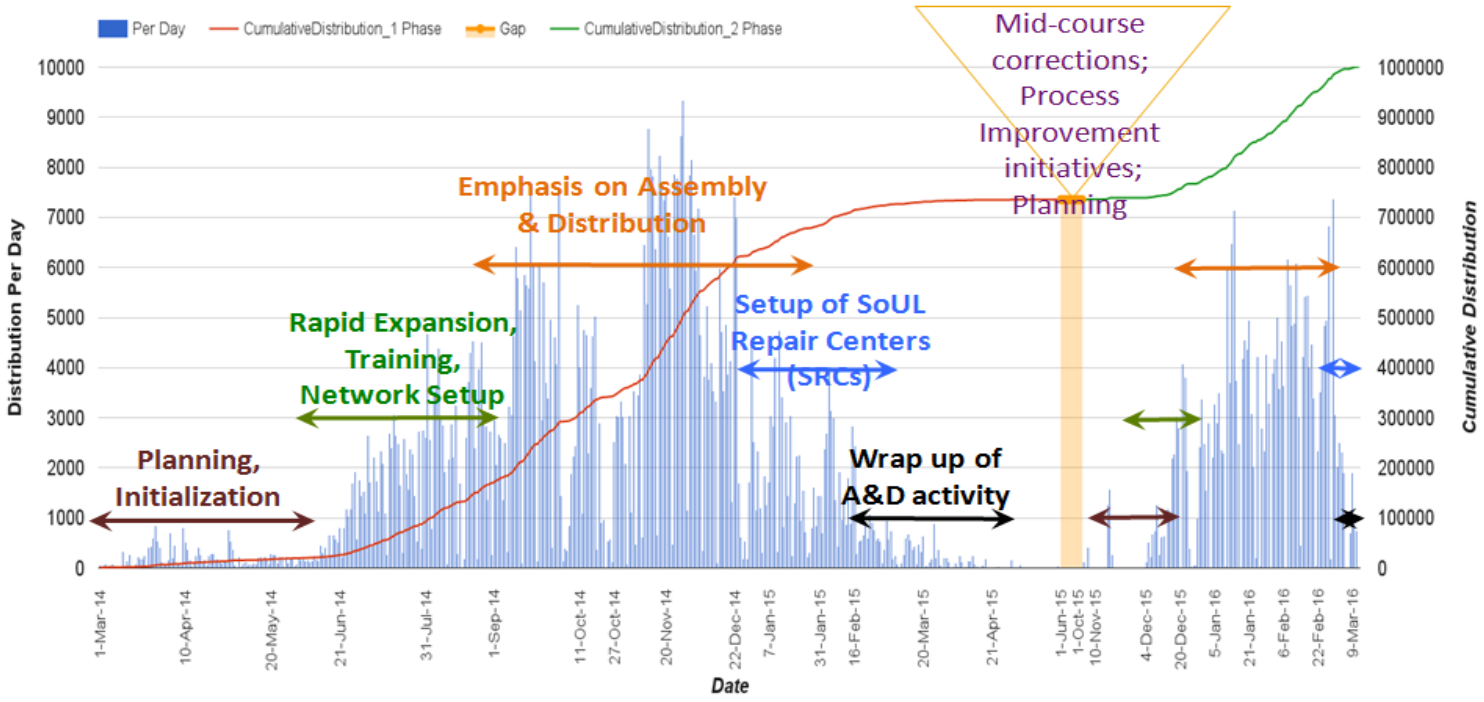
Localization of Solar Energy through Local Assembly, Sale and Usage of 1 Million Solar Study Lamps

Project Completion Report (January 2014 – March 2016)



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January 2014 – March 2016

Indian Institute of Technology Bombay

May 2016

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1. Project Information

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

MNRE Sanction order No & date: Sanction letter No. 32/1/2013-14/PVSE (Part-III) dated 23rd January, 2014. However, project started based on IMG office Memorandum dated 25th June, 2013 and subsequent authorization letter dated 7th August, 2013 (Ref no. 32/49/2012-13/PVSE) from MNRE to commence the project.

Name and complete address of PIs:

1. Prof. Chetan Singh Solanki, Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Powai, Mumbai 400076
2. Prof. N. C. Narayanan, Centre for Technology Alternatives for Rural Areas (CTARA), Indian Institute of Technology Bombay, Powai, Mumbai 400076

Name and complete address of co-PI:

1. Prof. Jayendran Venkateswaran, Industrial Engineering and Operation Research, Institute of Technology Bombay, Powai, Mumbai 400076

Date of start and completion of the project: January, 2014 to March, 2016.

Approved project budget: Rs. 18 crore

Total funds released by MNRE: Rs. 12.60 crores

2. Summary

India has one of the youngest populations in the world, with 350 million children less than 14 years of age. School education is thus essential for the future of the country. However, 7.8 crore families are still using kerosene as the primary source of lighting. Many young students going to schools either do not have access to alternate light source or suffer from erratic supply of electricity, both of which affects their study during evening hours. In order to provide light for 4 hours every evening for study purposes requires only 0.7 kWh of electricity per year! Thus as a solution, IIT Bombay launched a program called Million SoUL Program with an aim to distribute one million solar study lamp to school going children. The objective of the Million SoUL program is to **provide clean light for study purpose to each and every child in the country, in the fastest possible way and in the most cost-effective manner**.

The countrywide large-scale solar lamp program must address, simultaneously, the issues of *Scale*, *Speed* and *Skill*. IIT Bombay has developed one such model, the **Million Solar Urja Lamp (SoUL) Program** that focuses on the **localization of solar energy**. In this model, local people are engaged in assembly distribution and maintenance of the solar lamp. In order to achieve *scale*, the model is designed such that it can be replicated in multiple blocks, across districts and states in parallel. To achieve *speed*, assembly and distribution in any intervention block is defined to be completed in 90 days. In order to target *skill development*, rural people are trained in the assembling, distribution and repair of these lamps in their local areas.

The **Million SoUL Program (MSP)** developed by IIT Bombay has clearly **demonstrated the required scale, speed and skill to expand this program for the entire country**. The MSP has integrated IIT Bombay's technical expertise in solar lamp technology, operations and concurrent evaluation, and impact analysis. IIT Bombay is the central coordinating agency for this project. Assembly-cum-distribution centers are established at the block level, in the premises of partnering NGOs. Locals from the block are hired and trained to assemble quality solar lamps and to campaign and distribute the lamps to the target beneficiaries (i.e. the school students). The components for assembling the lamps are sourced from 4 different vendors, and supplied directly to the assembly centers. At the centers, components are assembled into Solar Urja Lamps (SoUL). The quality of the lamp is ensured through rigorous testing, both before and after assembly. SoULs are then sold at subsidized cost to students through their schools with an aim to saturate each block by selling one lamp per school child. Saturation is defined as providing solar lamp to minimum of 75% of enrolled student in intervention blocks. Basic information about every beneficiary is recorded. Further, SoUL Repair Centers (SRCs) are set up in the blocks to ensure the long term use of the lamps and sustainability of this initiative.

One million SoULs have been distributed in the states of Madhya Pradesh, Maharashtra, Rajasthan and Orissa, covering 23 districts, 97 blocks and more than 10,900 villages. There are 54 assembly and distribution centers and 350 SRCs in operation, with 1800 trained manpower. MSP has focused on reaching most marginalized population, as amongst its intervention blocks 77 percent is tribal blocks, while 83 percent are educationally backward blocks.

The impact analysis of MSP reveals that the study lamps have replaced one kerosene wick lamp in beneficiary households, thus contributing to saving in usage of kerosene for lighting. Besides its usage for study purpose, it has proved as an aid in various activities like domestic activities (like cooking, washing utensils etc.); carrying out livelihood activities (like irrigating farms during night, plucking flowers during early morning hours, in grocery shops etc.) and mobility during the dark hours and emergencies like taking patients to the hospital, etc.

Millions of school going children is still devoid of clean lighting for studying. With Million SoUL Program, IIT Bombay has provided a pathway to build a sustainable model of solar lamp distribution rural school going children in India. This will essentially ensure seeding and creating a market for other solar products.

3. Introduction

3.1. India: A 'Young' Country

India, as per Census 2011, is a young country with a population of 1.2 billion. Of this, 29.7 percent of the population is below 14 years of age (which is more than 360 million, in numbers), and more than 65 percent is under 35 years of age.

According to Census 2011, the population of India increased from 1.02 billion in 2001 to 1.2 billion in 2011 (see Table 1), which is an increase of about 182 million during the decade 2001-2011. In this decade 2001-2011, the growth (rate) is 17.64 percent with an annual average exponential increase of 1.64 percentage points. The decadal increase in the age group 0-14 years is 2.43 percent; while for 15 years and above, it is 25.92 percent (see Table 2). The net addition has increased over each decade in the last 50 years, with the exception of 2001-2011, where there was a small decline as compared to the previous years. Subsequently, the pace of net addition has been consistently declining (see Table 1). Over 363 million people (30 percent) of the entire population were between the age group 0-14 year during 2011, as compared to a little over 372 million (35 percent) in 2001. 273 million people (37.16 percent) belonging to the rural population were represented in the 0-14 age group in 2001, which constituted over 275 million (32.81 percent) of the total rural population of 742 million in 2011. The population pyramid clearly indicates that a large percentage of population is still below 14 years of age in both genders (see Figure 1).

Table 1: India's population and its growth 1951-2011 (Source: Census 2011)

Year	Population	Decadal Growth		Annual Avg. Exponential Growth
		Absolute	Percent	
1951	361,088,090	42,420,485	13.31	1.25
1961	439,234,771	77,682,873	21.51	1.96
1971	548,159,652	108,924,881	24.80	2.20
1981	683,329,097	135,169,445	24.66	2.22
1991	846,421,039	163,091,942	23.87	2.16
2001	1,028,737,436	182,316,397	21.54	1.97
2011	1,210,854,977	182,117,541	17.64	1.64

Table 2: Percentage change in age group wise population (Source: Census 2011)

Age Group	2001	2011	Change (percent)
0-14	363,610,812	372,444,116	2.43
15 and above	662,261,044	833,921,059	25.92
Total	1,028,610,328	1,210,854,977	17.64

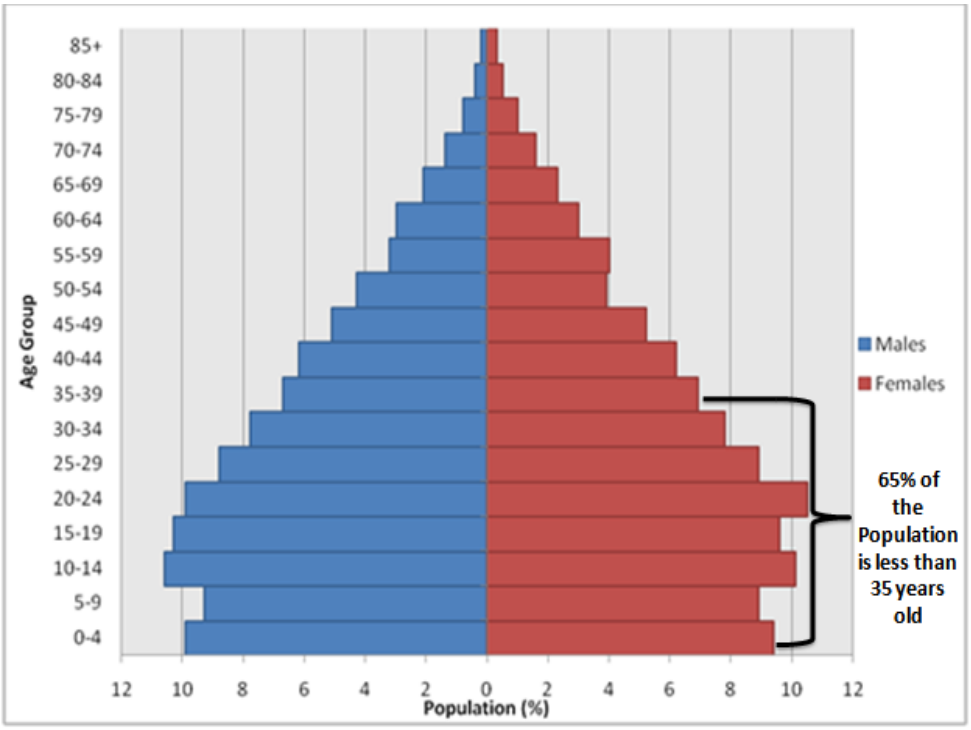


Figure 1: Population Pyramid of India in 2011 (Source: Census 2011)

The population measures indicate that India is a country with a large youth population. For its own, and by extension, the nation's growth, efforts must be made to educate and train this young population well. It has been argued that this young population could be of advantage to the country and can be considered a **"population dividend"**; while, if not properly nurtured, it could become a liability and result in "population disaster" in the nation.[1]

A key need to ensure the wellbeing of the population is its access to energy. Various studies conducted by the United Nations have shown that a greater access to energy leads to better education, increased income and better health. India's energy demands are growing due to its economic growth (6 to 8 percent) and population growth (1.34 percent). It is necessary,

[1]Nilekani, Nandan. *Imagining India: Ideas for a New Century* (Penguin Books, 2009; ISBN- 13: 978-0143116677)

therefore, to factor these needs into the implementation of programs for the nation's development.

3.2. The Energy Scenario – Gap between Demand and Supply in India

According to the United Nation's Human Development Index (HDI), which is a good indicator of the Health, Education and Income status of citizens in a country, a higher consumption of energy in general, and electricity in particular, results in a better HDI. A higher value of HDI is therefore desirable for a nation. The HDIs of several countries, developing as well as developed, are shown in Figure 2 as a function of electricity consumption. 80 percent of the world's population still has an HDI of less than 0.8, and most of these people live in developing countries.

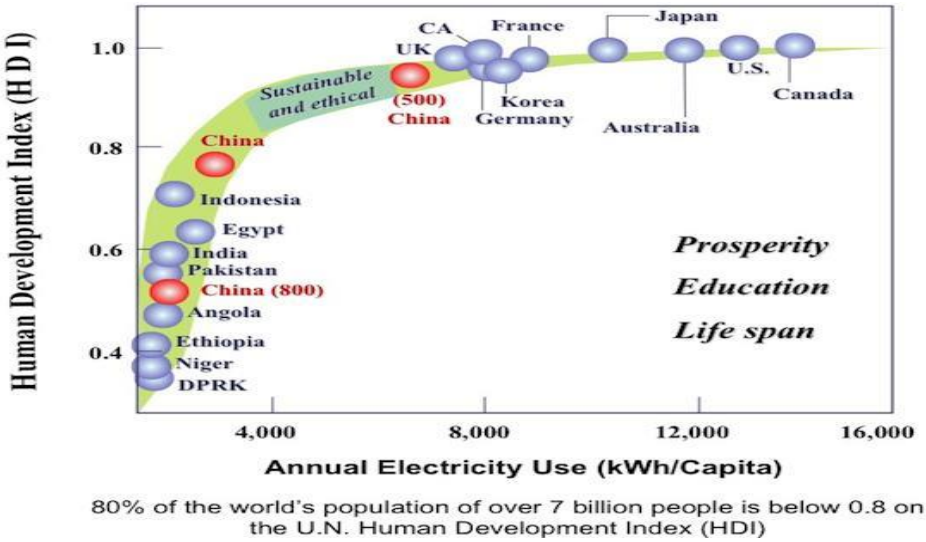


Figure 2: UN HDI and per capita annual electricity consumption (Source: forbes.com)

From the UN HDI (see Figure 2), it is evident that to live in reasonable comfort, an annual consumption of about 3000 to 4000 units (kWh) of electricity per capita is required. The world average consumption is around 2700 units per year per capita. The total capacity of India's power plants is around 280,000 MW, as seen in Table 3, with an annual electricity generation capacity of about 1050 billion units[2] in 2014. This leads us to a figure averaging 850 units of electricity available per person per year. However, it is to be noted that the access to, and availability of, electricity is not uniform across the country. Rural areas in most states get a much smaller amount of electricity, in the range of 100 to 200 units per person per year. To quote an instance, in 2013-14, the average electricity consumption per year per person in entire Bihar was about 97 units, while in Uttar Pradesh it was about 318 units and in Assam, about 175 units.

To ensure that every Indian citizen is provided an average of 3000 units of electricity per year (which approaches the world average and the HDI of above 0.7); it is necessary to install

[2] Source: Ministry of Power(www.powermin.nic.in), Last updated on 23rd November 2015

power plants with capacities of about 850,000 MW. Moving from the current installed capacity of 280,000 MW to 850,000 MW is a huge task. Achieving this target will require:

1. A very *large amount of fossil fuel resources***,** since currently more than 80 percent of India's electricity is generated using fossil fuels
2. A *huge amount of investment*
3. A very *long time*

Table 3: Power generation capacity in India, 2015 (Source: Ministry of Power)

Power Plant	**MW**	**Percentage**
Total Thermal (Coal: 60%, Gas: 9%, Oil: 0.7%)	1,95,604	69.80
Hydro	42,473	15.20
Nuclear	5,780	2.10
Renewable Energy	36,471	13.00
Total Current Capacity	**2,80,328**	**100.00**

India is not rich in terms of its fossil fuel resources. Though our country has 17 percent of the world population, it has only 6.8 percent of the world's coal reserves, 0.3 percent of the world's oil reserves and 0.7 percent of the world's gas reserves[3]. It is to be noted that the fossil fuel resources worldwide are depleting. For replenishment, the investments for setting up a 1 MW plant costs, on an average, about Rs. 4 to 5 Crore for a coal power plant, and Rs. 6 to 8 Crore for hydro and nuclear power plants. Evidently, moving from 260,000 MW to 850,000 MW will require a huge amount of investment.

