. duration for which they had exposed panel to the sun.
- "How many hours did the SoUL provide light yesterday?" This is divided into 3 sub-sections, where SRC managers needs to record information of back up provided in the early morning and evening hours.

IIT Bombay field officers were responsible for monitoring the entire process of data collection. Field officers facilitated selection of village and households to be monitored. They trained the SRC managers about the exercise and took every day follow-up and checked the forms. They were expected to accompany at least one SRC manager daily for the data collection and were to cover every SRC during the entire week.

3.2c Instructions to be conveyed to households by SRC Managers and IIT-B field officers

Charging

1. Every selected household should charge the lamps on all 7 days from **9 AM** in the morning to **6 PM** in the evening by keeping the solar panels outside of household where it can receive direct sunlight up to eight hours or longer each day. Make sure there is no shade falling on solar panel.
2. Solar panel should be kept facing in South direction by keeping panel elevated from top end by an approximate length of one inch (top part of index finger).
3. Gently insert the pin (male connector) at the end of the wire from the solar panel into the socket (female connector) at the base of the lamp.
4. Keep the lamp in off mode, while charging.
5. Extend the wire, so as to keep the lamp in shade, away from sunlight.
6. Please ensure the battery is charging by observing if the LED on the base glows red.

Light Backup/Usage

1. Each household is required to use the lamps in low mode on all 7 days during the dark hours and record number of hours lighting provided by lamps.

General Care

1. Wipe the panel clean and blow dust from the connector pin once a day.

Other Instructions

1. Keep a self record of the number of lighting hours received from SoUL lamp everyday than to depend on recall for yesterday.

3.3 Survey on Season-wise Load Shedding

The third type of survey conducted in the Million SoUL Program was on 'season-wise load shedding'. This survey looks at the electricity supply (availability) situation in the study area through collecting information on daily load-shedding data in three seasons. This exercise was conducted for a week (7 days) in every season namely - summer, winter and monsoon. This survey was done in only one household, i.e. at SRCs manager's house, across all established SRCs in the intervention areas. Load shedding information for the day was recorded in the slot of 6 hour basis i.e. load shedding during different times of the day (morning, afternoon, evening and night). SRC manager had to record information according to load shedding that happened during different time of the day. In order to capture variation within as well as across the block/s the survey was conducted in intervention blocks across four states with each SRC being involved in the exercise (for the tool, refer Annexure 4).

4. Qualitative Study

The nature of the required data defines the research method that is to be used. The qualitative research methods are used when the data or the information is difficult to obtain using the quantitative methods. Contrary to quantitative methods in which data is of numeric nature with structured or semi-structured data collection tools, the qualitative methods are engaged for collecting information that is of descriptive nature with focus on understanding the experiences, perceptions and behaviours of the people that help in gaining deeper insights. The questions in the data collection tools for qualitative research are open ended with wide scope for probing. The emphasis is on understanding the reasons, linkages, and the processes.

In the Million SoUL Program the qualitative methods that were engaged for the data collection are:

- focus group discussion (FGD),
- key informant interview (KII),

4.1 The sample, stakeholders and non-stakeholders covered

As in case of quantitative study, sampling is equally important in a qualitative study. If the sampling is not done properly, then the chances are that the data collected may be biased and will not represent the true nature of the population.

With an objective to know and understand the variations in impacts, the following criteria were considered for selecting the sample villages for qualitative study:

- One village per block
- Villages with sizeable number of households (at least 40) that have purchased SoUL
- Electrified and non-electrified village (at least a village with non-electrified houses)
- Forest/remote village and accessible village (easy accessibility to highway or *pucca* road with transport facilities)

Example of selecting sample villages: If there are 40 blocks in which program is implemented, then these blocks could be divided into the clusters on the basis of homogenous characteristics. Once the clusters are formed than from each cluster a representative block can

be selected for conducting the study. In the Million SoUL Program, as the representatives blocks were already identified for the household survey, the qualitative study also followed the same pattern and the study was conducted in 20 sample blocks of the total number of 72 blocks in which the Million SoUL program was implemented.

The stakeholder is defined by Freeman[3] as "any group or individual who can affect or is affected by the achievement of the organisation". This definition can vary in various contexts. In the context of the study related to community level solar lighting intervention "the stakeholder" can be defined as any person who directly benefited, affected or engaged in the program. The effect of the program intervention could be in terms of deriving economic or social benefit. On the other hand, the "non-stakeholder" can be defined as any person who did not directly benefit from the program or who did not derived any socio-economic benefits. However, a possibility needs to be recognised that the program might influence the formation of perception and or future decision about the solar products or solar technology.

In order to assess and develop comprehensive understanding of the impacts of any community based program it is vital to conduct interactions with both, firstly stakeholders that were involved in the program implementation and were deriving benefits from the program and secondly the community level non-stakeholders, to understand their perception, behaviour and experiences.

In the Million SoUL Program, the following stakeholders were involved. The first three stakeholders were at the institution level, while last two were at the community level:

1. *Program Staff of IIT-Bombay:* The program staff of IIT Bombay was at two levels: the central team in Mumbai consisted various departments such as operations, technical, finance, research, and administration; while the field team comprised of the state coordinator and field officers (FO). The field officers operated at the sub-district level (*taluka/*block), the unit at which the program was implemented and they were placed (to monitor and handhold) with the NGO partner responsible for block level intervention.

