Design, Technology and Innovation
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Indian Institute Technology Delhi

Lecture-5
Challenges of Reaching a Million Users Part 1

Good afternoon everyone. My name is *Chetan Singh Solanki.* I am a faculty at the Department of Energy Science and Engineering (IIT Bombay). And I have done my PhD in solar energy technologies way back in 2004. So, the last 15 years, I am working on this technology, and I have been trained to develop the technology on solar cell.

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What also we are doing at IIT Bombay is, I am heading what is called NCPRE which people visited National Centre for Photovoltaic Research in Education where we are really kind of researching on the very fundamental aspects of the materials,

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solar cell design, fabrication of solar cells, modules, reliability of modules, power electronics, whatever under the sun that you need to know, from right from the material till the integration with the generation of power integrate, everything we are doing it. But as I said, what I am not going to talk to you is about technology. Lot of us actually develop a, really wonderful technologies but not every technology reaches the people.

And therefore this experience that I am going to share with you, with my colleague Mr. *Chandran*, we have been working on this project together for many years now, is an example of how that can be done. So, the solar project is called Solar Urja Lamp project, you know, SoUL, and it is really touching to the souls of millions, millions of students. So, Solar Urja lamp is actually the lamp for study purpose.

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But before that let me give the background that there are 17 sustainable development goals, you might be aware about it. One of the goals, that is goal number 7 is a very important goal. What it says is, 'ensure access to affordable, reliable, sustainable and modern energy for all'. It is about energy but it touches every other sustainable development goal whether it is about the Poverty, whether it is about Literacy, GDP, Income Empowerment, or even Climate Change, everything as a relationship with this goal number 7.

So, basically I wanted to tell you in 2017, what is the status of the world, you know. 1 billion people still did not have access to electricity. 1 billion is almost 13-14% of the world population.

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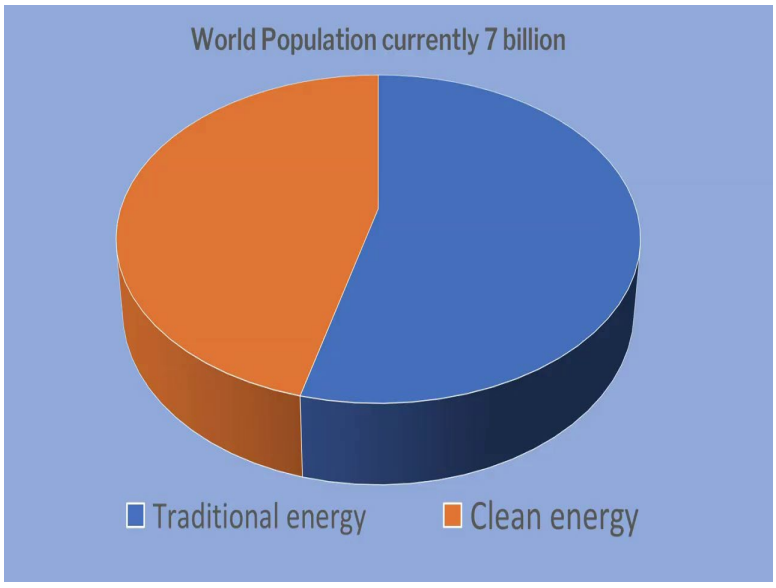

2.8 billion People did not have access to clean cooking, 40% of the world population.

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So they would be using biomass, cow dung, wood, coal kind of, you know. Can you imagine this scenario? That we are in the modern, the most modern world and we have all kinds of technologies reaching to the moon and Mars and what not? But about 40% of the people in the world still do have access to clean cooking. The worst problem is, use of energy is also affecting the climate change. So whatever action that we do using energy it is affecting the climate change.

And we need energy because energy drives our growth but on the other hand energy is also resulting in the climate change. So these are the two opposite ends of the problem.