Further, if we consider the current state of the young population in the country, the third factor, that is the time to provide desired electricity to every citizen through conventional efforts, is critical. Setting up a coal, hydro or nuclear power plant will take between 4 to 8 years. Despite a high installation of power plants, it will be difficult to guarantee electricity to every citizen. Consider, for instance, the Census of India 2011, which notes that there are 78 million households who use kerosene as their main source of lighting, particularly in remote rural areas, which do not receive electricity for basic needs, despite operational grid power.

For the financial year 2011-12, the per capita total consumption in India was estimated to be 883.63 kWh/year.[4] Despite the Eleventh Five Year Plan that created nearly 55,000 MW of new generation capacity, there continues to be an overall energy deficit of 8.7 per cent and a peak shortage of 9.0 per cent. Resources currently allocated to energy supply are not

[3] Source: www.bp.com
[4] Central Electricity Authority, Monthly Reports, February 2014 http://www.cea.nic.in/reports/monthly/executive_rep/feb14.pdf

sufficient for narrowing the gap between energy needs and energy availability.[5] Therefore, there is an inevitable time lag between electricity requirements and electricity generation. Setting up a power plant is characterized by a gestation period, and a child who is currently in school and in need of electricity will have to wait long for an energy solution to reach him/her.

Figure 3 below shows the inter-country comparison of the per capita electricity consumption for the year 2012-13. As can be seen, India's per capita electricity consumption is far less than that of World average, which highlights the need for concerted efforts in this sector.

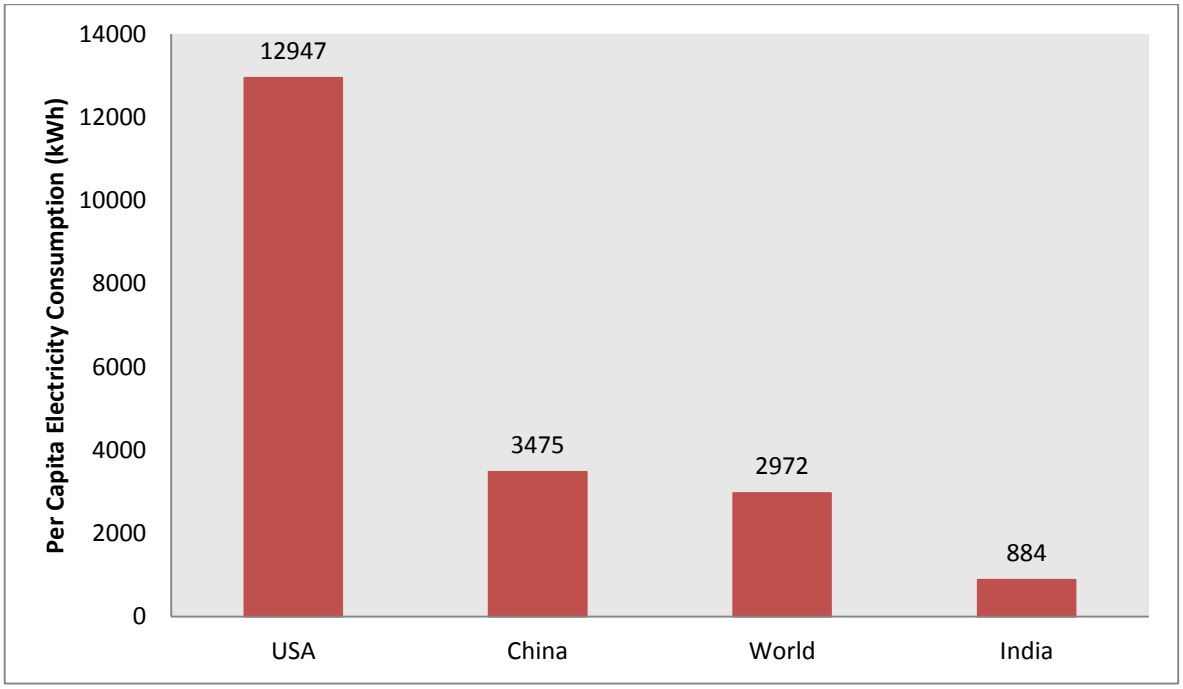


Figure 3: The per capita electricity consumption for some selected countries and world average for the year 2012-13 (Source: Central Electricity Authority, April 2015)

3.3. Kerosene Usage

Kerosene dependency has been a major issue for policy makers in the country. According to the 68th round of the National Sample Survey Organization, it has emerged that though hardly any kerosene is used in the kitchens of rural households, it remains a key source fuel for lighting lamps and lanterns in rural areas, particularly when the electricity has not reached them or when there are disruptions in power connections. It was seen that in rural areas, per capita kerosene consumption was 430 ml (0.431L).[6] It was also noted that 756 households per 1000 households were using kerosene in rural India. The highest consumption was found in Bihar, where 73.5 percent of the households used kerosene to provide light. Uttar Pradesh was the second highest where 58.5 percent of the households used kerosene as their primary

[5] Ministry of Statistics and Programme Implementation, Energy Statistics 2013 http://mospi.nic.in/mospi_new/upload/Energy_Statistics_2013.pdf

[6] National Sample Survey Organization (NSSO), 68th Round (http://mospi.nic.in/Mospi_New/upload/Report_no558_rou68_30june14.pdf)

source of lighting. Though the overall use of kerosene for lighting may have declined, the problem is still tenacious in the most deprived parts of India.

3.4. Enrollment in Schools: Urban and Rural

Following independence, policy makers viewed education as a tool for social change in the country. They had always placed special emphasis on improving rural education, since most of the Indian population resides in rural areas. A substantiation of the efforts in the education sector can be clearly seen in the increasing enrolment rates in schools. According to the data issued by the Ministry of Human Resource Development, the Gross Enrollment Ratio in India has increased from 32.1 percent in 1950-51 to 97.4 percent in 2011-12, for the age group 6-14 years.

Similar trends can be seen across rural and urban areas. The following graphs (Figure 4 and 5) shows the area-wise trends in enrolment (rural and urban) since 2002-03. As one can observe from the graph, the maximum increase in enrolment has happened in rural areas. According to the latest estimates (2013-14) of District Information for School Education (DISE)[7], more than 258 million students have enrolled in classes between I to XII all over India. Of these students, 189 million students, a substantial proportion of the total enrolment, are enrolled in rural areas.

Figure 5 shows the share of rural enrolment in total enrolment. For each of the years, more than 70 percent of the students enrolled in this period were from the rural areas. These children lack the access to the basic facilities and opportunities as compared to their urban counterparts. Hence, NaSSoLiM targets the rural young population of the country as the principal beneficiaries of the program.

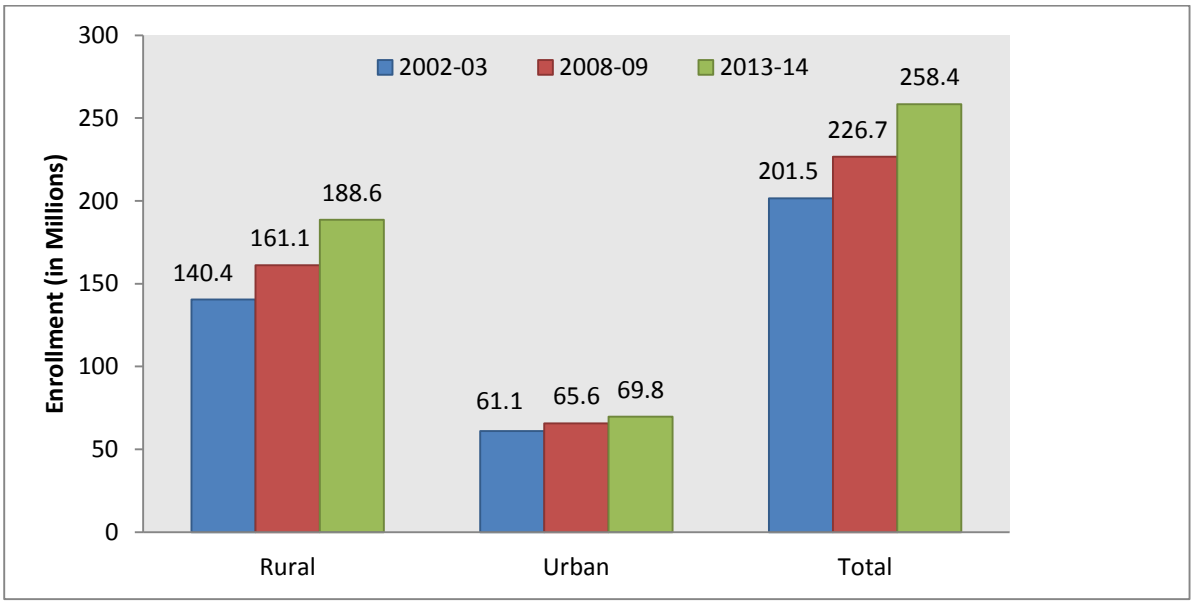


Figure 4: School enrolment (in millions) in rural and urban areas, over the last decade

[7] District Information System for Education
website: http://www.dise.in/

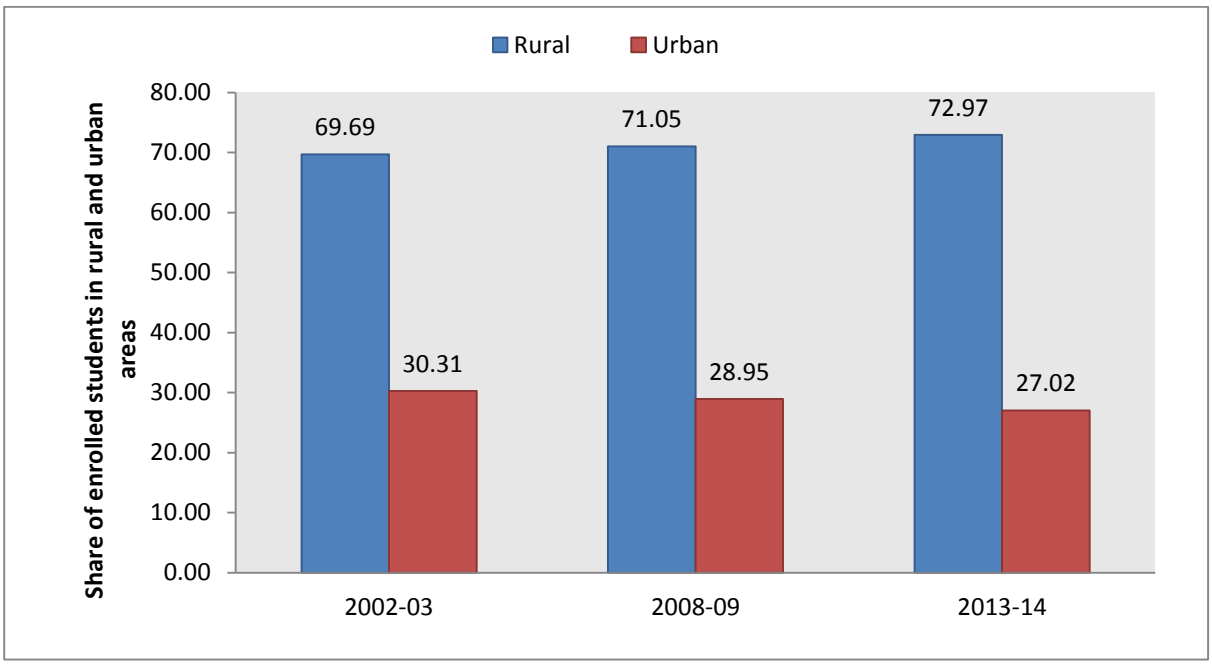


Figure 5: School enrolment (in percentage) in rural and urban areas

3.5. Education and skills required for economic growth

Education has long been viewed as an important determinant for economic well-being. As Mankiw[8] argues in the augmented neoclassical growth theory, education can increase the human capital inherent in the labor force, which increases labor productivity and thus transitional growth towards a higher equilibrium level of output. A country's competitiveness in an era of globalization depends on the strength of its economy. It is evident that countries with higher and better levels of education and skills will adjust to a globalized world more effectively than countries that lack these resources. In India, skill development would be critical in not only achieving faster, sustainable and inclusive growth, but will also help in providing decent employment to the growing young population. Education and skill development go hand in hand and, if imparted effectively, will further help economic growth.

3.6. Grid Electricity for Study: Not an Immediate Solution

Even though many concerted efforts have been made by the government to provide grid electricity to rural households in India, its feasibility as a quick and efficient solution remains doubtful. This is because not only does grid-based electricity involve a huge investment by the government, but also because geographical conditions may, at times, not permit the laying of grids. With the isolated and scattered nature of most rural households, transportation of materials, equipment and machinery become difficult due to the lack of accessible roads in remote areas. Further, maintaining the grids in these remote areas is cumbersome and incurs tremendous cost. Under the latest government scheme, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), a total of 112,228 villages were covered by March 2013, where electrification was done, thereby certifying them as 'Electrified Villages'. However,

[8]G. N. Mankiw, D. Romer, and D. N. Weil.A contribution to the empirics of economic growth. Quarterly Journal of Economics, 107(2):407–437, May 1992.

with the threshold for deeming a village electrified being set at 10 percent households[9] per village. Several rural homes across the country that have been certified fully electrified through grid-based transmission persist without electricity. Hence, grid electricity may not offer a viable solution to solving problems pertaining to electrification. Moreover, the electricity that is generated is used to cater to the ever-growing needs of urban areas, leaving a negligible amount for rural areas.

3.7. Solution Growth Rate need to Exceed Problem Growth Rate

India's population is currently growing at the rate of 1.34 percent, which means that in a country of 1.25 billion; about 16.75 million children are added every year. With 60 percent of this population living in rural areas, about 10 million children are born in villages annually. According to the Census 2011, since more than 35 percent of rural households use kerosene for lighting purpose, there is a need to provide at least 5.80 million solar lamps every year. This number will barely meet the needs of newborn children, who will eventually join the numbers of children attending schools in a few years. However, if we want to ensure that every school going student gets clean study light, then the number of solar lamps required every year is much higher. This rough calculation emphasizes that in order to completely replace kerosene lamps with solar lamps across India for the economic and social reasons listed above, the growth rate of the solution has to be faster than the growth rate of the problem.

There is, therefore, IIT Bombay initiated Million SoUL Program with aim of distributing one million solar study lamps to help children study in clean lighting environment.

[9] According to Electricity Amendment Act, 2005, a village is declared electrified if:
i) Basic infrastructure such as distribution transformer and distribution lines are provided in the inhabited locality as well as dalit basti / hamlet where it exists.
ii) Electricity is provided to public places like schools, panchayat office, health centre, dispensaries, community centres etc. and
iii) The number of households electrified should be at least 10 percent of the total number of households in the village
iv) Mandatory certification from Gram Panchayat regarding the completion of village electrification should be obtained.

4. Million Solar Urja Lamp (SoUL) Program

The Million Solar Urja Lamp (SoUL) Program (hereafter MSP) was initiated in June 2013 by Indian Institute of Technology Bombay (IIT Bombay).

4.1. Objective of the Project

The specific objectives of the project are:

- Localization in assembly, distribution and service of high quality study lamps
- Distribution of 1 Million SoULs to 1 Million students in rural India through the model of block saturation, in a time bound manner
- Develop a sustainable social entrepreneurship model in remote backward blocks

4.2. Concepts

4.2.1. Localization

Localization is envisaged as the backbone of this initiative as most of the other initiatives have either failed or yielded limited success due to their limitations in building local dependent systems. Localization represents local harnessing of solar energy, local assembly of the lamp, a local distribution network and locally available after-sales services. In doing so, the IIT Bombay attempted to transfer the basic know-how of solar PV technology by imparting systematic trainings to local people, men as well as women, for assembling components of the lamp locally. Also, local people were trained as service repair centre managers to provide repair and maintenance service to the beneficiary.

4.2.2. Affordability

Affordability is an important dimension that hinders the diffusion and upscaling of solar energy in developing countries. The objective of reaching every school-going rural child demanded to set the cost within the reach of even the poorest households. Furthermore, the principle of affordability is linked to the economic-financial viability of the program. Financial viability includes both purchasing capacity of the target beneficiaries as well as cost of solar study lamp is being made available including its after-sales service cost.

The cost of project was divided into three parts: first, through subsidy from Ministry of New and Renewable Energy (MNRE), second, raising funds from philanthropic agencies and third, beneficiary contribution. In order to ensure ‘affordability’ of the lamp by poor households, the beneficiary contribution was determined at INR 120 (approximately US$ 1.79), considering the average daily wage earned by an individual employed under the Government of India's Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) scheme. MNRE guaranteed INR 180 as a subsidy component while rest INR 200 was raised through partnering with philanthropic organizations (see details in section 4.3.2.).