[3] Mitchell et al. (1997), "Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts", Vol. 22, No. 4, pp 853-886. http://www.jstor.org/stable/259247?seq=2#page_scan_tab_contents dated 11-3-15 12.46 pm

2. *Vendors/manufacturers of the SoUL:* There were four vendors in the program who supplied solar lamp material, i.e. disassembled solar lamp (SoUL) kits to the partner NGOs.
3. *NGO Partners:* The program interventions were routed through NGO partners, having outreach at the sub-district level. In the Million SoUL Program there were nine such NGO partners in four states of India. NGO staff engaged in the program mainly included program in-charge and supervisors at the assembly centres.
4. *Local people:* The local people were employed as assemblers, distributors, data entry operators, and repair-maintenance service providers called as SoUL repair centre managers (SRCM).
5. *SoUL beneficiary households:* They were defined as students studying in class 5th - 12th who have purchased SoUL and their household member using the solar lamp for various purposes.

The community level non-stakeholders in the Million SoUL Program included:

1. *Non-beneficiary households* i.e. households of students studying in class 5th - 12th that have not purchased the SoUL
2. *Village community* included school teachers, ration shop owner (PDS – Public Distribution System), knowledgeable person from the village like *Sarpanch*.

In the qualitative study for the Million SoUL Program, the stakeholder interactions were conducted at two levels: community and NGO partner. The NGO level stakeholders covered were: NGO staff, local people employed in the program through NGO, and IIT Bombay field officers. The community level stakeholders and non-stakeholders covered included parents of the students that have purchased as well as not purchased SoUL, PDS shop owner, teachers in the school, knowledgeable person in the village, and Sarpanch/staff from Gram Panchayat office. The stakeholders not covered in the study include vendors and IIT-Bombay Mumbai office staff.

4.1 Tools for data collection

4.1a Focus Group Discussion

A focus group discussion (FGD) is an in-depth field method that brings together a small homogeneous group (usually six to twelve persons) to discuss a focused or specific topic on a study agenda. The FGD helps to know the views and perceptions of people about the efficacy of intervention. It can also help to understand reasons behind the trends and patterns emerging from the survey.

In the FGD, the facilitator should ask open ended question that would help to stimulate free discussion. The FGD guideline provides the framework or the structure for which the responses are to be sought. There are probing points as well that can be used if required to facilitate the discussion. It is not necessary that the facilitator asks the questions in the same words as given in the guideline or in the same sequence. Based on responses of the participants there is a flexibility to instinctively frame or reframe the questions.

Points to remember while conducting FGD

- ➢ There should be at least two persons for conducting the FGD, one person to facilitate and another to document the discussion in detail.
- ➢ Ensure that no one person dominates the discussion & all participants get an opportunity to speak.
- ➢ Do not ask indicative, judgemental questions. The questions should be open ended generating free discussion.
- ➢ Encourage all participants to share their views, even if there is disagreement.
- ➢ The person documenting the FGD should record verbal as well as non-verbal responses and interactions occurring during the FGD
- ➢ Material required is: note pad, pen, recorder (if the participants give consent to record, then FGD can be recorded), FGD guideline, chart paper, sketch pens.

In the Million SoUL Program, FGDs were conducted at two levels: NGO partners and community. At NGO level FGDs were conducted with assemblers, distributors, and SoUL

Repair Centre Managers (SRCM). The community level FGDs was held with the parents of beneficiary children (refer annexure 5).

4.1b Key Informant Interview (KII)

Key informant interview (KII) is an in-depth interview that is conducted with key persons or experts having thorough knowledge and information about the subject of enquiry. The tool for KII is loosely structured interview schedule with open ended questions. Based on the responses of the interviewee, the interviewer is expected to instinctively frame the questions to probe further so that reasoning, experience and opinion can be understood.

While conducting interviews, the interviewer should initiate the discussion by introducing herself/himself and explaining the purpose of the interview. After this, the general information about the respondent and their family can be asked followed by asking specific questions using interview schedule.

The key informant interviews of Sarpanch/staff of the Gram Panchayat, knowledgeable persons from the village, Public Distribution Shop (PDS) owners, school teachers, IIT Bombay field officers, in-charge of SoUL program at the level of NGO partner and their other staff related to SoUL were conducted**.** In order to collect the village level information Sarpanch/staff from Gram Panchayat office is interviewed.

4.2 Required Resources, data collection and timeline

In order to carry out the qualitative research in the Million SoUL Program, the following resources were required and their broad responsibilities were given below.

Sr. No.	Personnel & Number	Responsibilities
1.	Research coordinator (1)	Overall coordination, planning, developing methodology, training field investigators, monitoring data collection, analysis, report writing
2.	Research Associate (2)	Review of literature, designing tools, pilot testing of

		tool & its revision, budget for the data collection, identifying the sample villages, supervision of data collection and field notes, translation of data, data coding, data entry, analysis & report writing
3.	Field Investigators (8)	Data collection with the help of the tools & field notes
4.	Field Officers (of the respective block in which study is to be conducted)	Support in identifying sample villages with the help of NGO partner, identifying host family in the village (arrangements for stay, food) & informing village community about the study, schedule, taking appointments of NGO staff for the interviews, accompanying field investigators during data collection process

Pre-visit preparation is an essential activity for conducting the exercises smoothly. After selection of villages, field officers need to visit each selected village to inform them about the study. This will also include identification of site for conducting focus group discussion, for this field officer can take help from NGO staff. Since qualitative exercises are time-consuming, it is important to inform the participants in advance about the nature of the exercise and it should be conducted as per the suitability of the participants.