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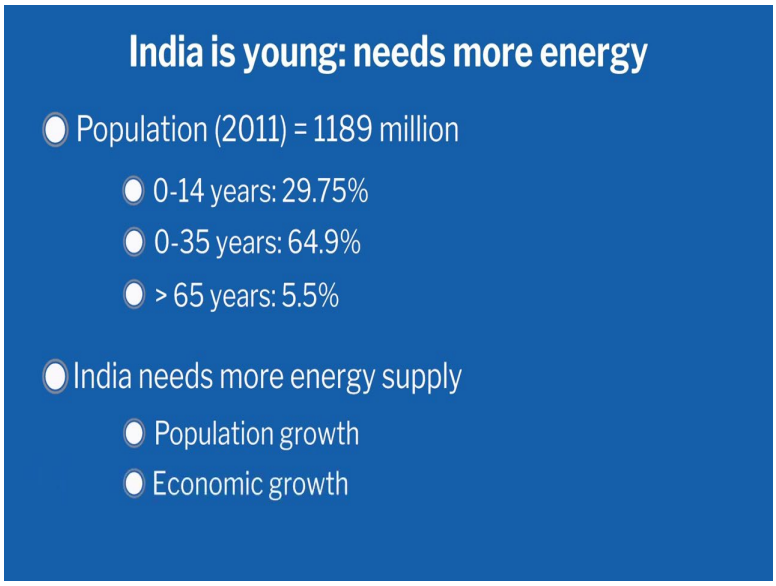

Also for Indian perspective particularly, but it is actually not only India's perspective, many countries are passing through this phases that they are, most of the population is very young. Almost 30% people in India are very young. We need a lot of energy. There is a population growth that requests energy. There is GDP growth that requires more and more energy. And India also imports a lot of energy from outside by the way. We are one of the biggest importers of coal, we import oil, we import gas, we import, you know, nuclear fuel, all kinds of things.

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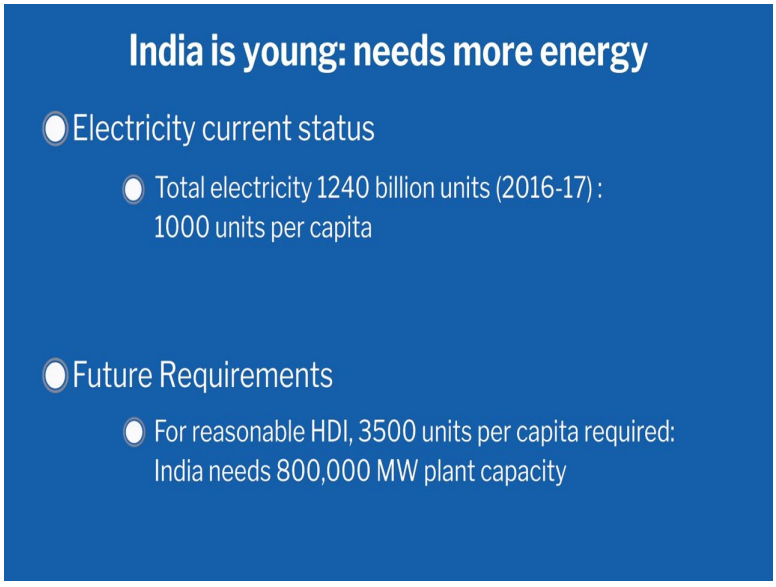

The current per unit capita electricity consumption is almost about 1000 units. And if we go by the average of the world that is about 3500 units, you need 800 thousand megawatt of power plant capacity in India. Right now we are about 350 thousand units. So, again huge capacity addition is

required. Why I am putting this context because you should understand that this path if we continue to walk on this path, you know, it is not really going to give sustainable solution.

Why this lamp which I am going to talk about is very important because education is very enabler, great enabler in every country.

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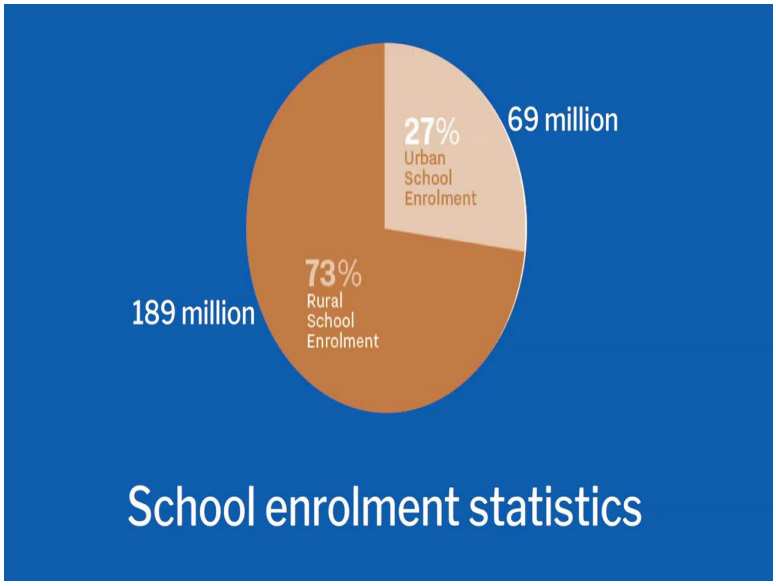

And in India, particularly, a lot of students in a rural area is almost more than 70%. And if you look at the number of enrollment of the students in an urban area and in a rural area, you will find that the dropout rates, i mean the curve is much steeper.