4.2.3. Saturation

In order to address the challenge of speedy upscaling of solar lamp for deeper penetration as well as geographical spread, saturation as a design principle of the model was applied in the program. It has both characteristics, of concentration in a single location and spread across

wider scale in terms of geography through sub-districts. Saturation principle had certain attributes such as: concentrated intervention in one location, predetermined target to achieve, replicability at multiple locations, and last, prioritizing the sub-districts having unfulfilled lighting needs. Saturation is defined as providing access to at least 75 percent of the enrolled students in each intervention sub-district. Saturation of blocks had three main objectives. Firstly, to reach maximum numbers of students so that they are assured of reliable clean light for study purpose. Secondly, to achieve economies of scale through creation of sound base of consumers (SoUL beneficiaries), which makes livelihood generation feasible at local level through technology transfer thus enabling assembly, distribution and provision of after-sales service. Thirdly, to seed rural market for solar technology that can be tapped for further spread of the solar technology.

4.3. Stakeholders of the project

4.3.1. Non-governmental Organizations (NGOs)

The partners in the program for assembly and distribution of lamps in rural areas are referred to as Institutional Partners (IPs). These included local rural organizations like NGOs. These NGOs were selected based on their outreach, credibility, infrastructure, staff and familiarity with the region. The chosen NGOs were established in their states and had considerable experience in implementing developmental work in the region. They had the necessary infrastructure and operational system in place to carry out medium and large-scale projects. Their knowledge of the local people, the culture, language and the region made implementation smoother. NGOs coordinated with IIT Bombay to train and empower the locals to assemble, distribute and to repair lamps in their respective blocks. Overall, 13 NGOs partnered with MSP to facilitate the implementation of the program at the block level. They are:

- Aga Khan Rural Support Programme (AKRSP),
- Ashagram Trust,
- BAIF Development Research Foundation,
- Centre for Advanced Research and Development (CARD),
- Foundation for Ecological Security (FES),
- Gramin Vikas Trust (GVT),
- Harsha Trust,
- Sahjeevan Samiti and
- Watershed Organization Trust (WOTR)

4.3.2. Funding Agency

The program was supported by Ministry of New and Renewable Energy (MNRE) of Govt. of India through National Clean Energy Fund (NCEF). MNRE provided INR 180 per lamp, which came across to INR 18 crores for the entire project. Along with principal promoter MNRE, mainly five philanthropic partners funded the program towards achieving the distribution of one million solar study lamps. The main philanthropic partners are:

- Sir Dorabji Tata Trust (SDTT),

- Idea Cellular (Aditya Birla Group),
- Larsen and Turbo (L&T),
- Government of Madhya Pradesh and
- Tata Motors Philanthropic partners

Philanthropic partners contributed INR 200 per lamp, which was into total INR 20 crore for MSP. Rest INR 120 per lamp was collected from student beneficiary as their contribution. As per financial arrangement, INR 180 came across from MNRE, INR 200 from philanthropic partners and INR 120 as beneficiary contribution (see Figure 6). The total cost of each solar study lamp was INR 500 which includes cost of components, tooling, training, assembly, logistics repair and maintenance and other overheads.

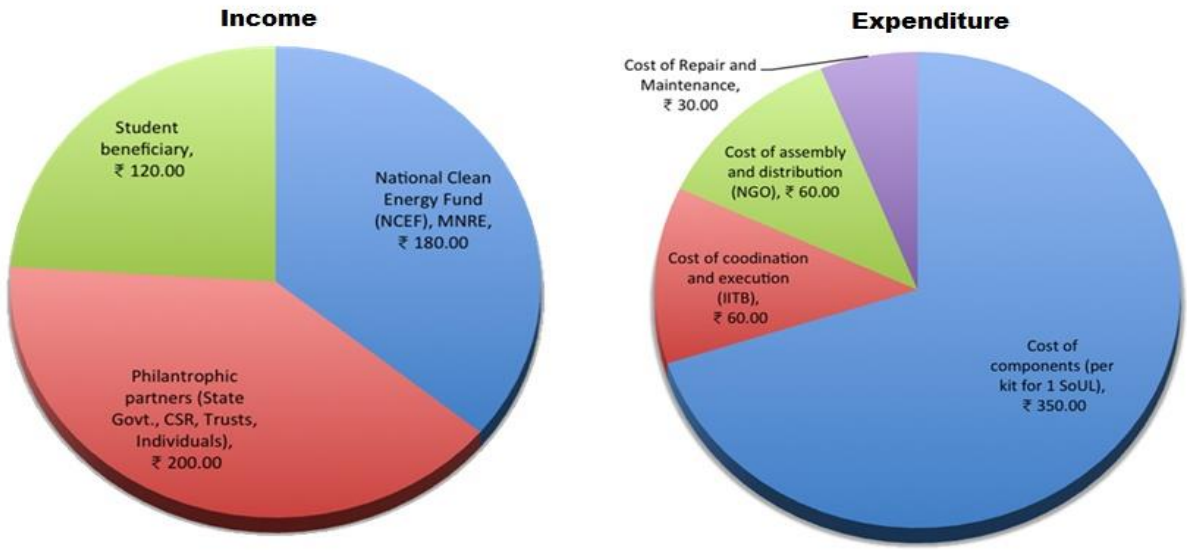


Figure 6: Funding and Expenditure structure of MSP

4.3.3. Vendors

The SoUL is assembled in rural areas for which the components of the lamp are procured from manufacturers. The manufacturers of SoUL kits were selected through tender process under fixed rate contract. A Draft Request for Proposal (DRFP) is made and advertised for inviting prospective manufacturers to the project. Technical Evaluation committee shortlists manufacturers based on technical aspects. Shortlisted manufacturers meeting the technical specifications are forwarded for financial bids. The manufacturers meeting both the technical and financial bids are awarded Annual Rate Contract (ARC). Purchase Orders (PO) are issued to vendors under ARC in staggered form based on requirement.

The manufacturer supply SoUL kits in Completely Knock Down (CKD) form i.e. fully disassembled solar lamp kits to NGO centre directly for assembling at the local level by rural community. This also helps in bringing in economies of scale by reducing the freight charges on the basis of space occupied by the SoUL and decentralizing supply chain.

In the initial tendering process held in July 2013 three vendors were selected. As the supply couldn't meet the peak demand period a re-tendering was done in May 2014. The re-tendering process was carried out to get more vendors under the uniform rate contract price of Rs. 350 per disassemble lamp kit. During, the process one more vendor qualified; which made the total number of vendors for lamp kits supply to four viz;

- Tata Power Solar Energy Ltd.,
- Thrive Solar Energy Pvt. Ltd.,
- Sirius Solar Energy Pvt. Ltd. and
- Gautam Solar Energy Ltd.

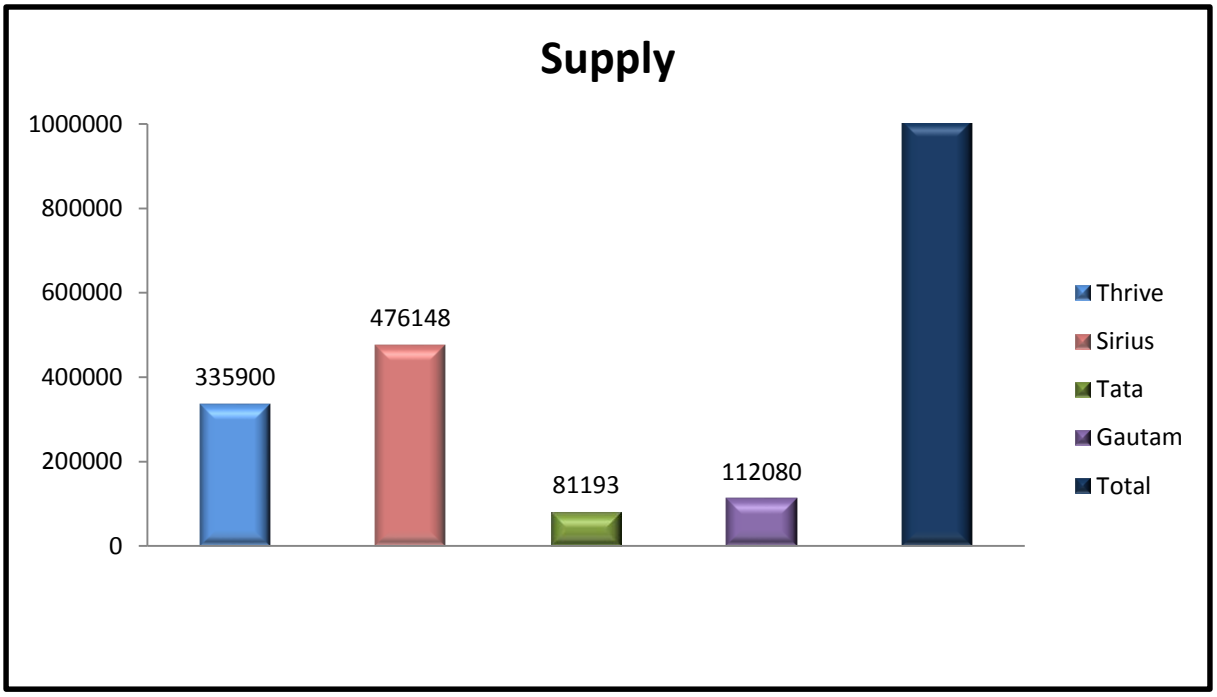


Figure 7: Supplier-wise material delivered

4.3.4 Community/Beneficiaries

Local communities are an integral stakeholder in MSP. Apart from being just recipient of SoUL (beneficiaries), local people were involved in assembly, distribution and after sales service provision process in MSP. Livelihood generation was important aspect of MSP, and hence local people were trained to assemble, distribute and provide after sales service for the lamp. Apart from livelihood generation, involving local communities through assembly, distribution and service repair centres also help generate communities' confidence on solar technology. Appropriate remuneration structure on piece rate basis was decided for the assembly and distribution (i.e. INR 10 for Assembler and INR 15 for distributor for each SoUL), while repair centre managers were given fixed salary of INR 2750 per month for their services.

5. Execution

5.1. MSP Executing Agencies

MSP is implemented by IIT Bombay and Institutional Partners in joint co-ordination. IITB plays the role anchor, while different IPs executes MSP at grassroot level. Figure 8 explains activities and roles each stakeholder executes in MSP.

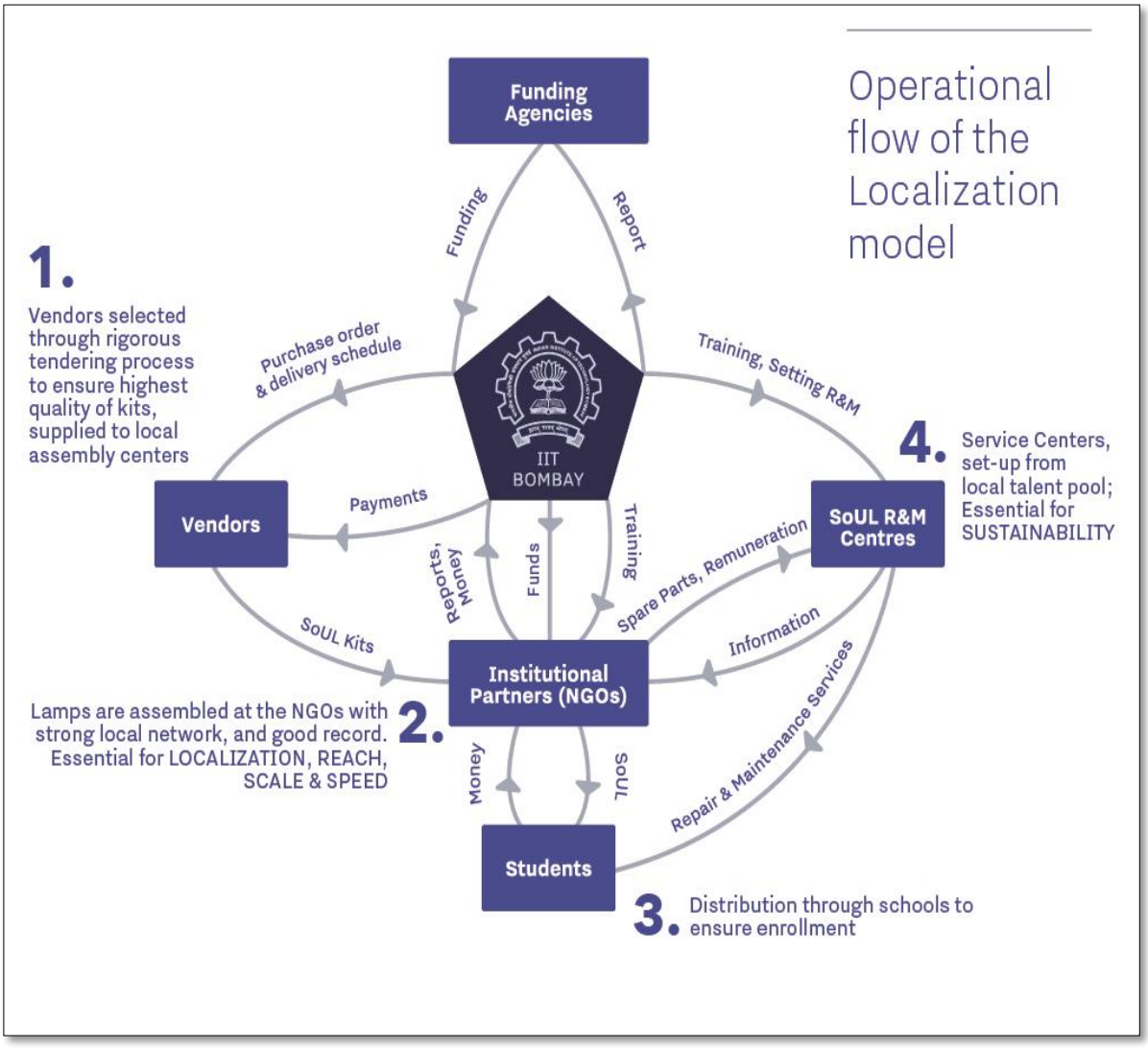


Figure 8: Operational Flow of the MSP

5.1.1. IIT Bombay as central coordinating agency

IIT Bombay played the crucial role in designing the model, providing knowledge-based support on the technological aspects of the lamp, and anchoring the entire program. It involved close coordination and monitoring of the entire implementation process from central office and field level personnel stationed with the NGOs for monitoring, handholding and support. As seen in figure 8, IIT Bombay co-ordinates with vendors and NGOs for establishing successful supply chain management. Similarly, it also provides technical

training to the local communities for assembly, distribution and after-sales service and management training to NGO partners for effective management of the program at local level. The typical sequence of operational activities, after the selection of the NGOs, is as follows:

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 by IIT Bombay to assemble and distribute the lamp at the center (Refer Technical Manual and Management Training Manual in Appendix),
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, and
iv. Campaigning and distribution of lamps is carried out at every school and every village in the block (Refer Chapter 6 of Management Training Manual in Appendix)

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.

IIT Bombay has 52 project staffs across four states to facilitate the implementation process of the program in four states. Figure 9 given below gives detail of staff under various profiles.

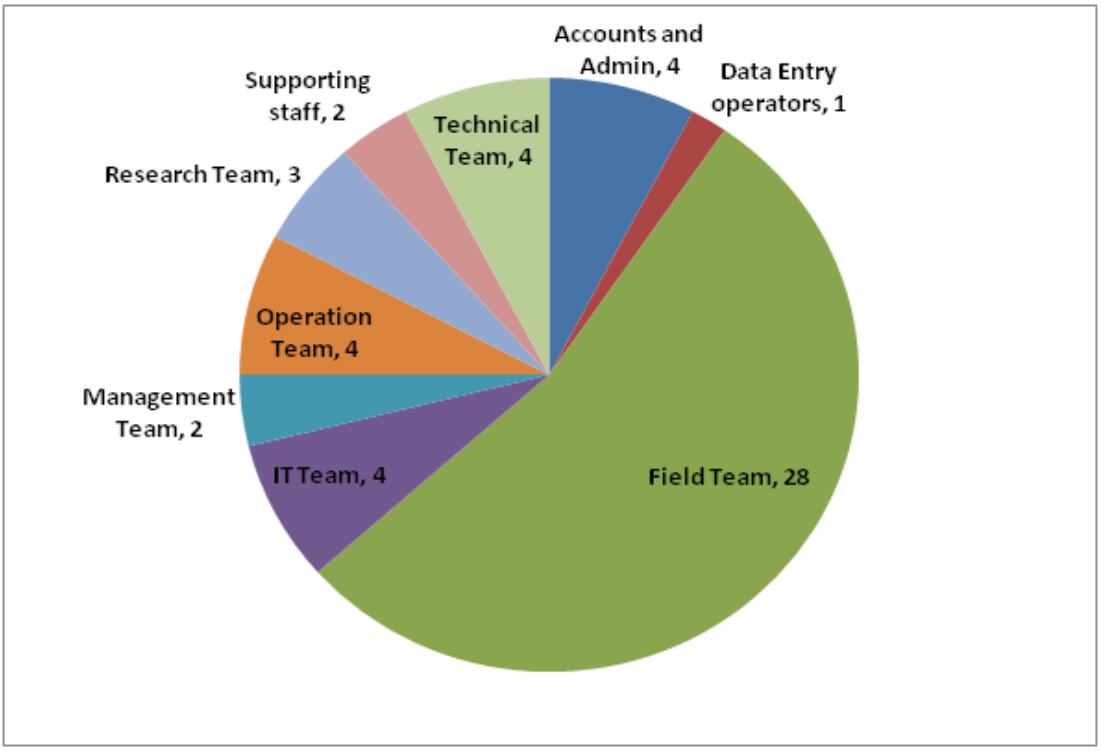


Figure 9: Manpower engaged in MSP

5.1.2. NGO as Implementation Partners

NGOs are local implementation partner of IIT Bombay. NGOs are responsible for successful assembly, distribution and repair and maintenance of SoUL in the implementation block. Multiple responsibilities are associated with NGOs. It particularly relates to identifying and selecting implementation blocks, providing necessary infrastructure like Assembly and Distribution centres (A&D Centres), appointing Project In-charge, hiring local people as assemblers and distributors, managing campaigning and distribution activities, maintaining records as per of distribution and payments, creating and managing Soul Repair Centres. Expected roles of NGOs are clearly communicated in Memorandum of Understanding (MoU) signed between IIT Bombay and NGO for creating accountability and transparency. There is constant interaction between IPs and IITB through Field Officers of IITB present at implementation block to facilitate smooth execution of the program.