While collecting the data, it is advisable to begin with the collection of village level information followed by key informant interviews and then in the end focus group interviews can be conducted. If the field investigators start with collecting general information about the village and conduct individual interviews, this helps them to develop the better understanding about the situation in the village and they are well equipped to conduct the focus group discussion.

In each village, there was a team of two persons for collecting the data. The time estimated for completing the data collection per village is 3-4 days.

4.3 Data coding, analysis and report writing

The coding serves the purpose of identifying similarity or difference in the data and also the patterns emerging from it. The research questions and the objectives of the concurrent evaluation guided the development of the codes. During the process of data classification, in case the data did not fit into the coding scheme, then new codes were added. After data is coded and classified, while report writing it was observed for the similarities, differences, linkages, and patterns that emerged.

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Annexure 1: Baseline Household Survey

Household Baseline Survey

State	[Pre-printed]	District	[Pre-printed]	Block	[Pre-printed]

Form Number													Interviewer's Name	Date	Gram Panchayat	Village	Hamlet
			/					/									
Block code [Pre-printed]			/	Village code				/	Serial number								

A. Household Details						
A1	Full Name of respondent		A3	Full Name of head of household		
			A4	Sex of head of household	◯ Male	◯ Female
A2	Relation of the respondent to the beneficiary		A5	Mobile Number		
			A6	Number of Members in the Family		
			A7	No of rooms in the house(including kitchen)		

B. Children's Details (applicable to all children from 5 to 17 years or in class 1st to 12th Class)

	B1	B2	B3	B4	B5	B6	B7	B8	B9
S. No.	Full Name	Age	Sex (M/F)	Does he/she go to school? (Yes/ No)	Class	Which lighting devices do you use for studying (Specify all the devices, else specify the reason for not studying in the dark hours)	How many hours do you study in the mentioned devices?	Father's years of Education?	Mother's years of Education?
1									
2									
3									
4									
5									
6									

B 10: Preferred Activity for the children in the family					
How do all *MALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same	**Activities**	**No. of Hours**	**How do all *FEMALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same**	**Activities**	**No. of Hours**
Remarks (if any)			**Remarks (if any)**		

C1 Kerosene Purchased					
S. No.	Source	Litre/s per month	Avg. Price per litre	Frequency (Number of trips for purchase per month)	If the Kerosene purchased from PDS is more than 5 litres, specify the reason?
1	Purchased from Govt. Ration shop - PDS				
2	Purchased from Market				

C2 Kerosene Used				
	Lighting	Cooking	Heating water	Other (Please specify)*
Consumption (litre/s per month)				

*Other use may also include resale, in vehicles, etc.

C3 Usage of other oil for lighting (For example, if used for lighting purpose, any of the cooking oils like groundnut, mustard, sunflower, etc.)			
Name of oil	Consumption (litre/s per month)	Avg. Price per litre	Device/s used

C4. Do you keep kerosene based devices ignited all night while sleeping?	Yes	No

C4 Devices using kerosene/ other oil					
S. No.	Device	Do you use the device? (Yes/ No)	Quantity used*	Number of hours per day	Number of days per month
1	Chimni (Simple wick lamp)				
2	Hurricane lamp				
3	Wick stove				
4	Other (Please specify)				

*By "Quantity used" we mean number of devices they are actually using for lighting purpose and NOT the number of devices they possess.

C5 Do you have electricity at home? If "No" go to F10	◯ Yes	◯ No
C6 Do you have electric meter/ one point connection/ shared connection?	◯ Yes	◯ No
C7 Interval of electricity bill receipt		

□ Not applicable	□ Every month	□ Every 3 months
□ Every 6 months	□ Every year	□ Other (Please specify)

C8	**Electricity bill amount paid as per the above mentioned interval (Rs)**	

C9 Features of electric lighting devices (bulbs/ tubes) used at home				
S. No.	Type of device	Number of devices	How much period (days/weeks/ months/ years) does this device last for?	Avg. price of device (Rs per unit)
1	Incandescent bulb			
2	CFL			
3	Tubes			
4	LED			
5	Chargeable torch			
6	Other (Please Specify)*			

* If using torch in mobile phone specify that also as other electric lighting device.