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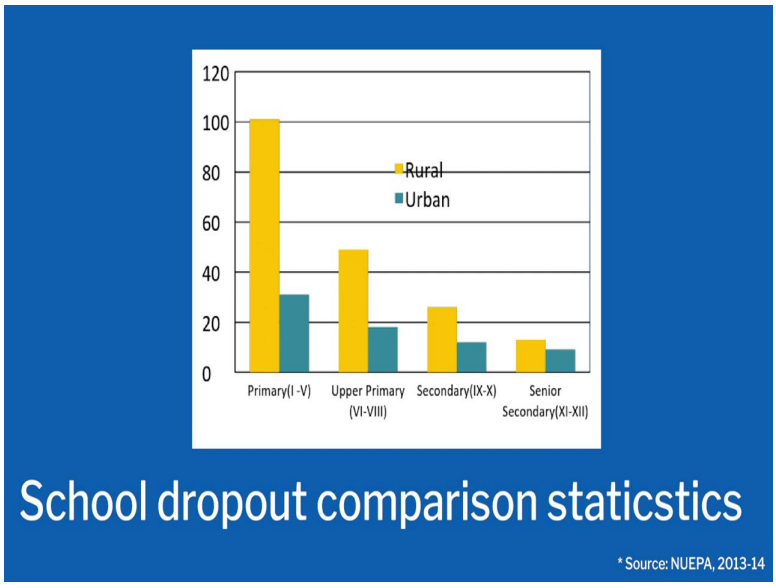

The yellow one is much deeper for the students in the rural area as compared to urban area. Now, there can be many reasons for that you know. Access to the school itself, the teacher, the quality, everything, but one of the reasons that is important, that plays a role here is availability of electricity. Until and unless there is a reliable, electricity solutions are available to them it does not work, the continuity of education is not there.

So as a result of that, many countries around the world, what people do is provide them solar lamp. Why because solar lamps are very simple, standalone devices. You can buy it in supply it and you can supply it in a very quickly.

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If somebody really wants to provide a basic light, it can be done using solar lamp. And everybody has been doing it, right? In India? or why India everywhere in the world. So, if you look at the first kind of solar lamp came in India in 1976. So, it is almost more than four decades that such a programs have been happening but it is not very successful. And that is where the innovation that we are done, in terms of the technology, in terms of the operations, in terms of the materials, in terms of the supply chain. Everything is very important. That is what I am going to share with you. Before that let me show a small video to put the whole thing in a context.

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Could you notice, what is the solution? Solution is of course a solar lamp, but the way we provide the solar lamp is very important. And as I mentioned that what we do is we involve local communities to do each and everything. But how we have come to this idea. I would like to share two kinds of project which did not work very well.

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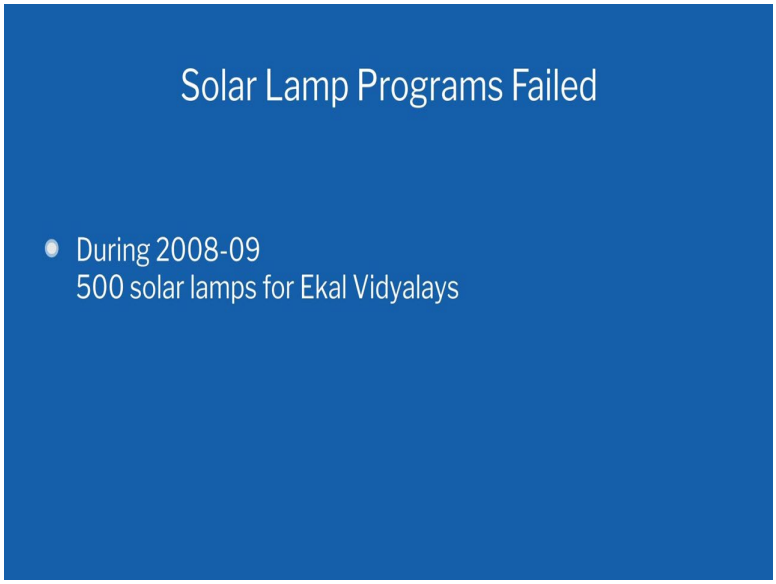

One of the project which we started in 2008 and 09, Ekal Vidyalaya is like a one school teacher and these are the very informal schools, run in a very remote rural areas where children go to the field in the daytime and they could not access the regular school. So they actually go to the schools in the evening. When I went first time to this village in middle of somewhere, you know, we stopped and I said probably we lost the road. They said no sir.