5.2. MSP Field Implementation Process

Figure 10 depicts the timeline of activities carried during implementation of MSP. Implementation of MSP starts post identification of NGOs. Mainly, identifying blocks for implementation, establishing A&D centres and training of local people, campaigning, distribution, SRC set up. Figure 10 represents the time line of various activities carried during implementation of MSP. Initial months were spent towards partnering with NGOs and identification of blocks for implementation. Post identification, rapid expansion and training took place to set up A&D centres. Emphasis on assembly and distribution led to increased rate of assembly and distribution, which called for setting up of SoUL Repair Centres. Post mid course correction and process improvements, the target of 1 Million SoUL distribution was successfully completed in March 2016.

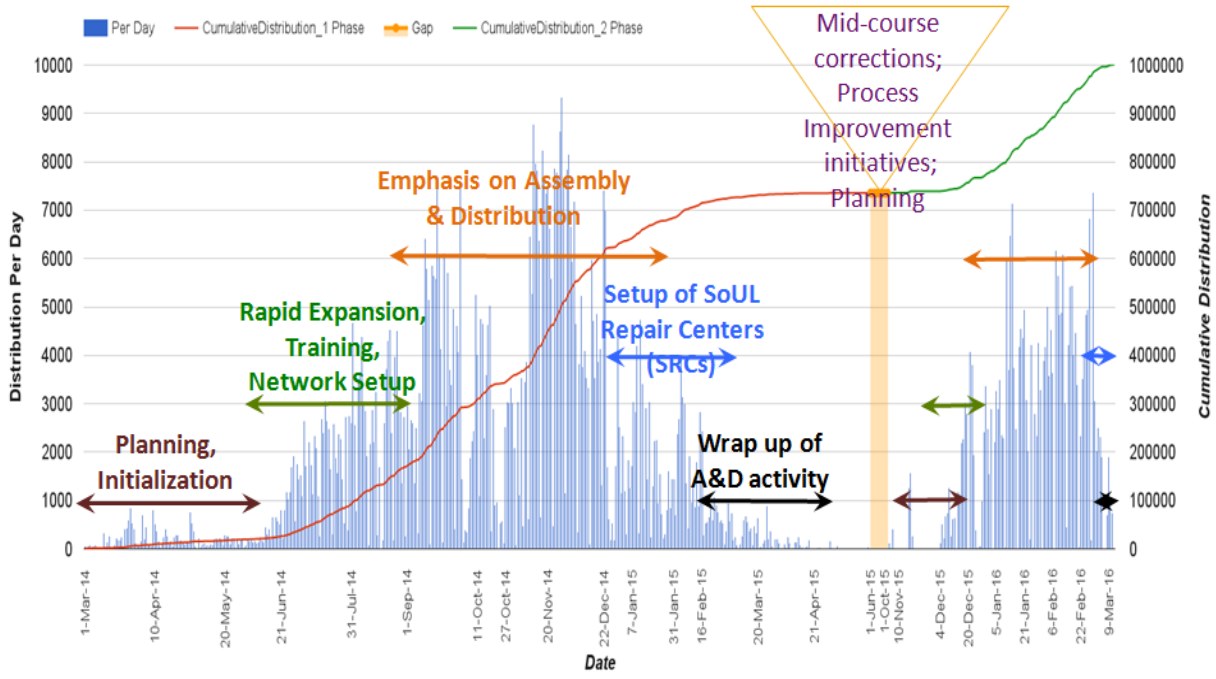


Figure 10: Timeline of MSP

5.2.1. Blocks selection

As the project was implemented at block level IPs were asked to identify possible implementation blocks based on two criterias, first, high kerosene consumption and second, tribal dominant population. Once, such blocks were identified, it was decided to implement MSP on lines of doability, i.e., where NGOs have good local presence to carry out implementation in speedy manner. Considering the above criterias, MSP was implemented in 97 blocks. Out of these implemented blocks, 77 are identified tribal blocks while 83 are listed as educationally backward block (EBB) by Ministry of Human Resource Department (MHRD).

5.2.2. Assembly and Distribution (A&D) Centres

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 (refer Figure 11). In short, an A&D center is at the heart of all the assembly and distribution process. Activities taking place at A&D centre includes - receiving, dispatching, storage, assembly, distribution and record keeping. 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.

Selection of 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.

A total of 54 Assembly and Distribution (A&D) centres across were established for implementation of MSP (see Figure 11 and Table 4 for details).

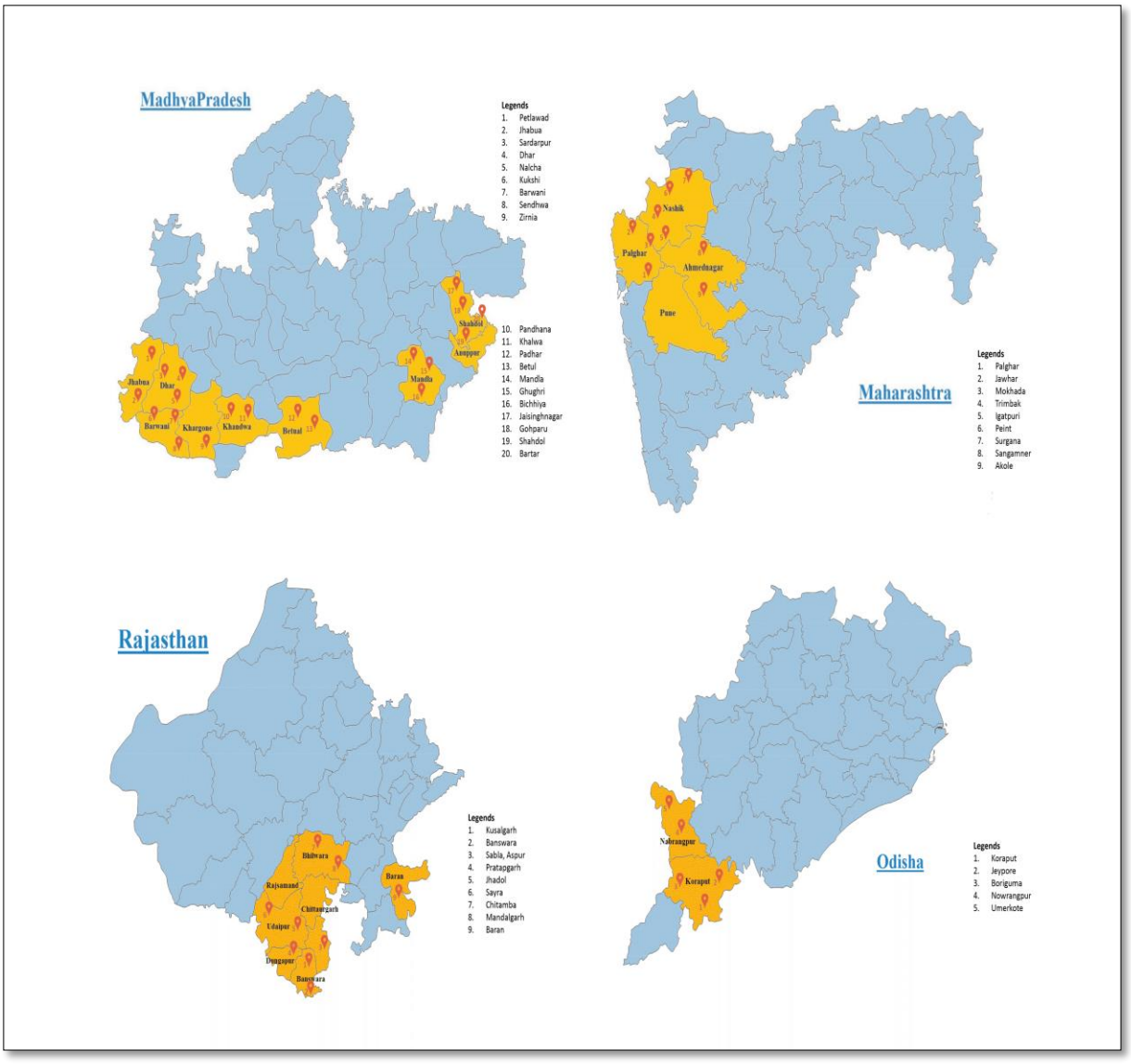


Figure 11: Location of Assembler & Distribution Centre

Table 4: Assembly and Distribution (A&D) Centre details state-wise

Sr.No.	State	Assembly & Distribution centre	District	Blocks
1	Maharashtra	Akole	Ahmednagar	Akole
2		Bhendipada (Mokhada)	Palghar	Mokhada
3		Igatpuri	Nashik	Igatpuri
4		Jawhar-joint	Palghar	Jawhar
			Palghar	Vikramgad
			Palghar	Wada
			Pune	Junnar
5		Palghar	Palghar	Palghar
6		Peint	Nashik	Peint
7		Sangamner	Ahmednagar	Sangamner
8		Surgana	Nashik	Surgana
9		Trimbakeshwar	Nashik	Trimbakeshwar
10	Rajasthan	Banswara-joint	Banswara	Bagidora
			Banswara	Talwara-Banswara
11		Baran-Joint	Baran	Kishanganj
			Baran	Baran
			Baran	Antah
12		Chitamba	Bhilwara	Mandal
13		Choti Sarvan	Banswara	Choti Sarvan
14		Garhi	Banswara	Garhi
15		Ghatol	Banswara	Ghatol
16		Jhadol	Udaipur	Jhadol

17		Kusalgarh	Banswara	Kusalgarh
18		Mandalgarh-joint	Chittaurgarh	Begun
			Bhilwara	Mandalgarh
19		Pipalkhoont	Pratapgarh	Pipalkhoont
20		Pratapgarh	Pratapgarh	Pratapgarh
21		Sabla	Dungarpur	Aaspur
22		Saira-joint	Udaipur	Gogunda
			Rajsamand	Kumbhalgarh
23	Madhya Pradesh	Balwadi (Sendhwa)	Barwani	Sendhwa
24		Bartar-joint	Shahdol	Burhar
			Annupur	Kotma
25		Barwani-joint	Barwani	Pati
			Barwani	Niwali
			Barwani	Barwani
26		Beohari	Shahdol	Beohari
27		Betul	Betul	Bhimpur
			Betul	Bhainsdehi
28		Betul	Betul	Chicholi
			Betul	Betul
			Betul	Athner
29		Bichiya	Mandla	Bichiya
30		Dhar	Dhar	Tirla
			Dhar	Dhar
31		Ghughri	Mandla	Ghughri
32		Ghughri	Mandla	Mohgaon

33		Gohparu	Shahdol	Gohparu
34		Jaisinghnagar	Shahdol	Jaisinghnagar
35		Jhabua-joint	Jhabua	Ranapur
			Jhabua	Jhabua
			Jhabua	Meghnagar
			Jhabua	Thandla
			Jhabua	Rama
36		Khalwa	Khandwa	Khalwa
37		Kukshi	Dhar	Kukshi
38		Mandla	Mandla	Mandla
39		Mawai	Mandla	Mawai
40		Multai	Betul	Amla
			Betul	Multai
			Betul	Prabhat Pattan
41		Nalcha	Dhar	Nalcha
42		Narayanganj	Mandla	Narayanganj
			Mandla	Bijadandi
43		Padhar-joint	Betul	Shahpur
			Betul	Ghoda Dongri
44		Pandhana	Khandwa	Pandhana
45		Petlawad	Dhar	Badnawar
			Jhabua	Petlawad
46		Saka (Zhirniya)	Khargone	Zhirniya
47		Sardarpur	Dhar	Sardarpur
48		Shahdol-joint	Shahdol	Sohagpur

49	Odisha	Boriguma	Koraput	Boriguma
50		Jeypore	Koraput	Kundra
			Koraput	Jeypore
			Koraput	Bariguma
			Koraput	Baipariguda
51		Koraput-Joint	Koraput	Dasmantpur
			Koraput	Koraput
			Koraput	Potangi
			Koraput	Bandhugaon
			Koraput	Laxmipur
			Koraput	Narayanpatna
			Koraput	Lamtaput
			Koraput	Nandapur
			Koraput	Semiliguda
			Koraput	Sunabeda NAC
52		Nabarangpur	Koraput	Kotapad
			Nabarangpur	Nabarangpur
			Nabarangpur	Kosagumda
			Nabarangpur	Papadahandi
53			Nabarangpur	Dabugam
			Nabarangpur	Nandahandi
			Nabarangpur	Tentulikhunti
54		Umerkote	Nabarangpur	Jharigam
			Nabarangpur	Umerkote

5.2.3. Training

Basically, two types training takes place in MSP implementation: first, technical training and second management training. This is done for NGOs, assemblers and distributors, and for

SRC managers. Technical training includes basic know how of solar technology, various application of solar energy, functionality of solar study lamp, assembling of SoUL, etc. For management of the MSP, separate management training is provided to different stakeholder including NGO personnels, assemblers, distributors and repair centre managers. Management training includes largely on management of large supplies of inventory, hiring of local people and type of skills required, A&D centre management, payment and receipts, data management, etc.

The details of training aspect on assembly of lamp are given in Module 9 of Appendix B. Similarly, training is provided to distributors on distribution techniques, campaigning strategy, filling of Distribution Information Sheet (DIS) form. Simultaneously, SRC managers are identified and training similar to assembly training is organized (see section 5.2.7). Further, they are provided with additional training on spare part management and record maintenance of repaired lamps. Generally, refresher trainings are also held keeping in mind the need of people to continuous update their skills. Management related training related details are in Appendix C.

Image 1: Training of Women Assemblers in Zhirniya Block, Madhya Pradesh

5.2.4. Assembly Process

After training, assembly of Figure 12 explains step by step process involved in assembly of solar study lamp. It is a 15 step process starting with physical and technical testing of SoUL parts and finishing with final packing of SoUL (Refer Manual 9 of Appendix B). After assembly, the dissembled solar kit is completed into solar study lamp (Figure 13).