C10 Features of candle		
Number consumed/ month (Specify candle or pack)	Usage in hours per day	Avg. price of candle or pack (Rs per unit)

C11 Features of battery torch at home (non-rechargeable)				
	Number of cells	Number of times cells replaced per month	Avg. price of torch (Rs per unit)	Maintenance Cost (Rs per unit)**
Torch 1				
Torch 2				
Torch 3				

** If use-and-throw (Chinese) torch, then in 'Maintenance Cost' write **not applicable**

D. Reliability of Current Source of Energy (Electricity/ Kerosene) (Please tick in the appropriate option)					
D1	**How reliable is the current energy supply in households?**				
Source	Very Reliable	Somewhat Reliable	Neutral	Somewhat Unreliable	Very Unreliable
Kerosene					
Electricity					

D2	**What is the average daily load shedding in your household after sunset (6 P.M.)**

No. of Hours	Summer	Winter	Monsoon
Never			
Less than an hour			
1-2 hours			
2-3 hours Daily			
3 hours or more			

D3	**Have you had an incidence in last three months where there was no electricity supply to your household for more than 7 days continuously or more?**	Yes	No

E1 Are you aware of Solar Products?	Yes	No

E2 Features of renewable energy devices used at home (if any)

S. No.	Name of device	Number	Capacity	Initial investment (Rs)*	Working (Yes/ No)	Maintenance Cost (Rs per unit)	Year of purchase
1							
2							
3							

* If no investment has been made (grant/ donation), then in 'Initial investment' write **not applicable**

E3 Are you aware of any shops or centres where you can purchase solar products like solar lanterns, SHS etc.	Yes	No
E4 Are you aware if you can avail loan (through banks or govt. programmes) for the purchase of Solar Products?	Yes	No

F. Willingness to pay for other Solar Products (Please tick in the appropriate circle)			
F 1	**What are the solar energy related needs of the household?**	**Product**	**How much you are willing to invest in Solar Products for the following uses?**
		□ Solar Pocket Lamp	
		□ Solar Lantern	
		□ Solar Home Lighting System (Only Lights)	
		□ Solar Home Lighting System (Lights + Fans)	
		□ Solar Fan	

		□ Solar Cooker	
		□ Others (Please specify)	
		□ None	

F.2 Preference of Lighting in the household		
What is the preferred source of lighting for the Household- Electricity; Kerosene Source; Solar Product? (Eg. Rank1 given to first preferred source etc.)	**Energy Needs**	**Preferred Source of Lighting**
	Rank 1	
	Rank 2	
	Rank 3	
	Reason for the preference?	

G. Environment, Health & Fire Incidents (Please tick in the appropriate circle)			
G1	**Do you ever worry about the environmental effects of using kerosene?**	Yes	No
	If yes, then please explain how? _____ _____ _____ _____		
G2	**Do you feel the kerosene which you are currently using for lighting in your households affect you and your children's vision in a negative way?**	Yes	No
G3	**Do you ever worry about the health effects of using kerosene on you or your children in your household? (If no, then move to I3)**	Yes	No
G3.1	**If yes, then what are the negative health impacts that you observe on you or your children? (Tick the appropriate box)**		

□ Coughing	□ Nostril Blackening	□ Headache	□ Red and Itchy Eyes
□ Sore Throat	□ Asthma	□ Others _____	

G3.2	**How often do the people of your household suffer from above symptoms? (Tick the appropriate box)**		
□ Always (more than thrice in last six months)	□ Very Frequently (less than thrice in last six months)	□ Occasionally(once in past six months)	□ Rarely(Can't remember when it happened last time)

G3.3	**Did you spend on medical expenses due to above mentioned symptoms in last three months?**	Yes	No
G4	**Do You Have any burn incidents in past 6 months? (If no, then move section J)**	Yes	No
G5	**If yes, then what was the nature of loss during such incident?**		

□ Casualty	□ Material
□ Body Part	□ Others, please specify: _____

H. Access to finance (Please tick in the appropriate circle)			
H1	**Do you have savings in any different source?**		
□ Commercial Banks/RGB's	□ Co-Operatives	□ Post Office	□ Others Specify _____
□ SHG's	□ Post Office	□ Informal Sources	□ None
H2	**Have you ever borrowed money or loan from any different source? (if none, then go section K)**		
□ Commercial Banks/RGB's	□ Co-Operatives	□ Post Office	□ Others Specify _____
□ SHG's	□ Post Office	□ Informal Sources	□ None
H3	**For what purpose did you borrow the money?**		
□ Personal Expenditure (Marriage, Debt, Festivities, house repairing etc.)	□ Agriculture	□ Education	□ Others Specify _____ ____ _____ ____
□ Entrepreneurship	□ Health		
H4	**What amount did you borrow?**		
□ 0-5000	□ 10000-15000	□ 20000-25000	
□ 5000-10000	□ 15000-20000	□ Above 25000	

I. Community Details (Please tick in the appropriate circle)		
I1	**Type of Card Holder (Please tick in the appropriate circle)**	
□ Below Poverty Line (BPL)	□ Antyoday	□ Other (Please specify)
□ Above Poverty Line (APL)	□ No card	

I2	**Primary Source of Income (Please tick only one)**		
□ Agriculture	□ Agricultural Labor	□ Non- Agricultural Labor	□ Dairy
□ Service	□ Agriculture + Agricultural Labor	□ Agriculture + Non-Agricultural Labor	□ Skill-based occupation (carpentry, pottery, etc.)
□ MGNREGS	□ Remittance		□ Other (Please specify)

I3	**Religion (Please tick only one)**		
	□ Hindu	□ Muslim	□ Christian
	□ Sikh	□ Buddhist	□ Jain
	□ Other (Please specify)		