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The place where you are standing is actually the road. So, we could not even figure out the ways to reaching to this village and there are many villages like that.

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I found what people used to do is study like this in kerosene lamp, and so this Ekal Vidyalay's what will people do, they will take a kerosene lamp, they will walk to the school. The school is very informal as I said.

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It is in somebody's house they gather together and study in the kerosene.

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So what we have done is, we have provided them a solar lamp. Now at that time this lamp is as you can see here is about a 5 watt CFL based lamp and around 20 people 25 people would sit.

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And we got a sponsorship at that time when we provided solar lamps to nearly 500 villages. This went to many places in UP, in Madhya Pradesh, even this photo I think belongs to Tamilnadu somewhere.

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So, there are like, it was very nicely distributed and as every other solar program there is a lot of fun fair that, you know, project implemented, 500 villages, so many students are using this. One of the problem of this kind of approach was that the light was not reaching everywhere.

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So we did a small experimentation. Why don't we put it, you know, above the ground? Then as soon as we put above the ground then you will have the shading problem that the base will actually shade the light everywhere else.

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So then we said why don't we hang it upside down. So what I have done is, I have separated the base of the lamp. This is a very old photograph. Somehow I got access, and then we connected another wire in the light was hang on the top so that way the distribution was fine. Well these were some of the experiments we did but within 5 month, 6 months, 7 months the lamp stopped functioning. Sometimes, the battery will not be charged, the fuse will not be working.

Or even if some people, you know, tell us that even my lamp is not working, we couldn't do anything, because there is no way we could reach out to so many different places.

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At the same time, I did another project as I said, with the TERI that a, Light a Billion Lives project where the whole model was a little different what, in this model was that you actually create a central charging station, charge all your lights at one place. The user will actually pay the rent for using it. So the user will come to the centre, take the lamp in the evening the charged lamp, use it overnight and then bring it back in the morning so that it can be charged again.

So, I did three villages with this kind of model, you know, in my village, and the neighbouring villages. But the, after 5-6 month, one year it was the same, the lamps stopped working. Nobody will come to repair it, lamps were also expensive, so people could not afford it.

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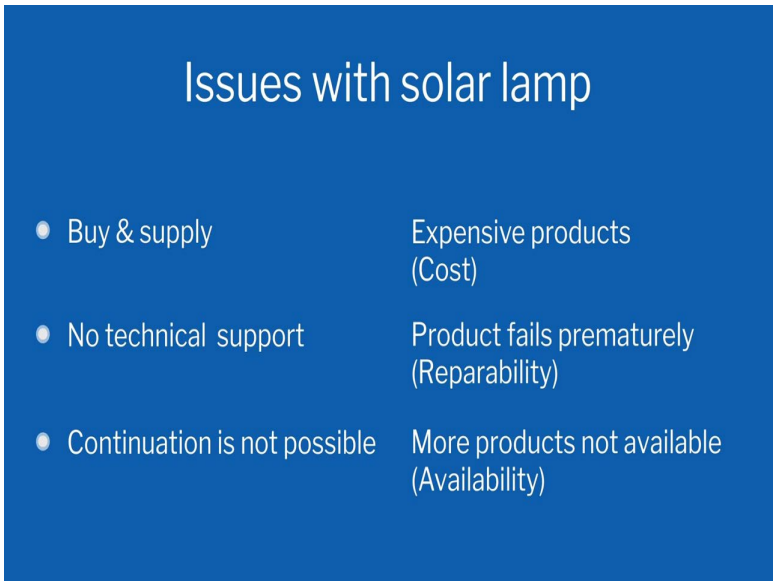

So, in 2012, so one of the problems that I identified is this mechanism of 'Buy and Sell'. What everyone will do? State government, Central Government, NGOs, for those who were running the program, they would buy and sell, as a result the core product will become expensive. Why? Because somebody will make it, somebody will buy it, then it will be transported. Second problem I figured out is that there is no technical support.