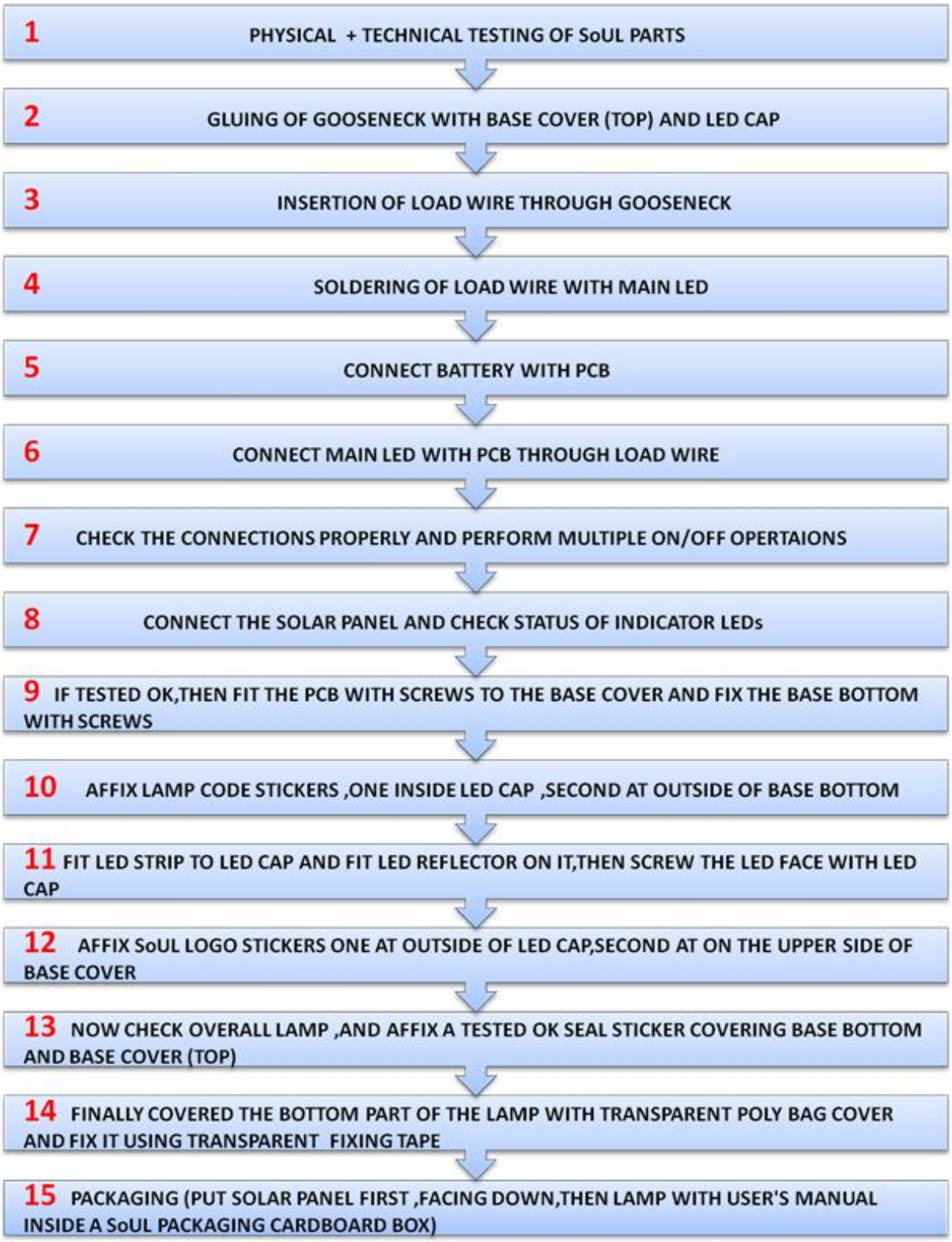


Figure 12: Step by step Assembly Process

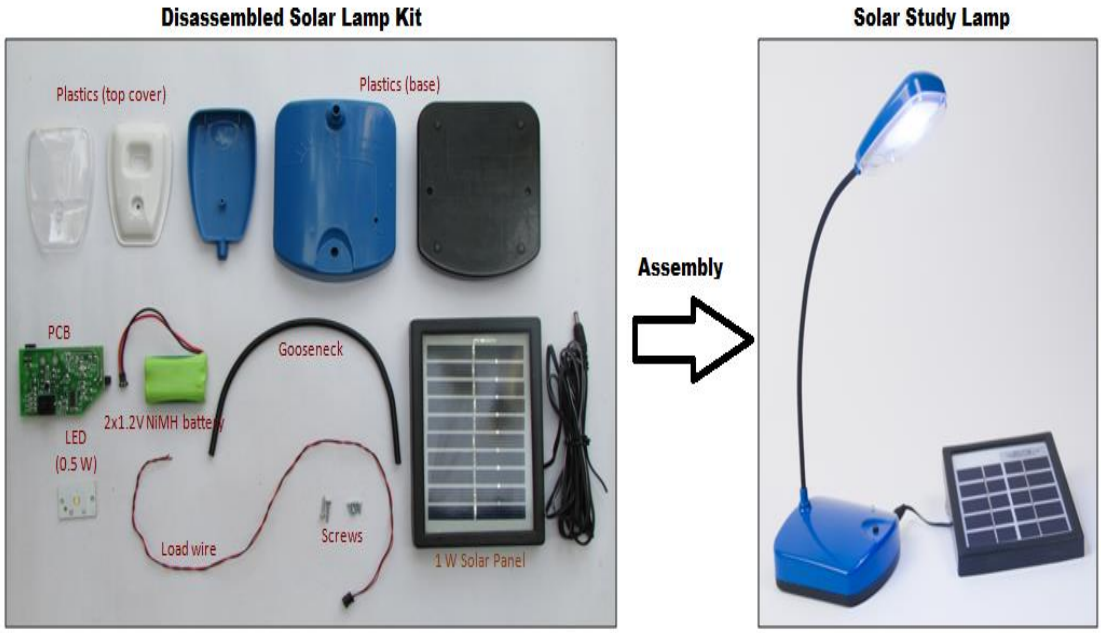


Figure 13: Disassembled Kit to Assembled Solar Study Lamp

Image 2: Women assembling SoUL in Igatpuri Block, Maharashtra

5.2.5. Distribution Process

Each and every school in implementation block is contacted for distribution of SoUL. Distributor usually goes to each school and explains about the program and benefits of using SoUL. Distributor asks respective teacher or school in-charge collect names of interested students and send an informal demand of number of lamps required. Distributor delivers the

SoUL to school, distributes it to the children, and collects the information in DIS. DIS sheet is verified by school in-charge, Institutional Partner and IIT Bombay. Each DIS has three copies; one is with school, one with IP and one with IIT Bombay. Generally, distributor visits same school twice or in cases thrice until there is a saturation of SoUL demand in the school. Figure 14 is an example of actual DIS that was filled with details.

IIT Bombay Copy/NGO Copy/School Copy

Million SoUL Program, IIT Bombay

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

Figure 14: Distribution Information Sheet (DIS)

Image 3: Distribution of SoUL in Koraput Block, Odisha

5.2.6. Campaigning

Campaigning was carried out to create general awareness of program, and to promote knowledge of SRCs. Various campaigning strategy were employed by IPs including night campaigns, at village level media poster & pamphlets newspaper advertisement, local meeting, door to door campaigns, etc. Also, radio campaigning and text messaging were used to create awareness about MSP to local people. IPs also created awareness at schools through notifications by Block Education Office (BEO) about MSP and its need to promote amongst students.

Figure 15: Illustration of Pamphlet used as campaigning tool

5.2.6. Information and Payment Flow

Information flow is very important for transparency and accountability. Distribution Information Sheet (DIS) is filled with beneficiary details such as name, school, class, caste, village, etc. This is entered into IITB managed Management Information System through data entry operators from IPs end. Data updated by IP is checked for accuracy at IITB and resent to IP if data is found to be inaccurate or incomplete. IITB established Real Time Monitoring through establishing guidelines for daily updates of solar lamp kit receipt, assembly and distribution in MIS. Similarly, guidelines were established for payment systems i.e. flow of money from student to IITB and IITB back to IP. Milestone based payment system was established so as to regulate and compel regular payments and motivate IPs.

5.2.7. SoUL Repair Centre

Sustainability not only depends on making solar lamps available, but also ensuring functionality of the solar lamps during the project period. The program is designed to make rural people capable of assembly, distribution and repair & maintenance of solar lamps. In this process, IIT Bombay with help of local NGOs identified local assemblers and distributors who were involved in the lamp assembly & distribution and to act as repair center managers. In the program these centers were called as SoUL Repair Centers (hereafter SRCs), with each center catering to roughly every 3,000 lamps distributed. So far in this project, IIT Bombay has established 350 SRCs. (see Table 5 for list of SRCs established). The idea behind setting up of SRCs, together with their repair activity would be give them platform to sell other solar products at commercial rates and to promote solar technology through market mechanism. These managers have enough skills to understand working of solar technology and repair of solar lamps. New solar products can be introduced with additional training about those products. Vendors are encouraged to sell new products through these SRCs.

Selection of SRC Location

SRC location was based on cluster mapping approach. Cluster mapping is a process of categorizing the block locations in several small parts which allow you to concentrate on specific region. Cluster mapping serves as a tool to provide a visual representation of information in a particular geographical context. 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 are identified, roughly for every 3000 lamps distributed.

On identification, SRC managers are provided training on:

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)

Table 5: SoUL Repair Centre (SRC) details state-wise

Serial Number	State	District	Block	Village, Hamlet
1	Madhya Pradesh	Annupur	Kotma	Nigwani
2		Annupur	Kotma	Behra bandh
3		Annupur	Kotma	Kothi
4		Barwani	Pati	Bokrata
5		Barwani	Pati	Palwat
6		Barwani	Pati	Rosar
7		Barwani	Niwali	Jogwada
8		Barwani	Sendhwa	Warla
9		Barwani	Sendhwa	Dhanora
10		Barwani	Sendhwa	Jhopali - gagar faliya
11		Barwani	Barwani	Barwani
12		Barwani	Barwani	Silawad
13		Barwani	Pati	Pati
14		Barwani	Barwani	Talwada bujurga
15		Barwani	Barwani	Bhavti
16		Barwani	Sendhwa	Dhawli
17		Barwani	Sendhwa	Shendhwa
18		Barwani	Niwali	Chatli
19		Barwani	Niwali	Niwali
20		Barwani	Niwali	Palsud
21		Barwani	Barwani	Menimata
22		Barwani	Sendhwa	Balwadi
23		Betul	Betul	Betul

24		Betul	Betul	Bharkawadi
25		Betul	Ghoda Dongri	Paadhar
26		Betul	Chicholi	Chunagosai
27		Betul	Shahpur	Shitaljhiri
28		Betul	Athner	Athner
29		Betul	Ghoda Dongri	Ghoda dongri
30		Betul	Athner	Bakud jod
31		Betul	Shahpur	Shahpur
32		Betul	Shahpur	Shahpur
33		Betul	Betul	Koraban
34		Betul	Chicholi	Malanjpur
35		Betul	Chicholi	Chicholi
36		Betul	Ghoda Dongri	Sobhapur
37		Betul	Ghoda Dongri	Ranipur
38		Betul	Ghoda Dongri	Baretha
39		Betul	Shahpur	Dhodramau
40		Betul	Ghoda Dongri	Banjari dhal
41		Betul	Betul	Mandai khurd
42		Betul	Betul	Dahergaon
43		Betul	Betul	Kila
44		Betul	Athner	Hidli
45		Betul	Athner	Mandvi
46		Betul	Betul	Pratap ward Tikare
47		Betul	Shahpur	Ghisi bagla
48		Betul	Shahpur	Bhoura
49		Betul	Bhainsdehi	Jhallar

50		Betul	Bhainsdehi	Bhainsdehi
51		Betul	Bhainsdehi	Sawalmeda
52		Betul	Bhainsdehi	Khamla
53		Betul	Bhimpur	Ratanpur
54		Betul	Bhimpur	Pipariya
55		Betul	Bhimpur	Damjipura
56		Betul	Bhimpur	Chikhali
57		Betul	Bhimpur	Chunaloma
58		Betul	Bhimpur	Rambha
59		Betul	Bhimpur	Dodajam
60		Betul	Multai	Multai
61		Betul	Multai	Chikhlikala
62		Betul	Multai	Saikheda
63		Betul	Multai	Mohi
64		Betul	Multai	Parashingha
65		Betul	Amla	Khedli bazar
66		Betul	Amla	Amla
67		Betul	Amla	Barangwadi
68		Betul	Amla	Jambada
69		Betul	Amla	Bordehi
70		Betul	Prabhat Pattan	Masod
71		Betul	Prabhat Pattan	Bisnor
72		Betul	Prabhat Pattan	Prabhat pattan
73		Dhar	Tirla	Satipura
74		Dhar	Tirla	Prem nagar (tirla)
75		Dhar	Tirla	Salkanpur

76		Dhar	Nalcha	Bagadi
77		Dhar	Nalcha	Nalcha
78		Dhar	Kukshi	Aali
79		Dhar	Kukshi	Kukshi
80		Dhar	Sardarpur	Rajgarh
81		Dhar	Sardarpur	Sardarpur
82		Dhar	Sardarpur	Ledgaon
83		Dhar	Sardarpur	Amzera
84		Dhar	Dhar	Tornod
85		Dhar	Dhar	Sadalpur
86		Dhar	Nalcha	Mevad jamniya
87		Dhar	Sardarpur	Ringnod
88		Dhar	Dhar	Ghatabiilod
89		Dhar	Sardarpur	Mangod
90		Dhar	Kukshi	Dehari / panva
91		Dhar	Nalcha	Mandav
92		Dhar	Nalcha	Digthan
93		Dhar	Sardarpur	Labariya
94		Dhar	Nalcha	Indorama
95		Dhar	Dhar	Dhar
96		Jhabua	Meghnagar	Gadwada
97		Jhabua	Meghnagar	Nogava
98		Jhabua	Thandla	Thandla
99		Jhabua	Thandla	Walakhari
100		Jhabua	Thandla	Timrwani
101		Jhabua	Rama	Padalghati

102		Jhabua	Jhabua	Pipliya
103		Jhabua	Rama	Kalidevi
104		Jhabua	Petlawad	Petlawad
105		Jhabua	Petlawad	Bani
106		Jhabua	Petlawad	Sarangi
107		Jhabua	Jhabua	Dhekal badi jhabua
108		Jhabua	Meghnagar	Madrani/ kakanwani
109		Jhabua	Jhabua	Jhabua
110		Jhabua	Petlawad	Raipuriya
111		Jhabua	Meghnagar	Meghnagar
112		Jhabua	Jhabua	Bhagor
113		Jhabua	Petlawad	Bamaniya
114		Jhabua	Badnawar	Kod
115		Jhabua	Badnawar	Badnawar
116		Jhabua	Petlawad	Jhaknawda
117		Jhabua	Rama	Umarkot
118		Jhabua	Rama	Para
119		Khandwa	Pandhana	Pandhana
120		Khandwa	Khalwa	Medarani
121		Khargone	Zhirniya	Zhirniya
122		Khargone	Zhirniya	Karanya
123		Khargone	Zhirniya	Saka
124		Khargone	Zhirniya	Chiriya
125		Khargone	Zhirniya	Batti faliya/mandwa
126		Mandla	Ghughri	Ghughri
127		Mandla	Ghughri	Nejhar

128		Mandla	Ghughri	Dongar mandla
129		Mandla	Mandla	Padmi
130		Mandla	Mandla	Mandla
131		Mandla	Mandla	Binjhiya
132		Mandla	Mandla	Maharajpur
133		Mandla	Bichiya	Dhutka
134		Mandla	Mandla	Bakouri
135		Mandla	Mandla	Patpara raiyat
136		Mandla	Bichiya	Ourai
137		Mandla	Bichiya	Madhopur
138		Mandla	Bichiya	Dudhka
139		Mandla	Bichiya	Anjaniya
140		Mandla	Mandla	Bamhni banjar
141		Mandla	Bichiya	Bichhiya
142		Mandla	Ghughri	Salwah
143		Mandla	Narayanganj	Narayanganj
144		Mandla	Narayanganj	Manegaon
145		Mandla	Narayanganj	Babliya
146		Mandla	Bijadandi	Bijadandi
147		Mandla	Bijadandi	Maniksara
148		Mandla	Mawai	Mawai
149		Mandla	Mawai	Ghutas
150		Mandla	Mawai	Dadi bhanpur
151		Mandla	Mawai	Bhai bahan nala
152		Mandla	Mohgaon	Mohgaon
153		Mandla	Mohgaon	Singarpur

154		Mandla	Mohgaon	Munu
155		Shahdol	Burhar	Tengha
156		Shahdol	Burhar	Keshwahi
157		Shahdol	Burhar	Dhanpuri
158		Shahdol	Sohagpur	Karkatti
159		Shahdol	Sohagpur	Manjhgava
160		Shahdol	Burhar	Rasmohani
161		Shahdol	Sohagpur	Shahadol
162		Shahdol	Gohparu	Gohparu
163		Shahdol	Gohparu	Khannoudhi
164		Shahdol	Gohparu	Chuhiri
165		Shahdol	Burhar	Jheek bijuri
166		Shahdol	Burhar	Girva
167		Shahdol	Sohagpur	Sinhpur
168		Shahdol	Sohagpur	Samantpur
169		Shahdol	Sohagpur	Pipriya
170		Shahdol	Gohparu	Barkoda
171		Shahdol	Burhar	Khamidool
172		Shahdol	Sohagpur	Lalpur
173		Shahdol	Burhar	Jetpur
174		Shahdol	Jaisinghnagar	Amjhor
175		Shahdol	Jaisinghnagar	Jaisinghnagar
176		Shahdol	Jaisinghnagar	Bansukali
177		Shahdol	Jaisinghnagar	Amdih
178		Shahdol	Jaisinghnagar	Bijhaa
179		Shahdol	Beohari	Beohari

180		Shahdol	Beohari	Bholhra
181		Shahdol	Beohari	Papoundh
182		Shahdol	Beohari	Pasgadi
183		Shahdol	Beohari	Devlond
184		Ahmednagar	Sangamner	Nimgaonpaga
185		Ahmednagar	Akole	Akole
186		Ahmednagar	Akole	Rajur
187		Ahmednagar	Akole	Khadki khurd
188		Ahmednagar	Akole	Ghoti
189		Ahmednagar	Akole	Shendi
190		Ahmednagar	Sangamner	Sangamner
191		Ahmednagar	Sangamner	Sakur
192		Ahmednagar	Sangamner	Talegaon
193		Ahmednagar	Akole	Rajur
194	Maharashtra	Ahmednagar	Sangamner	Ghargaon
195		Ahmednagar	Akole	Devgoan
196		Ahmednagar	Akole	Bhojdari
197		Ahmednagar	Sangamner	Varodi phata
198		Ahmednagar	Akole	Devthan
199		Ahmednagar	Akole	Kotul
200		Ahmednagar	Sangamner	Ashwi
201		Ahmednagar	Sangamner	Chandanapuri
202		Nashik	Surgana	Bharhe
203		Nashik	Surgana	Palsan
204		Nashik	Surgana	Mankhed