I4	**Social Group (Please tick only one)**	
	□ Scheduled Tribe (ST)	□ Scheduled Caste (SC)
	□ Other Backward Caste (OBC)	□ Nomadic/ Denotified Nomadic Tribe/ Vimukta Jati Nomadic Tribe (NT/ DNT/ VJNT)
	□ Open (General)	□ Other (Please specify)

I5	Name of caste/ tribe you belong to	

I6	Wealth Indicator					
Name of the asset	**#**	**Name of the asset**	**#**	**Name of the asset**	**#**
Radio		Table		Bicycle	
Chair		Motorcycle/Scooter		Mattress	
Washing Machine		Bullock Cart		Fans	
Heaters		Colour Television		Thresher	
Tractor		B/W Television		Buffalo	
Telephone Set/ Mobile Phone		Sewing Machine		Cow	
Pressure Cooker		Watches		Bullock	
Goats		Cock/Hen/Duck		Pigs	
other asset 1		other asset 2		other asset 3	

I7 Household type: Tick the correct option		
Kacchha	**Semi- Pakka**	**Pakka**

Signature of the respondent		Signature of the interviewer	

Please note the suggestions and complaints by the respondent below.

Interviewer's Notes:

Annexure 2: Impact Household Survey

Household Impact Survey

State	[Pre-printed]	District	[Pre-printed]	Block	[Pre-printed]

Form Number													Interviewer's Name	Date	Gram Panchayat	Village	Hamlet
			/					/									
Block code [Pre-printed]			/	Village code				/	Serial number								

A. Household Details						
A1	Full Name of respondent		A3	Full Name of head of household		
			A4	Sex of head of household	◯ Male	◯ Female
A2	Relation of the respondent to the beneficiary		A5	Mobile Number		
			A6	Number of Members in the Family		
			A7	No of rooms in the house(including kitchen)		

B. Children's Details (Irrespective of receipt of SoUL lamp, applicable to all children from 5 to 17 years or up to 12th Class)										
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
S. No.	Full Name	Age	Sex (M/F)	Does he/she go to school? (Yes/ No)	Class	Has he/she received SoUL lamp? (Yes/ No)	If **"Yes" for B6**, specify the **lamp code** here. If only one child has bought and others are applicable why other children have not brought SoUL?*	Which devices** do you use for studying (Specify all the devices, else specify the reason for not studying in the dark hours)	If, **for B8**, one of the devices is SoUL lamp, specify **time** of **study using SoUL lamp**. If, **for B8**, none of the devices is SoUL lamp, specify the **reason for not using SoUL lamp** for studying	If the SoUL is working, and the child is using Chimni/Electricity with SoUL, mention the reason for using the same?
1										
2										
3										
4										
5										
6										

*If unable to obtain the lamp code, state the reason in B7

** If studying in street light or community light (in temple) etc. then specify in B8

C. Performance of SoUL lamp (Interviewers can themselves check SoUL lamp for following details)											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11

S. No.	Lamp Code	Is the SoUL lamp working? (Yes/ No) **If "Yes" go to C4**	If No, for how much time did it work? (days/weeks/ months) **Specify and go to E1**	Is the Switch working? (Yes / No)	Is LED working? (Yes / No)	Is red light in indicator working properly? (Yes/ No)	Is green light in indicator working properly? (Yes/ No)	After one day of charging, for how much time SoUL lamp works?	Is there any loose connection? (Yes/ No)	Is the panel broken? (Yes/ No)	State other problem, if any. If SoUL is not working; then state the problem with it?
1											
2											
3											
4											

D. Usage of SoUL lamp								
D1 Lamp code	D2 Do you charge SoUL lamp with mobile charger? (Yes/ No)	D3 What is the usage of SoUL in hours per day for purposes **other than Studies**?	D4 For what other purposes **other than Studies** SoUL lamp is used & used by whom **(Relation to the beneficiary)**					
			Other purpose 1	Used by whom	Other purpose 2	Used by whom	Other purpose 3	Used by whom

E. Repair and Maintenance of SoUL										
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10

S. No.	Lamp code**(Repeat the lamp code again if R&M availed more than once)**	Have you availed R&M service?# (Yes/ No) **If Yes, Go to E4**	If **E2 is "No"**, & SoUL lamp is not working then why service is not availed? **Specify and go to E11**	If **E2 is "Yes"**, what was the problem in the SoUL lamp before repair?	Was it repaired at SoUL R&M centre? (Yes / No)	Where was it repaired? (Shop name, Village name, Gram Panchayat name)	When did you avail R&M? (Month & year)	In how many days was SoUL lamp repaired ?	How much did you pay for it? (Rs.)	Are you satisfied with R&M service? (Yes/ No)
A										
B										
C										
D										
E										
F										

E11 If any of the SoUL lamps have been repaired at home (yourself), was it successful? (Yes/ No):
E12 Specify which component was not working before repair at home (yourself):

F1 Kerosene Purchased					
S. No.		Litre/s per month	Avg. Price per litre	Frequency (Number of trips for purchase per month)	Generally collected by whom? (specify whether Adult woman/Adult man/ Girl child/boy child)
1	Purchased from Govt. Ration shop - PDS				
2	Purchased from Market				

F2 Kerosene Used				
	Lighting	Cooking	Heating water	Other (Please specify)*
Consumption (litre/s per month)				

*Other use may also include resale, in vehicles, etc.