So many times a lamp is a very simple device and the problems that were with the lamp were very simple. Sometimes the fuse in the lamp will not be working so you need to change the fuse. Sometimes the soldering point will, you know, get off so you need to solder it again. Sometimes the, the battery will not be a properly charged, so it is a very simple thing. But as a result of this the product will actually fail prematurely. They will not work throughout their life.

And that is the case not only with the solar lamp but all kinds of solar products. It is the same story. The third problem is every time because you are buying and selling the continuity is not there. So if somebody is, you know, buying and providing 500 lamps, if somebody wants to buy one more lamp, (say) 501, it is not available. Right? As a result of that, the Solar solution never becomes continuous. Availability is not there.

So you understood? Everyone? So this is a basic problem. Not only this technology, I believe with every technology. Your mobile phones are working everywhere because you find some guy who

can actually give recharge of 10 rupees also. You can find someone who can actually repair phones in every corner. So, similar thing was required. And not only required, then we also found that even if there is electricity connection in the houses of people still solar lamp is required, because when we talking about study purpose, for studying you need about 150 Lux of light.

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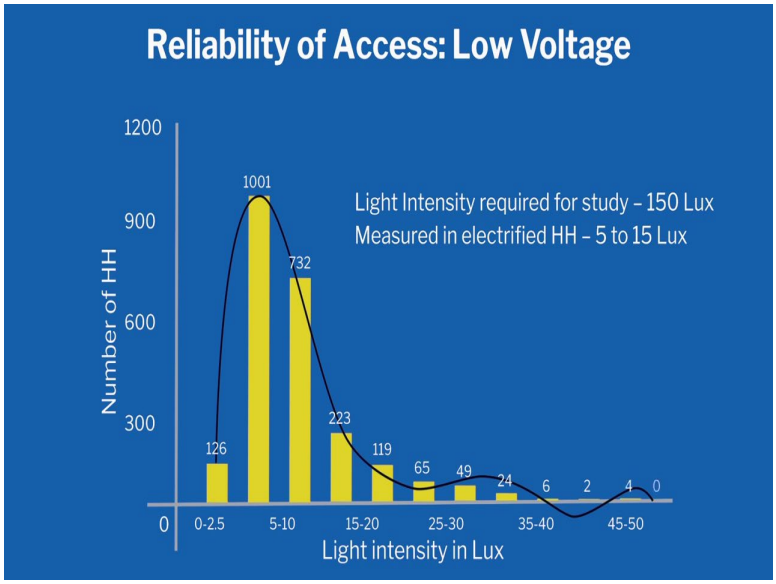

Lux as a unit of light, you measure how much lux is there, say for example, on your table you will have something about 150 lux of it. That is the kind of intensity that we need. We measure this in various houses, almost more than 2000 houses we measured this in various states, like, you know, Punjab, Haryana, UP, Rajasthan, Maharashtra, and Madhya Pradesh. What we found among 2000 households is that the majority of them will have the light level very, very low.

What is this tell you that even if there is electricity there is not sufficient light on the, on the book and in villages there is no table chair, right? So the distance between the light and the floor will be higher. The light will be typically hanged in between the door of the two rooms. So therefore it will be distributed to wider areas.

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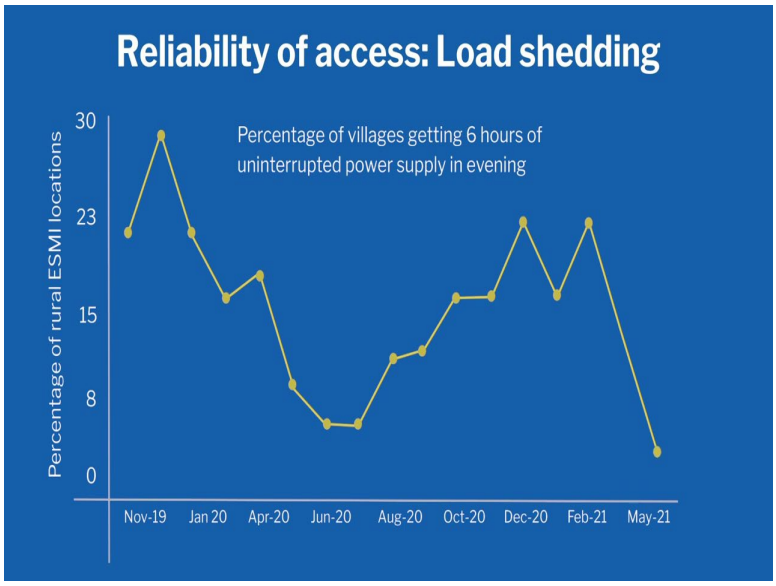

And another problem even if there is electricity connection, the supply is not continuous. So, there is fluctuation in voltage, fluctuation in the availability of the power voltage. There is a power cuts. All those kinds of things will be happening. So together, first of all, when there is no electricity we need a solution. Even if there is a full episode 24 by 7 we need a solution and even if there is partial electricity, we need a solution.