205		Nashik	Surgana	Surgana
206		Nashik	Surgana	Umbharthan
207		Nashik	Surgana	Borgaon
208		Nashik	Trimbakeshwar	Dalaptpur
209		Nashik	Trimbakeshwar	Thanpada
210		Nashik	Trimbakeshwar	Ozharkhed
211		Nashik	Trimbakeshwar	Welunje
212		Nashik	Trimbakeshwar	Dahalewadi
213		Nashik	Peint	Peint
214		Nashik	Peint	Dabhadi
215		Nashik	Peint	Gangodbari
216		Nashik	Peint	Kohor
217		Nashik	Igatpuri	Ahurli
218		Nashik	Igatpuri	Krushnanagar/mundegaon
219		Nashik	Igatpuri	Ghoti
220		Nashik	Igatpuri	Ghoti
221		Palghar	Jawhar	Dhanoshi
222		Palghar	Vikramgad	Yeshwant nagar,Vikramgarh
223		Palghar	Jawhar	Nangermode,pimplegaon
224		Palghar	Jawhar	Boricha pada,Dehere
225		Palghar	Mokhada	Bhendhicha pada,saaturli
226		Palghar	Mokhada	Wakadpada
227		Palghar	Wada	Guhir
228		Palghar	Wada	Chinchpada
229		Palghar	Vikramgad	Tetavala

230		Palghar	Vikramgad	Kokanipada,alonde
231		Palghar	Wada	Tilgao
232		Palghar	Jawhar	Amrai campus jawhar
233		Palghar	Jawhar	Ambyachapada
234		Palghar	Mokhada	Mokhada
235		Palghar	Wada	Kudus
236		Palghar	Palghar	Ganje
237		Palghar	Mokhada	Khodala
238		Palghar	Mokhada	Mokhada
239		Palghar	Vikramgad	Bhopoli
240		Palghar	Palghar	Manor
241	Odisha	Koraput	Kotapad	Kusumi
242		Koraput	Kundra	Kundra
243		Koraput	Jeypore	Jeypore
244		Koraput	Baipariguda	Baipariguda
245		Koraput	Bariguma	Bariguma
246		Koraput	Kundra	Lima
247		Koraput	Baipariguda	Ramgiri
248		Koraput	Baipariguda	Tanginiguda
249		Koraput	Kotapad	Kotpad
250		Koraput	Kundra	Digapur
251		Koraput	Jeypore	Randapali,jeypore
252		Koraput	Semiliguda	Dudhari busstand nh -26
253		Koraput	Koraput NAC	Gutamnagar, 1st lane
254		Koraput	Boriguma	Boriguma

255		Koraput	Boriguma	Boriguma
256		Nabarangpur	Nabarangpur	Nabarangpur
257		Nabarangpur	Papadahandi	Papadahandi
258		Nabarangpur	Papadahandi	Maidalpur
259		Nabarangpur	Kosagumuda	Madeigam
260		Nabarangpur	Papadahandi	Jatabal
261		Nabarangpur	Kosagumuda	Katagam
262		Nabarangpur	Nabarangpur	Jambuguda
263		Nabarangpur	Kosagumuda	Kosagumuda
264		Nabrangpur	Dabugam	State bank lane
265		Nabrangpur	Dabugam	Junapani market road
266		Nabrangpur	Nandahandi	Sagar munda
267		Nabrangpur	Tentulikhunti	Tarinisahi
268		Nabrangpur	Tentulikhunti	Anchalaguma
269		Nabrangpur	Jharigam	Dhorda
270		Nabrangpur	Jharigam	Jharigam
271		Nabrangpur	Jharigam	Chachha
272		Nabrangpur	Umerkote	Umerkote
273	Rajasthan	Banswara	Talwara-Banswara	Abapura
274		Banswara	Talwara-Banswara	Nayagaon
275		Banswara	Talwara-Banswara	Makod
276		Banswara	Talwara-Banswara	Talwada
277		Banswara	Bagidora	Rakho

278		Banswara	Bagidora	Badodiya / karji road
279		Banswara	Kusalgarh	Dungripada
280		Banswara	Kusalgarh	Kushalgarh
281		Banswara	Kusalgarh	Chooti sarwah
282		Banswara	Kusalgarh	Nagdabadi
283		Banswara	Talwara-Banswara	Rayanpada, suvala
284		Banswara	Bagidora	Barigama
285		Banswara	Choti sarvan	Tejpur
286		Banswara	Choti sarvan	Sarvani
287		Banswara	Choti sarvan	Napla
288		Banswara	Ghatol	Padoli gordhan
289		Banswara	Ghatol	Ghatol
290		Banswara	Ghatol	Khamera
291		Banswara	Pipalkhoont	Pandawa / pipalkhoont
292		Banswara	Pipalkhoont	Nalchoki
293		Banswara	Pipalkhoont	Kela mela
294		Banswara	Pipalkhoont	Ghantali
295		Banswara	Pipalkhoont	Talaya/suhagpura
296		Banswara	Garhi	Bhimkund
297		Banswara	Garhi	Partapur
298		Banswara	Garhi	Saredi badi
299		Baran	Kishanganj	Ranibarod
300		Baran	Kishanganj	Relawan
301		Baran	Kishanganj	Nahargarh
302		Baran	Kishanganj	Bhanwargarh

303		Baran	Baran	Baran
304		Baran	Antah	Antah
305		Baran	Kishanganj	Jalwada
306		Baran	Antah	Mangarol
307		Bhilwara	Mandalgarh	Shyampura
308		Bhilwara	Mandalgarh	Manpura
309		Bhilwara	Mandal	Luhariya
310		Bhilwara	Mandal	Chitamba
311		Bhilwara	Mandal	Gyangarh
312		Bhilwara	Mandalgarh	Mandalgarh
313		Bhilwara	Mandalgarh	Kachola
314		Bhilwara	Mandalgarh	Jassu ji ka kheda
315		Bhilwara	Mandal	Mandal
316		Bhilwara	Mandalgarh	Tilswan
317		Bhilwara	Mandalgarh	Bijoliya
318		Bhilwara	Mandal	Khamanpura
319		Bhilwara	Mandal	Bagour
320		Bhilwara	Mandal	Karera
321		Chittaurgarh	Begun	Parsoli
322		Chittaurgarh	Begun	Narsinghpura
323		Chittaurgarh	Begun	Begun
324		Chittaurgarh	Begun	Thukrai
325		Dungarpur	Aaspur	Richa
326		Dungarpur	Aaspur	Sabla
327		Dungarpur	Aaspur	Ramgarh
328		Dungarpur	Aaspur	Punjpur

329		Dungarpur	Aaspur	Aaspur
330		Dungarpur	Aaspur	Paslasa
331		Pratapgarh	Pratapgarh	Achalpur
332		Pratapgarh	Pratapgarh	Narayankheda
333		Pratapgarh	Pratapgarh	Sanoti
334		Pratapgarh	Pratapgarh	Baranverda
335		Pratapgarh	Pratapgarh	Ratanjana
336		Pratapgarh	Pratapgarh	Kharot
337		Rajsamand	Kumbhalgarh	Charbhuja
338		Rajsamand	Kumbhalgarh	Kelwara
339		Rajsamand	Kumbhalgarh	Janvate
340		Udaipur	Gogunda	Saira
341		Udaipur	Gogunda	Nandeshma
342		Udaipur	Jhadol	Kolyari
343		Udaipur	Jhadol	Ogana
344		Udaipur	Jhadol	Badrana
345		Udaipur	Jhadol	Banswari
346		Udaipur	Jhadol	Baghpura
347		Udaipur	Gogunda	Gogunda
348		Udaipur	Gogunda	Padawle kala
349		Udaipur	Jhadol	Jhadol
350		Udaipur	Jhadol	Panerwa

Image 4: SRC set up in Betul Block, Madhya Pradesh

6. Key Outputs

The Million Solar Urja Lamp (SoUL) program was initiated in June 2013 by IIT Bombay, to provide one Million Solar Urja Lamps (SoUL) to as many school children. During more than 10,00,000 solar study lamps have been distributed to school students spread across 4 Indian states viz, Madhya Pradesh, Maharashtra, Rajasthan and Odisha, in 97 blocks over 23 districts through 13 NGOs. The project is supported by the Ministry of New and Renewable Energy, Madhya Pradesh State Government, Sir Dorabji Tata Trust, Idea Cellular (Aditya Birla Group), Tata Motors and other philanthropic partners. Under the Million SoUL Program, 350 SoUL Repair Centres (SRCs) have been set up in these blocks, with the cooperation of the local Non-Government Organizations (NGOs). The SRC Managers have been imparted the knowledge and skills to understand the working of solar technology and repair of SoUL. These centers were formed keeping in mind their future evolution into solar shops where variants of solar products are available for sale.

6.1. Progress of MSP

Table 6 gives an overview of MSP partner NGOs and presence across four states. Table 7 provides a summary of one million solar study lamps distribution across NGOs, states and blocks.

Table 6: State wise overview of MSP

Sr. No.	State	No. of NGO Partners	No. of Districts	No. of Blocks	No. of A&D Centers	Distribution	No. of Villages & Hamlets covered
1.	Maharashtra	2	4	12	9	1,70,316	
2.	Madhya Pradesh	6	9	43	26	5,19,032	
3.	Rajasthan	3	8	18	13	2,21,101	10,900+
4.	Odisha	3	2	24	6	89,551	

Table 7: SoUL Distribution as per NGO partner, district & block

Sr. No.	NGO Partner	District	Blocks	Total Distribution
1	BAIF	Palghar	Jawhar	14,373
2	BAIF	Palghar	Vikramgad	12,507
3	BAIF	Palghar	Wada	12,393
4	BAIF	Pune	Junnar	1,500
5	BAIF	Palghar	Mokhada	10,525
6	BAIF	Palghar	Palghar	10,501

7	WOTR	Ahmednagar	Sangamner	25,028
8	WOTR	Ahmednagar	Akole	28,489
9	BAIF	Udaipur	Jhadol	19,071
10	BAIF	Dungarpur	Aaspur	18,084
11	GVT	Banswara	Kusalgarh	12,400
12	GVT	Banswara	Bagidora	7,563
13	GVT	Banswara	Talwara-Banswara	15,686
14	GVT	Baran	Kishanganj	13,339
15	GVT	Baran	Baran	1,549
16	GVT	Baran	Antah	6,150
17	FES	Pratapgarh	Pratapgarh	17,400
18	FES	Chittaurgarh	Begun	9,916
19	FES	Bhilwara	Mandalgarh	18,770
20	FES	Bhilwara	Mandal	20,379
21	FES	Udaipur	Gogunda	11,877
22	FES	Rajsamand	Kumbhalgarh	8,009
23	Ashagram	Barwani	Pati	10,781
24	Ashagram	Barwani	Niwali	11,672
25	Ashagram	Barwani	Barwani	14,070
26	Ashagram	Barwani	Rajpur	312
27	AKRSP	Barwani	Sendhwa	15,900
28	AKRSP	Khargone	Zhirniya	13,789
29	AKRSP	Khandwa	Pandhana	2,060
30	AKRSP	Khandwa	Khalwa	2,920
31	CARD	Mandla	Bichiya	16,000
32	CARD	Mandla	Mandla	18,700
33	CARD	Mandla	Ghughri	10,800

34	CARD	Dhar	Tirla	6,600
35	CARD	Dhar	Nalcha	15,892
36	CARD	Dhar	Dhar	11,662
37	CARD	Dhar	Sardarpur	21,000
38	GVT	Dhar	Kukshi	9,500
39	GVT	Jhabua	Ranapur	1,492
40	GVT	Jhabua	Jhabua	13,595
41	GVT	Jhabua	Meghnagar	9,963
42	GVT	Jhabua	Thandla	9,865
43	GVT	Jhabua	Rama	8,585
44	Sahjeevan	Shahdol	Burhar	20,663
45	Sahjeevan	Annupur	Kotma	10,145
46	Sahjeevan	Shahdol	Sohagpur	20,940
47	Sahjeevan	Shahdol	Gohparu	11,757
48	CARD	Dhar	Badnawar	4,035
49	CARD	Jhabua	Petlawad	16,565
50	BAIF	Betul	Chicholi	8,638
51	BAIF	Betul	Betul	22,153
52	BAIF	Betul	Athner	11,355
53	BAIF	Betul	Shahpur	15,449
54	BAIF	Betul	Ghoda Dongri	16,554
55	HarshaTrust	Koraput	Kundra	6,702
56	HarshaTrust	Koraput	Jeypore	5,466
57	HarshaTrust	Koraput	Bariguma	1,101
58	HarshaTrust	Koraput	Kotapad	4,351
59	HarshaTrust	Koraput	Baipariguda	7,466
60	HarshaTrust	Nabarangpur	Nabarangpur	6,062

61	HarshaTrust	Nabarangpur	Papadahandi	8,309
62	HarshaTrust	Nabarangpur	Kosagumda	10,629
63	FES	Koraput	Bandhugaon	393
64	FES	Koraput	Dasmantpur	183
65	FES	Koraput	Koraput	2,691
66	FES	Koraput	Lamtaput	586
67	FES	Koraput	Laxmipur	100
68	FES	Koraput	Nandapur	361
69	FES	Koraput	Narayanpatna	630
70	FES	Koraput	Potangi	262
71	FES	Koraput	Semiliguda	721
72	FES	Koraput	Sunabeda NAC	538
73	CARD	Mandla	Mawai	11,500
74	CARD	Mandla	Bijadandi	6,120
75	CARD	Mandla	Narayanganj	9,600
76	CARD	Mandla	Mohgaon	9,300
77	Sahjeevan	Shahdol	Beohari	15,000
78	Sahjeevan	Shahdol	Jaisinghnagar	15,000
79	BAIF	Betul	Bhainsdehi	12,856
80	BAIF	Betul	Bhimpur	17,400
81	BAIF	Betul	Multai	14,000
82	BAIF	Betul	Amla	14,803
83	BAIF	Betul	Prabhat Pattan	10,041
84	GVT	Banswara	Choti Sarvan	8,908
85	GVT	Banswara	Ghatol	9,000
86	GVT	Pratapgarh	Pipalkhoont	14,000
87	GVT	Banswara	Garhi	9,000

88	BAIF	Nashik	Surgana	17,000
89	BAIF	Nashik	Trimbak	13,700
90	BAIF	Nashik	Peint	12,507
91	BAIF	Nashik	Igatpuri	11,793
92	Harsha Trust	Nabarangpur	Dabugam	4,372
93	Harsha Trust	Nabarangpur	Nandahandi	3,023
94	Harsha Trust	Nabarangpur	Tentulikhunti	4,785
95	Harsha Trust	Nabarangpur	Jharigam	9,511
96	Harsha Trust	Nabarangpur	Umerkote	4,309
97	Harsha Trust	Koraput	Borigum	7,000
TOTAL DISTRIBUTION				**10,00,000**

6.1.1. Saturation

Saturation of block has been one of the unique achievement of MSP with **37** blocks been saturated in four intervention states. Figure 16 given below presents the status of saturated blocks.

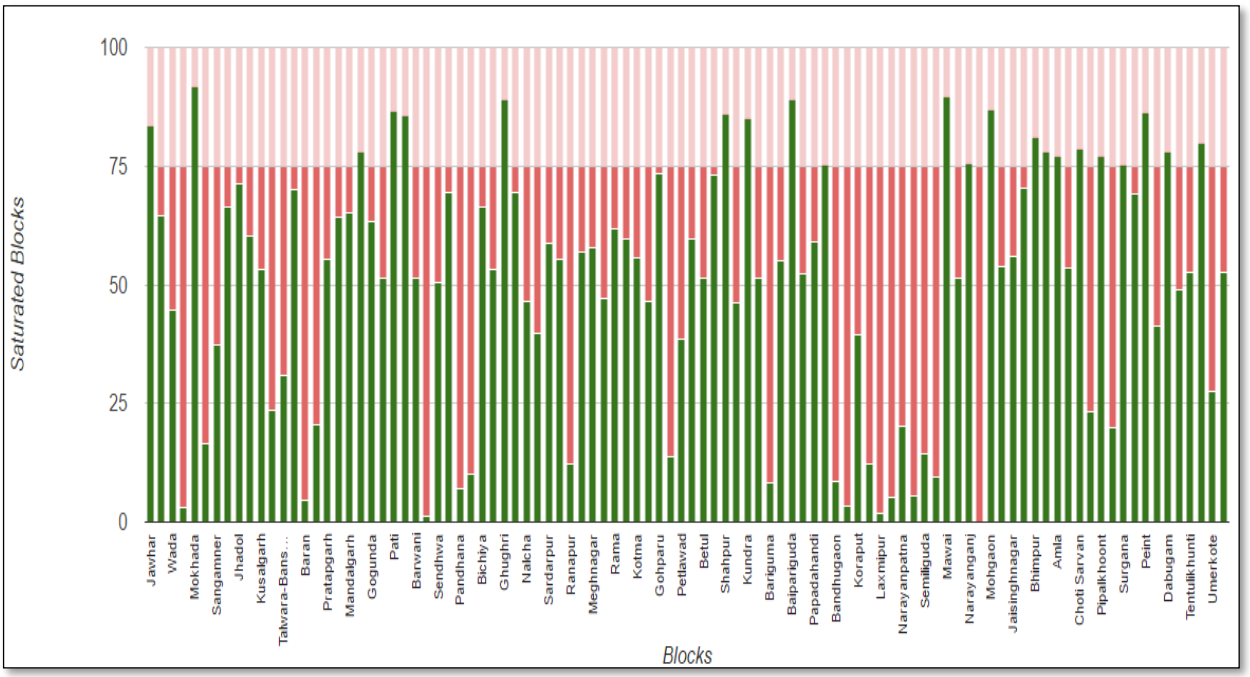


Figure 16: Status of saturated blocks across four intervention states

6.1.2. SRC for Sustainability

Sustainability not only depends on making solar lamps available, but also ensuring functionality of the solar lamps during the project period of 1 Million SoUL program of IIT Bombay. MSP has been conceptualized to make rural people capable of assembly, distribution and repair and maintenance of solar lamps. In this process, IIT Bombay identified the local assemblers and distributors who were involved in the lamp assembly and distribution, some of them are later selected as repair centre managers. These centers are called as SoUL Repair Centers (SRCs), with each centre catering to 3,000 beneficiaries. Under MSP, 350 SRCs were established across the four states to provide after sales service to the beneficiaries. Table 8 given below presents state wise number of SRCs that were established.