F3 Usage of other oil for lighting (For example, if used for lighting purpose, any of the cooking oils like groundnut, mustard, sunflower, etc.)			
Name of oil	Consumption (litre/s per month)	Avg. Price per litre	Device/s used

F4 Devices using kerosene/ other oil					
S. No.	Device	Do you use the device? (Yes/ No)	Quantity used*	Number of hours per day	Number of days per month
1	Chimni (Simple wick lamp)				
2	Hurricane lamp				
3	Wick stove				
4	Other (Please specify)				

*By "Quantity used" we mean number of devices they are actually using for lighting purpose and NOT the number of devices they possess.

F5 Do you have electricity at home? If "No" go to F10	◯ Yes	◯ No
F6 Do you have electric meter/ one point connection/ shared connection?	◯ Yes	◯ No

F7 Interval of electricity bill receipt		
□ Not applicable	□ Every month	□ Every 3 months

□ Every 6 months		□ Every year	□ Other (Please specify)
F8	**Electricity bill amount paid as per the above mentioned interval (Rs)**		

F9 Features of electric lighting devices (bulbs/ tubes) used at home				
S. No.	Type of device	Number of devices	How much period (days/weeks/ months/ years) does this device last for?	Avg. price of device (Rs per unit)
1	Incandescent bulb			
2	CFL			
3	Tubes			
4	LED			
5	Chargeable torch			
6	Other (Please Specify)*			

* If using torch in mobile phone specify that also as other electric lighting device.

F10 Features of candle		
Number consumed/ month (Specify candle or pack)	Usage in hours per day	Avg. price of candle or pack (Rs per unit)

F11 Features of battery torch at home (non-rechargeable)				
	Number of cells	Number of times cells replaced per month	Avg. price of torch (Rs per unit)	Maintenance Cost (Rs per unit)**
Torch 1				
Torch 2				
Torch 3				

** If use-and-throw (Chinese) torch, then in 'Maintenance Cost' write **not applicable**

F12 Features of renewable energy devices other than SoUL used at home								
S. No.	Name of device	Purchase inspired by SoUL lamp (Yes/ No)	Number	Capacity	Initial investment (Rs)*	Working (Yes/ No)	Maintenance Cost (Rs per unit)	Year of purchase

1								
2								
3								

* If no investment has been made (grant/ donation), then in 'Initial investment' write **not applicable**

G. Willingness to pay for other Solar Products (Please tick in the appropriate circle)			
G3	**What are the solar energy related needs of the household?**	**Energy Needs**	**As you are aware, actual cost of SoUL lamp is Rs 500 but due to subsidy it is available for students at Rs 120. Keeping this in mind, how much you are willing to invest for the following uses?**
		□ Lighting	
		□ Cooking	
		□ Irrigation	
		□ Others (Please specify)	
		□ None	

G.3.1 Preference of Lighting in the household			
G3.1	**What is the preferred source of lighting for the Household- Electricity; Kerosene Source; Solar Product? (Eg. Rank1 given to first preferred source etc.)**	**Energy Needs**	**Preferred Source of Lighting**
		Rank 1	
		Rank 2	
		Rank 3	
		Remarks (if any)	

G.3.2 Solar Needs

G3.2	**Does SoUL lamp satisfy your child's study lighting needs? If No, then why?**	

H. Community Details (Please tick in the appropriate circle)		
H1	**Type of Card Holder (Please tick in the appropriate circle)**	
□ Below Poverty Line (BPL)	□ Antyoday	□ Other (Please specify)
□ Above Poverty Line (APL)	□ No card	

H 2	**Primary Source of Income (Please tick only one)**	
□ Agriculture	□ Labor	□ Agriculture + Labor
□ Service	□ Dairy	□ Skill-based occupation (carpentry, pottery, etc.)
□ MGNREGS	□ Remittance	□ Other (Please specify)

H3	**Religion (Please tick only one)**		
	□ Hindu	□ Muslim	□ Christian
	□ Sikh	□ Buddhist	□ Jain
	□ Other (Please specify)		

H4	**Social Group (Please tick only one)**	
	□ Scheduled Tribe (ST)	□ Scheduled Caste (SC)
	□ Other Backward Caste (OBC)	□ Nomadic/ Denotified Nomadic Tribe/ Vimukta Jati Nomadic Tribe (NT/ DNT/ VJNT)
	□ Open (General)	□ Other (Please specify)

H5	**Name of caste/ tribe you belong to**	

H 6	**Wealth Indicator**					
Name of the asset		**#**	**Name of the asset**	**#**	**Name of the asset**	**#**
Radio			table		other asset 1	
Bicycle			chair		other asset 2	
motorcycle/scooter			mattress		other asset 3	
washing machine			bullock cart			

Fans		thresher	
Heaters		tractor	
colour television		buffalo	
b/w television		Cow	
telephone set/ mobile phone		bullock	
sewing machine		goats	
pressure cooker		cock/hen/duck	
Watches		Pigs	

H7 Household type: Tick the correct option		
Kacchha	**Semi- Pakka**	**Pakka**

H8: Preferred Activity for the children in the family					
How do all *MALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same	**Activities**	**No. of Hours**	**How do all *FEMALE* children spend their non-schooling hours? Enlist three activities in which he spends most of his time and the number of hours spent on the same**	**Activities**	**No. of Hours**
Remarks (if any)			**Remarks (if any)**		

Signature of the respondent		Signature of the interviewer	

Please note the suggestions and complaints by the respondent below.

Interviewer's Notes:

Annexure 3: Seasonal Performance of SoUL in terms of back-up

Performance Monitoring (Technical)

Field Officers will fill Section 1 from H to L. SRC manager are expected to fill Section 1 from A to G and entire Section 2 from the each of the 5 selected Households.

1. General Data

A	Household (HH) Head Name	
B	Electrification Status	
C	HH Contact Information (Mob. No.)	
D	Hamlet	
E	Village	
F	Block	
G	District	
H	Season	
I	Vendor	
J	Monitoring In-charge (Field Officer)	
K	SRC Code	
L	Period of Data Collection (__ to __)	

2. How were the weather conditions on the day (Please tick on the right option)?

Day	Clear Skies (Sunny day)	Cloudy
Sunday		
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		

3. Charging time

How many hours did you charge the lamp (Please write in ‘when’ to ‘when’ format as described)

Day	SoUL Charging (Hours)	Other Issues/Discrepancies with Performance of Lamp
Sunday	am to pm	
Monday	am to pm	
Tuesday	am to pm	
Wednesday	am to pm	
Thursday	am to pm	
Friday	am to pm	
Saturday	am to pm	

4. Daily SoUL Performance

For how many hours did the SoUL lamp provide light yesterday?

Day	SoUL Worked (Hours)			Other Issues/Discrepancies with Performance of Lamp
	Ist Use	IInd Use	IIIrd Use	
Sunday	am to am	pm to pm	pm to pm	
Monday	am to am	pm to pm	pm to pm	
Tuesday	am to am	pm to pm	pm to pm	
Wednesday	am to am	pm to pm	pm to pm	
Thursday	am to am	pm to pm	pm to pm	
Friday	am to am	pm to pm	pm to pm	
Saturday	am to am	pm to pm	pm to pm	

Annexure 4: Survey on Season-Wise Load Shedding

Load Shedding Monitoring

Field Officers will fill Section 1(H to J). SRC manager are expected to fill Section 1 from A to G and entire Section 2 from the selected household.

1. General Data:

A	Household Head Name	
B	HH Contact Information (Mob. No)	
C	Hamlet	
D	Village	
E	Block	
F	District	
G	Season	
H	Monitoring In-charge (Field Officer)	
I	SRC Code	
J	Period of Data Collection (__ to __)	

2. Daily Load Shedding Chart

Please let us know the load shedding (in terms of hours) that took place yesterday.

Day	Load Shedding (Hours)				Other Issues/Discrepancies
	6 am to 12 pm	12 pm to 6 pm	6 pm to 12 am	12 am to 6 am	
Sunday					
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					

Annexure 5: Qualitative Tools

Annexure 5.1: FGD Tools

FGD with Parents (Men and Women) of Beneficiary Students

Note down following information of the participants

Name	Type of poverty card
Age	No. of rooms in the house
Occupation	Number of SoULs in HH
Education	Number of Children b/w 5 -17 years
Caste	

FGD Guideline

1. What were the reasons they decided to purchase SoUL?
2. What is the kerosene use and expenditure at household level?

   Probing Points:

   i. Where do you purchase your kerosene from (sources: PDS, Market etc)?
   ii. How much do you purchase (Quantity) and at what rate (describe individual sources)?
   iii. For what all purposes is the kerosene being used generally?
   iv. What are the problems associated with use of kerosene? (sufficiency in terms of quantity received)
   v. Has your usage of kerosene (for lighting purposes) changed since the purchase of SoUL?

   a. If said Yes, ask if increase or decrease? (Please refer below table)

<table>
<tr><td rowspan="2">If increased, why has it increased and how much?</td><td colspan="2">If mentioned decrease in consumption of kerosene for lighting purposes, are they still purchasing the quantity they used to earlier (proceed as per below instructions)?</td></tr>
<tr><td>If Yes, where are they using kerosene and for what all purposes? Has the kerosene consumption of some other activity increased?</td><td>If No, how much are you saving? (Rs. Per month)</td></tr>
</table>

   b. If No, why? For what other purposes kerosene being used?

vi. What strategy do you think is required to eliminate use of Kerosene for lighting at the household level?

3. How has the SoUL (Program) impacted your life? Please tell us if it has helped in improving your over all living conditions?

   Probing Points

   i. How has it affected your child's education? (Please note down increase or decrease in study time including night & early morning/dawn, interest taken in studies or reading newspaper/other stuff, performance in school)
   ii. Do you think it provides a better environment for studying? How?
   iii. Has is it affected your ability to do household chores? How?
   iv. Is it contributing to livelihood activity and income generation? If yes, specify how?
   v. Has the purchase of lamps realized into economic savings for the households? How? (Probe: if saving in the electricity bill factors contributing to it)
   vi. Any impact on health? If yes, specify how?