Table 8: State wise number of SRCs

Sr. No.	State	No. of NGO Partners	No. of Districts	No. of Blocks	No. Of SRCs	Percentage of SRCs
1.	Maharashtra	2	4	12	57	16
2.	Madhya Pradesh	6	9	43	183	53
3.	Rajasthan	3	8	18	78	22
4.	Odisha	3	2	24	32	9

6.1.3. Local employment generation

Local people were involved in assembly, distribution and repair services of SoUL. It was done through systematic training of local people which helped skill transfer and local employment generation. Assembler and distributors were provided remuneration based on fixed piece rate basis, while SRC were provided with monthly remuneration of INR 2750. Overall 1873 people were trained under the program with overall local livelihood more than INR 3,65,00,00 being generated. Table 9 presents an overview number of people trained in different capacities and overall capital infused across into local economy.

Table 9: Livelihood Generated under MSP

State	Assemblers		Distributors		SRC	
	No. of Personnel Trained	Livelihood (in INR)	No. of Personnel Trained	Livelihood (in INR)	No. of Personnel Trained*	Livelihood (in INR)
Madhya Pradesh	405	51,96,570	421	77,94,855	183	65,56,120

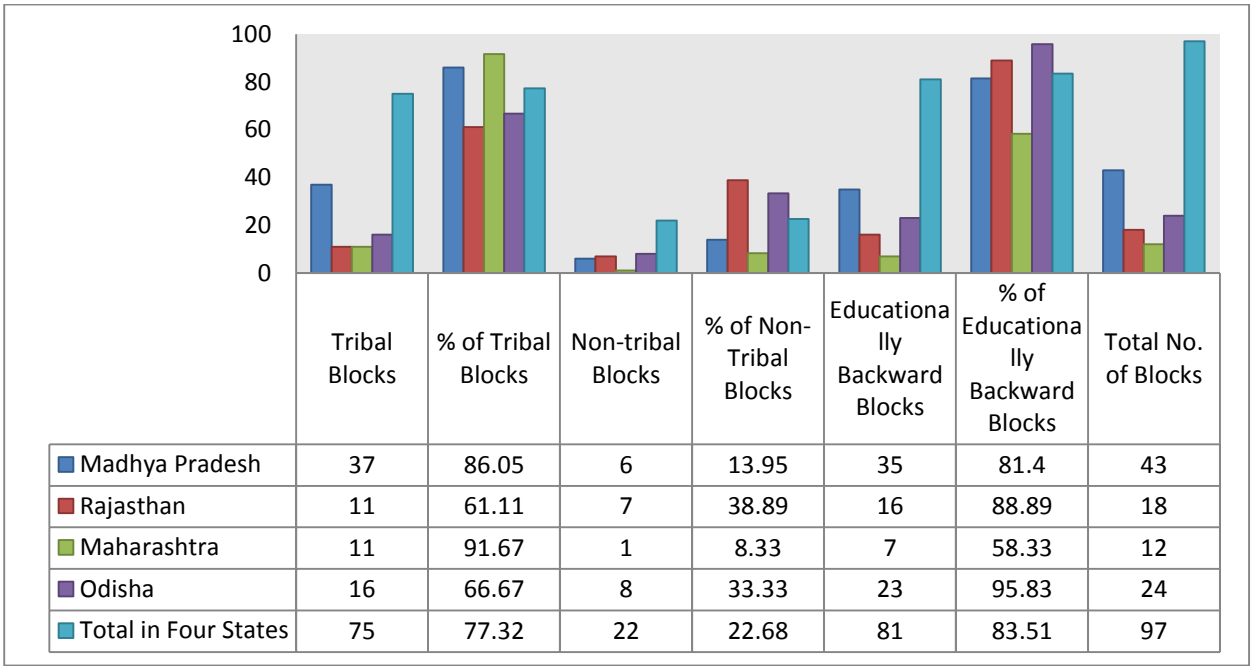
Maharashtra	118	16,96,400	124	25,44,600	57	17,63,200
Rajasthan	155	22,11,350	157	33,17,025	78	23,38,300
Odisha	84	8,95,680	59	13,43,520	32	9,32,050
Total	**762**	**1,00,00,000**	**761**	**1,50,00,000**	**350**	**1,15,89,670**

(* Few people were same as Assemblers, yet they received SRC training separately)

6.2. Beneficiary Profile – 1 Million Students

6.2.1. Characteristics of MSP intervention blocks

MSP has a strong presence in tribal[10] as well as educationally backward blocks (EBB)[11] indicating that it catered to the communities that are marginalized, poor and underdeveloped. Amongst 97 intervention blocks across four states, 77 percent were tribal blocks and 83 percent were educationally backward blocks. Figure 18 presented below gives an overview of state wise presence of MSP in tribal and educationally backward blocks. Percentage of tribal blocks was highest in Maharashtra; while more than 95 percent intervention blocks in Odisha were EBB blocks (see Figure 17).



	Tribal Blocks	% of Tribal Blocks	Non-tribal Blocks	% of Non-Tribal Blocks	Educationally Backward Blocks	% of Educationally Backward Blocks	Total No. of Blocks
Madhya Pradesh	37	86.05	6	13.95	35	81.4	43
Rajasthan	11	61.11	7	38.89	16	88.89	18
Maharashtra	11	91.67	1	8.33	7	58.33	12
Odisha	16	66.67	8	33.33	23	95.83	24
Total in Four States	75	77.32	22	22.68	81	83.51	97

Figure 17: Presence of MSP in Tribal & Educationally Backward Blocks

6.2.2. Distribution of SoUL beneficiaries in MSP intervention states

In MSP 51.97 percent SoUL beneficiaries were in Madhya Pradesh. Reasons for high concentration of beneficiaries in Madhya Pradesh were higher percentage of tribal population (27%), 42 percent rural households relying on kerosene as a main source and government of

[10] Tribal blocks are those blocks that have high tribal concentration (Ministry of tribal affairs)

[11] List of educational backward blocks (EBBs) was made in connection with the Sarva Shiksha Abhiyan. The basis for identification of EBB was twin criteria of Female Literacy Rate being below the national average of 46.13% and Gender Gap in Literacy being above the national average of 21.59%. Subsequently this list was expanded to include 406 more blocks, out of which 404 blocks were having rural FLR of less than 45% irrespective of the Gender Gap (Ministry of human resource development).

Madhya Pradesh providing financial support to 2,00,000 beneficiaries'. For state wise distribution of student beneficiaries refer figure 18 given below.

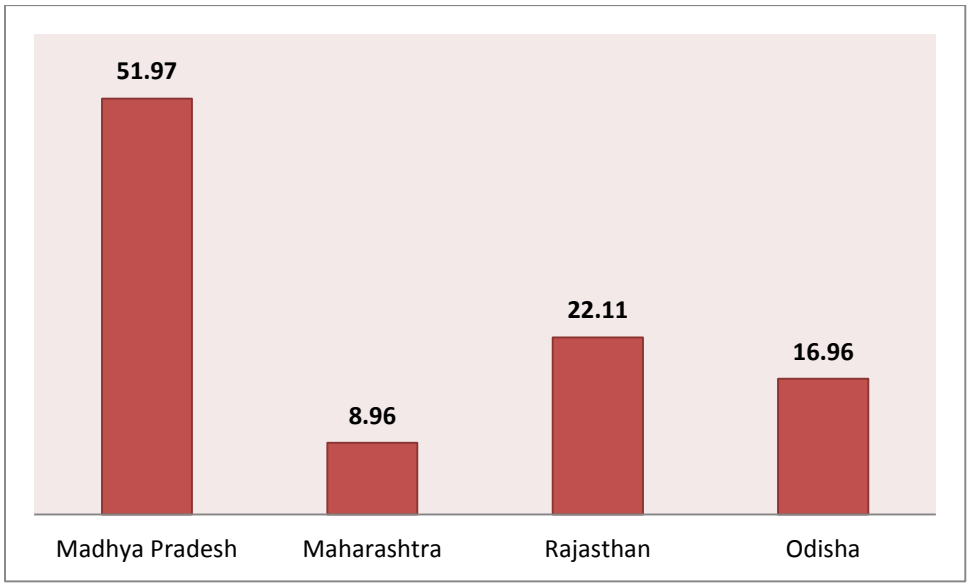


Figure 18: State wise percentage of SoUL beneficiaries

6.2.3 Gender distribution: rural enrollment and SoUL beneficiaries

Gender wise distribution of SoUL beneficiaries in MSP demonstrated that 56 percent were males, while 44 percent were female. Figure 3 given below present gender distribution for class 5th to 12th as per National University of Education Planning & Administration (NUEPA) rural enrollment in year 2013-14 as well as for MSP beneficiaries. Both these data are for MSP intervention blocks and states. As observed in figure 19, in Maharashtra percentage of gender distribution for NUEPA enrollment as well as for MSP beneficiaries is similar, whereas in other three states percentage of female beneficiaries in MSP is lower than percentage of NUEPA female enrollment.

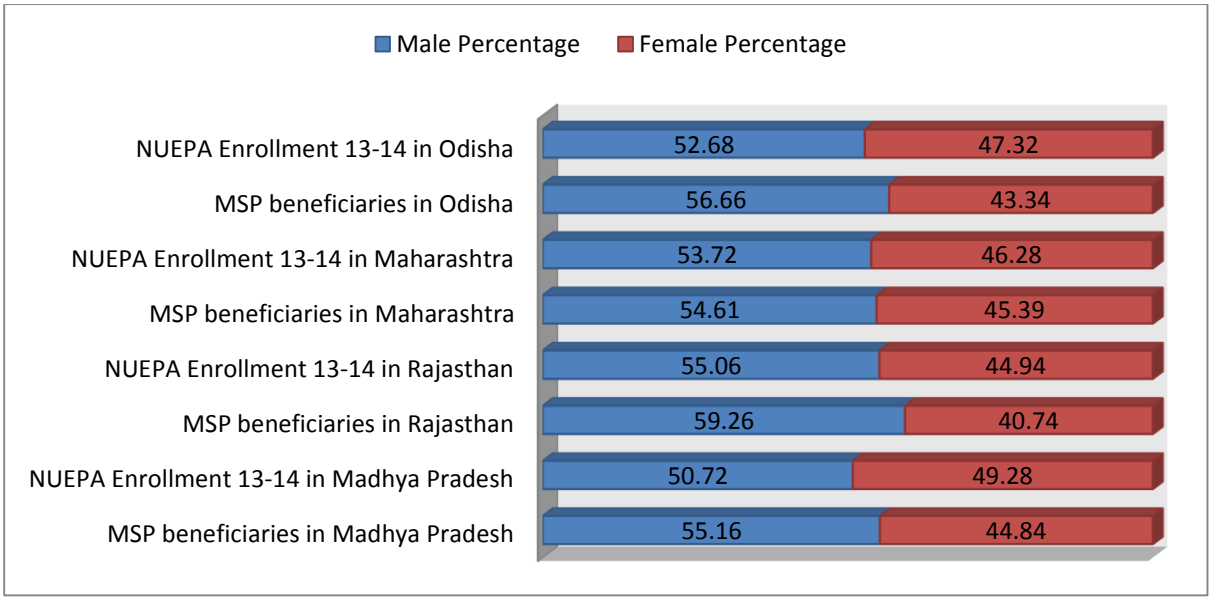


Figure 19: State wise gender distribution: NUEPA class 5th-12th rural enrollment & MSP beneficiaries

6.2.4. Social categories and distribution of SoUL beneficiaries

Distribution of beneficiaries as per social category revealed that highest percentage were from scheduled tribes at 61 percent (refer figure 20 for caste distribution), whereas 8.72 percent beneficiaries were from general category. Caste wise distribution of beneficiaries informed that MSP was successful in reaching most marginalized and poor communities as majority of beneficiaries belonged to social categories designated as backward in India such as scheduled tribe (ST), scheduled caste (SC), nomadic tribe (NT), socially and economically backward classes (SEBC) and other backward classes (OBCs).

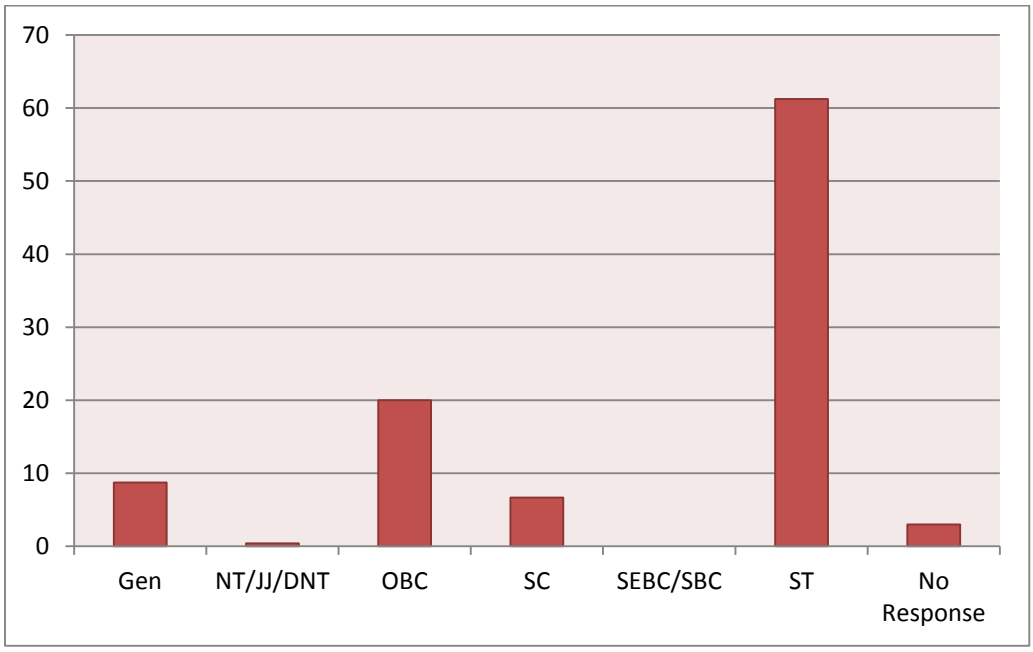


Figure 20: Caste distribution: Percentage of MSP beneficiaries across four intervention states

State wise beneficiary distribution according to social category is presented in figure 21 below. Beneficiary data across intervention states revealed that highest percentage of ST beneficiaries were in Maharashtra (70%) and lowest were in Rajasthan (55%).

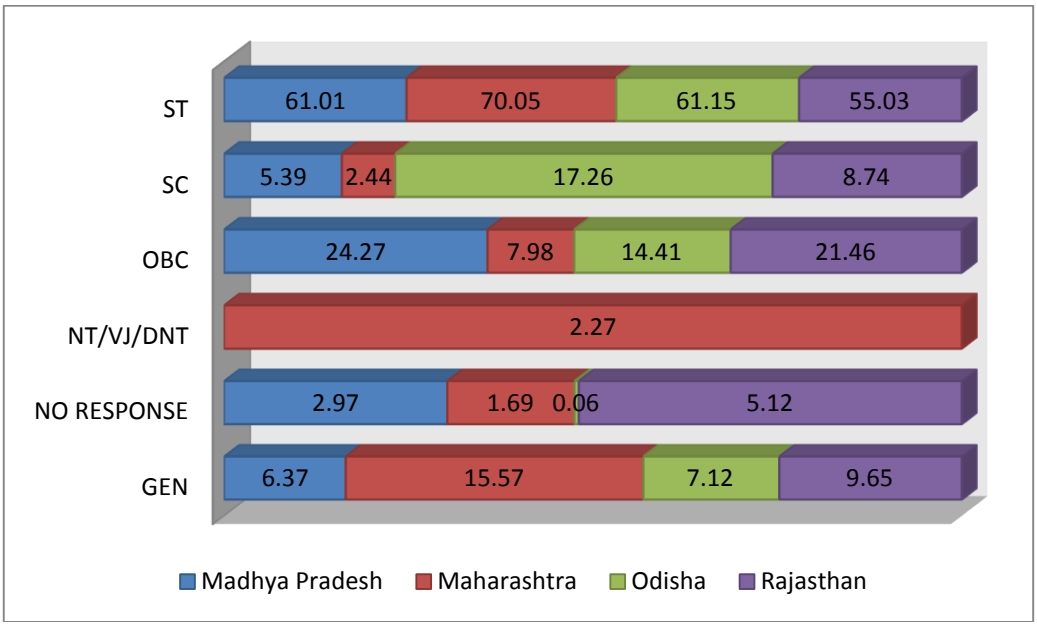


Figure 21: State wise beneficiary distribution as per caste category

6.2.5. Electrification status

Data on electrification status in revealed that 15.34 percent beneficiaries' had no electricity access. State wise electrification status in MSP intervention states revealed that except for Madhya Pradesh (8.67%) in each of remaining three states more than 18 percent SoUL beneficiaries did not have access to electricity (Fig. 22). This situation indicated heavy reliance on kerosene as a main source of lighting.

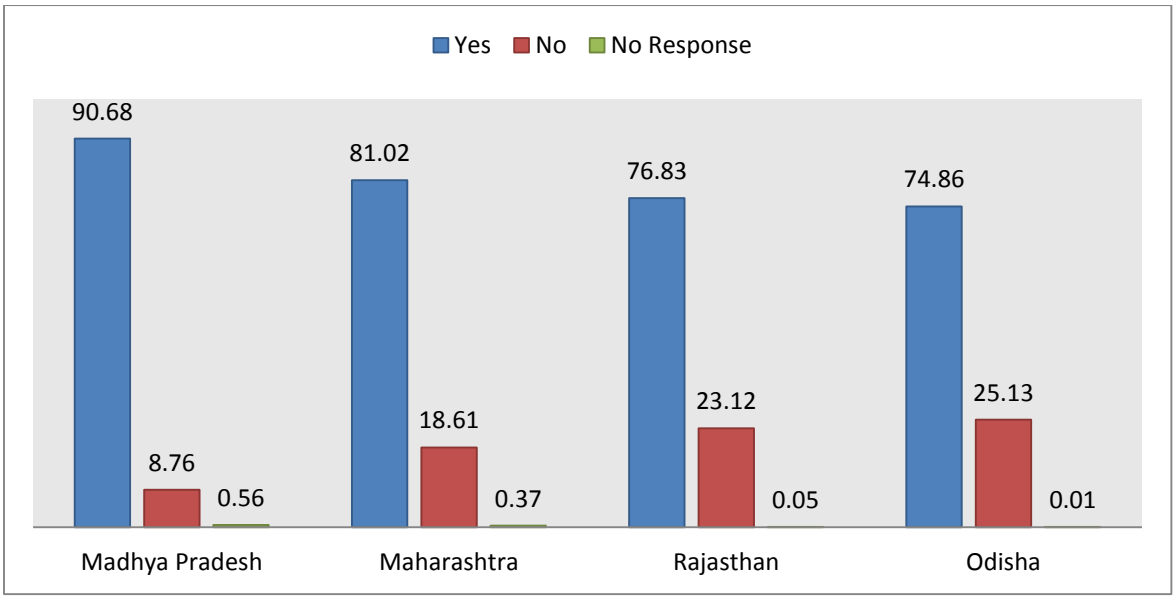


Figure 22: State wise percentage of beneficiaries with electricity access

6.2.6. Beneficiary distribution as per class

As observed from figure 23 below significant percent of beneficiaries, i.e. 68 percent, studied in upper primary (between classes 5th to 8th). Concentration of SoUL beneficiaries in upper primary, whereas lower beneficiary percentage in other two categories corroborate rural school enrollment pattern in which enrollment is more in upper primary, while in secondary and senior secondary classes lesser enrollment is observed given the dropout rate increases as students go in higher classes.

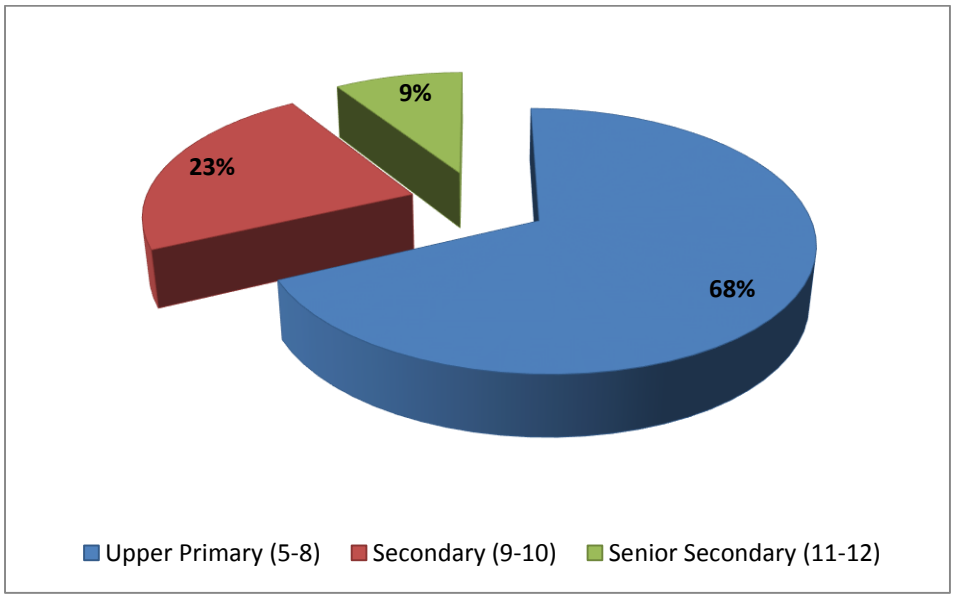


Figure 23: Distribution of beneficiaries as per class enrollment

7. Consultation and Workshops

Stakeholder consultation and workshop were carried out for disseminating information and feedback on the MSP. A national level consultation took place in New Delhi where multiple institutions were invited to participate and share knowledge on upscaling of MSP. Similarly, multiple workshops were carried for capacity building of SRCs and partner NGOs.

7.1. National Consultation

Ministry of New and Renewable Energy (MNRE) in collaboration with Indian Institute of Technology (IIT) Bombay had organized a one-day consultation workshop on December 11, 2015 in New Delhi to discuss the concept, outcomes and pathway forward for the Million SoUL program. The main objective of the workshop was to bring together expertise from different sectors on one platform to seek their feedback and inputs on various aspects of program, which can contribute towards upscaling of program.

Image 5: National consultation at Delhi

Participants present in the workshop commended the initiative taken by IIT Bombay to provide clean light to rural children and also thought that there is a need to implement this program at much wider national scale that can cover electricity deprived parts of India especially states like Uttar Pradesh, Bihar and West Bengal. The contribution of the Million SoUL Program was acknowledged since it has demonstrated utility of solar light on lives of the student beneficiaries and their families, most of who are at the bottom of social and economic pyramid. During the workshop, criticality of upscaling the program was emphasized since it targets the students who are future of our country.

There was a general consensus that IIT Bombay has to take a lead in upscaling the program at national level given its experience in implementing the program and the trust and expertise it holds. Furthermore while upscaling, it is imperative that schools should undertake a larger role by providing a platform for not only distribution of the study lamps, but also for rendering after-sales service. NGOs will continue to play a crucial role in reaching far flung rural areas.

7.2. SRC Success Workshop

Total three workshops were held in Jawhar (11-2-2015), Bhilwara (2-3-2015) and in Indore (22-3-2015) with Institutional Partners, vendors, financiers, SRC Managers and project field staff. The objective of this meet was to develop capacity building and make these SRCs solar entrepreneurs. The manufactures who participated in the workshop had national and local presence. They presented different variety of products and schemes to promote solar products to the rural community. National Bank for Agriculture & Rural Development (NABARD) presented schemes to avail loan facilities in procuring these products from manufacturers. They also suggested active involvement of NGOs in facilitating these financing schemes to SRC Managers. The financiers having presence at local level (microfinance companies) and national level were present for the meet.

Image 6: Participants during SRC success workshop

8. Research Activities

Concurrent evaluation was a major part of MSP for continuous improvement. Concurrent evaluation being a systematic and objective assessment of the implementation process of MSP operation aimed at determining the relevance and fulfillment of objectives, as well as efficiency & effectiveness. Evaluation was mainly conducted through two methods, one quantitative methods consisting of large household surveys, and qualitative methods consisting of focus group discussions and interview methods. Qualitative methods acted a supplementary to quantitative methods.

8.1. Methodology

Mainly, mixed approach was used for evaluation which included household survey along with focused group discussions (FGD) and key informant interviews (KII). The objective of household impact survey is to bring transparency in the Million SoUL Program, make mid-course corrections and assess impact of the SoUL. Similar, FGDs and KIIs were used to understand different stakeholder perception and gain supporting evidence to quantitative methods. The research team of IITB conducted the evaluation (Refer Appendix D for details). Within household survey, a comparison between treatment sample (households of students who purchased SoUL) and control sample (households of students who didn't purchase SoUL) as well as electrified and non-electrified households in both the samples were made to understand the impact of the SoUL.

Sampling Strategy for Households Surveys

The household survey was conducted in 20 representative sample blocks. The sampling method employed for selecting the sample was "stratified purposive sampling". The sampling size for treatment was 1.2% and control sample was considered as 10% of the treatment sample. The sampling plan comprises of two stages: Purposive Sampling followed by Stratified Sampling. For Purposive Sampling, the blocks where the MSP has been implemented were clustered and then a representative block was chosen for the survey. This clustering was based on homogeneity of geographical and social characteristics of the population in each block. The second stage of sampling involved dividing the population into strata and then taking a sample through purposive sampling. There were two strata, viz. electrification status of house and caste category of the household. The castes were divided into three categories, namely, Scheduled Castes (SC), Scheduled Tribes (ST) and others comprising general and Other Backward Classes (OBC). Thus, the sample (number of households to be surveyed) was arrived at by referring to Census 2011 block level data which determined the proportionate percentage of electrified and non electrified households and caste composition. A total of 12,771 sample households were covered in the survey, with 11,328 treatment households and 1,443 control households.

8.2. Results from Evaluation

Main findings across four states indicate a shift towards use of solar study lamp from kerosene wick lamp for different tasks like studying, household chores, etc.

8.2.1. Less dependence of kerosene for studying

Direct impact due to SoUL is less or no dependence of kerosene based devices to study. It was observed that only 4.87 percent of children in treatment households used only kerosene based devices for studying, while 22.88 percent of children in control households studied using only kerosene based device.

8.2.2. Improved education

Better lighting facilitates more studying hours amongst children. Interviews with school teachers confirm children now are regularly completing their assignments. Similarly, parents agree that children are now more motivated to study as compared when they were required to study with kerosene chimnis.

8.2.3. Economic saving possibilities

Differences observed between the treatment group and control group in terms of kerosene consumption and overall lighting expenditure indicates the positive impact of SoUL on the rural households. On an average, treatment households spent approximately four rupees less on kerosene per month when compared to control households. Similarly, overall monthly expenditure on lighting was six rupees higher in control households as against treatment households.

8.2.4. Health and Safety benefits

Studying under clean lighting source can have health advantage like no exposure to soot coming from kerosene wick lamp. Children in treatment households are less prone to getting sick or fire burns due to use of SoUL. Similarly, there is increased perception of safety amongst the users as there less fear of animal attack or snake bite incidents due to better lighting from SoUL

8.2.5 Gendered Impacts

Apart from children, SoUL has proved most beneficial to women in the households. Better lighting has improved possibility to complete household chores like cooking, cleaning, etc. with ease. This also allows them to have free time as women have informed to complete their work faster and spend time with children.

8.2.6. Other uses

SoUL aids other activities including ones for livelihoods purposes. Variety of uses with respect to aiding livelihood have been reported by respondents including extended business hours during evening time, milking cows during morning, plucking *mogra*, etc. Better lighting through aids conducting livelihood activities with ease which increases the possibilities of additional income to the households.

8.2.5. Demand for other products

Amongst surveyed households, 48.23 percent of treatment households and 63.89 percent of control households displayed willingness to pay for solar PV technology based lighting

devices. Results from impacts of MSP show potential of targeted renewable energy programs providing alternative solution to energy access (specifically for lighting) problem.

Image 7: A shopkeeper using SoUL during evening hour

8.3. Mid Course Corrections

One main concern with respect to performance of SoUL is the non-functionality rate which was above 16 percent in all the surveyed blocks. While the product quality is being observed as an important issue, inappropriate user handling also serves as a major barrier in long term functioning of SoUL.

Based on this result, mid-course corrections were made in terms of campaigning about availing free servicing facility, organising lamp repairing camps in the schools and improvement in the lamp design. Unavailability or non-reliability of electricity is the key driver for requirement of renewable energy products. Amongst surveyed households, 48.23 percent of treatment households and 63.89 percent of control households displayed willingness to pay for solar PV technology based lighting devices. Results from impacts of MSP show potential of targeted renewable energy programs providing alternative solution to energy access (specifically for lighting) problem. Since purchasing power of rural communities is low suitable financial models need to be evolved so as to convert this demand into purchase and thus fulfil energy needs of the rural communities.

9. Conclusion

Million SoUL Program has successfully distributed 1 million solar study lamps across four states in India. Similarly, over 1800 local people were provided with new livelihood opportunity under the program. MSP model has shown pathway for sustainable model of solar lamp distribution program in India.

The main impacts of MSP are:

- Children have completely stopped depending upon kerosene based devices for studying purpose altogether.
- Children are able to study longer hours at home using SoUL
- Studying with SoUL has led to higher motivation and concentration towards studies amongst children
- SoUL has led to reduced kerosene consumption on lighting by households with SoUL
- Saving on overall kerosene and lighting expenditure there by leading economic saving for household
- SoUL has provided a healthy environment to study which was free of fire risk or black soot emission
- SoUL has increased the perception of safety amongst the users as there less fear of animal attack or snake bite incidents due to better lighting facility
- Further, SoUL has also aided women in completing their household chores like cooking or cleaning the house
- SoUL also proved useful in conducting livelihood activities like running local shops by extending evening business hours

MSP also focused on localization, which has generated confidence in solar products amongst the users. Locally available SoUL along with their service repair warranty has translated to demand for new products in local areas.

Way Forward: National Solar Student Lighting Mission (NaSSoLiM)

If we look at current situation of kerosene using households in India, it showcases a fossil dependent country. Census 2011 reports that in over 2,000 blocks in India, more than 50 percent of the rural households use kerosene as their main source of lighting, which is a very high number. Similarly, India has large percentage of its tribal population. They face infrastructural backwardness and have been distanced from the economic growth and development that India has achieved in the past few years. The literacy rate for tribal populations was 58.96 percent, against 72.99 percent for pan-India, indicating a gap in education. There are 878 blocks fall which have more than 25 percent of its total population as tribal. Overall, there are 2900 blocks falling under the above criterion. It is estimated that over 76 million children enrolled between classes I to XII within these 2900 blocks are indeed in need of sustainable project like Million SoUL Program. This calls for a national level effort towards scaling up of solar lamp program to these disadvantaged blocks. A proposal for National Student Solar Lighting Mission (NaSSoLiM) has been submitted by IIT

Bombay to Prime Minister Office (PMO) and Ministry of New and Renewable Energy (MNRE). MSP has paved way for implementation strategy for national scale program like NaSSoLiM which will help million of students towards education along with creating a large market for other solar products.

10. Utilization Certificate

ANNEXURE –II

FORMAT FOR SUBMISSION OF UTILIZATION CERTIFICATE AS **ON 24/05/2016**

(To be submitted in duplicate)

S. N	Letter No. & Date	Amount
1.	32/2/2013-14/PVSE (Part-III) dt. 23.01.2014	18,00,00,000 (Sanctioned)
	Received on 21.03.2014	10,36,70,000 (Released)
	Received on 08.03.2016	2,23,30,000 (Released)
		5,40,00,000 Balance

Certified that out of **Rs. 12,60,00,000 of grants-in-aid released** during the year 2013-16 in favour of Registrar, IIT Bombay under this Ministry/Department Letter No. 32/2/2013-14/PVSE (Part-III) dt. 23rd January, 2014 given in the Margin a sum of **Rs. 12,60,00,000** has been utilized for the purpose of project "Localization of Solar Energy through Local Assembly, Sale and Usage of 1 Million Solar Study Lamps" and an amount of **Rs. 5,96,12,914** has been overspent of this year.

2. Certificate that I have satisfied myself that the conditions on which the grant-in-aid was sanctioned haven been duly fulfilled / are being fulfilled and that I have exercised the following check to see that money was actually utilized for the purpose for which it was sanctioned. Kinds of checks exercised.

1. Vouchers
2. Cash Book
3. Bank Book
4. Others

Date: 24th May, 2016
Place: Mumbai

Accountant

Signature: _____
Designation: Prof. Chetan Singh Solanki, Principal Investigator
Date: 24th May, 2016
(to be countersigned by the Division Concerned)

S. Sivakumar 26/5/16
सहायक कुलसचिव / Assistant Registrar
परियोजना एवं परामर्शद लेखा
Project & Consultation Accounts
संकायाध्यक्ष, अनुसंधान एवं विकास कार्यालय
Dean (R & D) Office, IRCC
भारतीय प्रौद्योगिकी संस्थान मुंबई
Indian Institute of Technology Bombay
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