4. What do think of the performance of SoUL?

   Probing Points

   i. How many hours do you charge SoUL?
   ii. How is the performance of the SoUL? (If satisfied (expectations - requirement of light for no. of hours), why? If not satisfied, what are the reasons? If any problems with the working of SoUL, what did you do to resolve it – did you open/repaired it yourselves or approached anyone/ SoUL Repair Centre (SRC) specify).
   iii. Do you have any feedback about the design of the SoUL (compact, use friendly, any additions, improvement)? Any suggestions in this regard.

5. What are the energy related needs of the households (no. of rooms, no. of hours) that could be addressed through solar technology? (Probing points: requirement, expectation) If there are no needs, why?

6. How do you think can solar technology be disseminated and promoted in rural areas?

Annexure 5.2: KII- PDS

Name:

Village:

Gram Panchayat:

Registration Number:

Number of Villages Covered				
Total Distribution Quota				
Total Number of Registered Families				
Number of Card Holders	APL	BPL	Antyodaya Yojana (AAY)	Others (If Any)
Kerosene Quota as per card holder				
Per month received in litres (as per rules)	APL	BPL	Antyodaya Yojana (AAY)	Others (If Any)

Annexure 5.3: KII- Sarpanch/Knowledgeable Person

1. What is the kerosene usage pattern of households in the village?

Probing Points:

a. What are the major uses (domestic/ commercial)?

b. What are the minor uses (domestic/ commercial)?

c. If kerosene falls short, what do they generally do?

d. If kerosene is surplus, what do they generally do?

2. From where is kerosene purchased and how?

Probing Points:

a. What is the typical PDS allotment (litres per month) for BPL, APL and Antyoday; and price (Rs per litre)?

b. Does the PDS shop sell kerosene throughout the month, on certain days or only one day in a month?

c. Does everyone receive the allotted PDS kerosene? Are there any discrepancies or grievances (eg. Information regarding availability at PDS, how far do they have to travel and how long they have to wait)?

d. Where is the kerosene available in the market (if not in the village, how far) and at what price?

e. Is it available in shops or sold by hawkers?

3. Where is kerosene sold by the households and how?

Probing Points:

a. Is it sold within the village to other households directly or to a shop?

b. Is it sold outside the village?

c. What are the costs involved in sale of kerosene?

4.What are your perception/opinion about SoUL project (about implementation process, any improvement required, employment generated, utility)?

5. What is your view on adaptation solar technology in your village (Probe: people liked/satisfied with it, expectation met/not, willingness to purchase)

Annexure 5.4: KII- School Teachers

1. When the SoUL lamps were distributed through your school, what role did you play in the project?

2. How was the response of the students in your school w.r.t. to purchasing of SoUL? (probe: ratio of students purchasing and not purchasing, reasons noticed by you for not purchasing)
3. After purchasing the SoUL, have you noticed any change in behavior and general performance of the students? If yes, how did you come to know about it?

   Probing Points:

   a. Whether students/parents shared that they are studying by using the lamp in the night? Whether it reflects in: attendance, home work, marks or classroom interaction/activity?
   b. Is there any difference between performance of female students and male students? If yes, describe the difference and also the reasons behind it.
4. What is your opinion about the SoUL project?

Annexure 5.5: Village Level Information

Village Level Information					
Date			Name of interviewer		
Month & year of SoUL distribution					
A. Interviewee Details					
A1	Name of the respondent/s				
A2	Designation				
B. Location Details					
B1	Name of village		B2	Gram Panchayat	
B3	Block/ Taluka/ Tehsil		B4	District	
B5	State		B6	Distance from district/state/national highway (km)	
B7	No. & names of hamlet				
B8	Geographical characteristics (hills, plains etc.)				

B7	Is it a forest village?	□ Yes	□ No

C. Population	
C1. Population of the village	
C2. Number of households in the village	
C3. Main Religion (in terms of HHs)	
C4. Main caste (in terms of HHs)	
C5. Majority type of card holders (BPL, APL, Antyodaya)	
D. Sanitation & Electricity	
D1. No. of households with Open Defecation practice	
D2. Number of electrified households	

E. Education (within village or if outside specify distance)					
Level	**Within Village/Outside Village**	**Distance**	**Level**	**Within Village/Outside Village**	**Distance**
Primary (Class I to V)			Class XI & XII		
Class VI to VII			Graduation		
Class VII to X					

F.	Occupation (main livelihood source) and Migration details			
F1	Agriculture	Yes	No	Comment:
	Main crops			
	Irrigation if available what is water source & electricity used for pumping water			
F2	Farm labour	Yes	No	Comment:
F3	Non farm labour (specify nature)	Yes	No	Comment:

F4	Type of migration	Permanent		Seasonal	
F5	Number of households migrating				

F6	No. of Households migrating with children who are in the school-going age			
F. Infrastructure and Services				
S. No	Type	Distance	Common mode of transport	If not in this village, specify the village in which it is located
F1	Transport facility		Frequency	
F2	PHC			
F3	PDS (Ration Shop)			
F4	Nearest market for Kerosene			
F5	Nearest market for electronic devices			
F6	Mobile Repair Shop			
F7	SoUL Repair centre (SCR)			
G. Solar Energy Project other than Million SoUL				
G1	Nature of project & no. of beneficiaries (subsidy & contribution)			
G2	Year of implementation & implementation agency			
G3	Devices: working & not working			
G4	Perceptions about the project (satisfied/not & reasons)			