But the solution should actually solve the problem of affordability, availability and reparability. That is what our lamp can picture. If you look at the needs of people in that there is an energy ladder.

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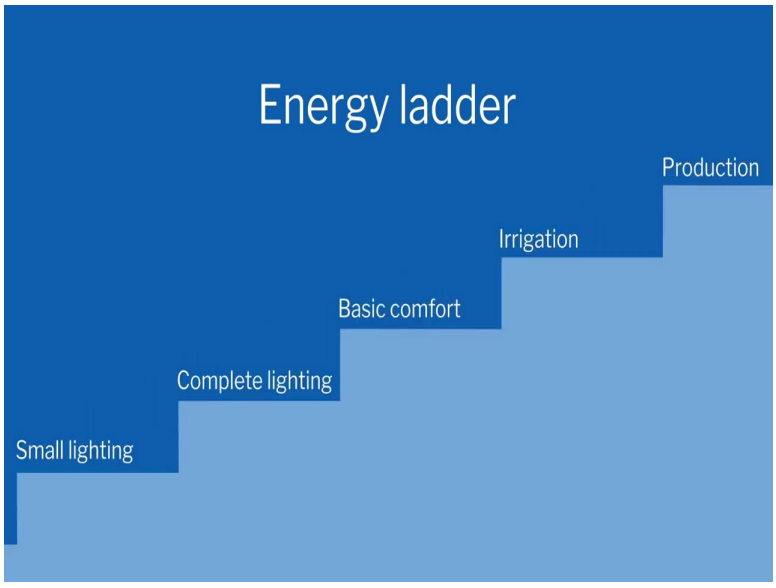

So people need electricity or energy for basic purpose lighting, ones, you know, basic lighting like torch in the flashlight that you use, ones that is completed people would like to illuminate every room, every house, ones that is there you like to have a fan, you would like to have refrigerator, TV then you would like to of course irrigate the farms and then finally if more energy is available you will use it for the production purpose.

You would run some manufacturing, do some processing. So this is the entire energy ladder that we needed to work. But one of the most basic things is providing them light for study purpose as I told you earlier, that we wanted to solve this problem of access to the light so that everybody can study well.

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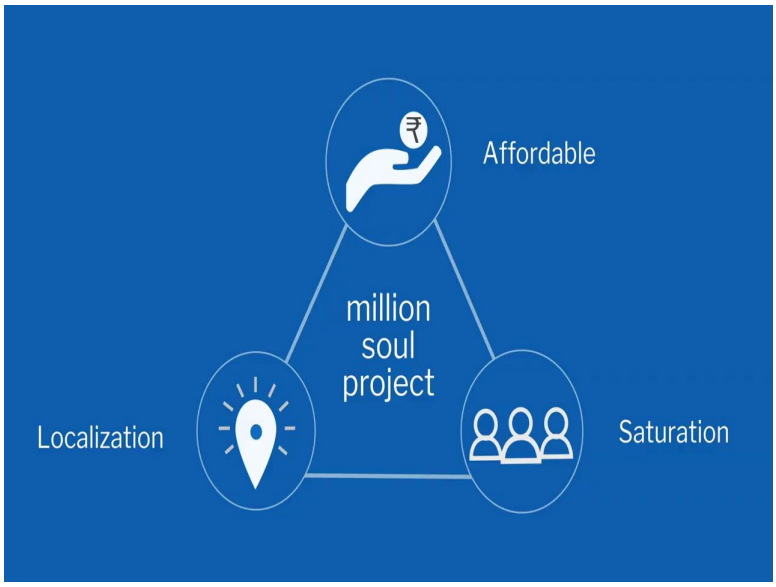

Now, the three problems that I have told you, we thought there could be 3 solutions. Solutions included: How do you find and make the product affordable? How do we involve the local community? and, How do we saturate the area with which we work?

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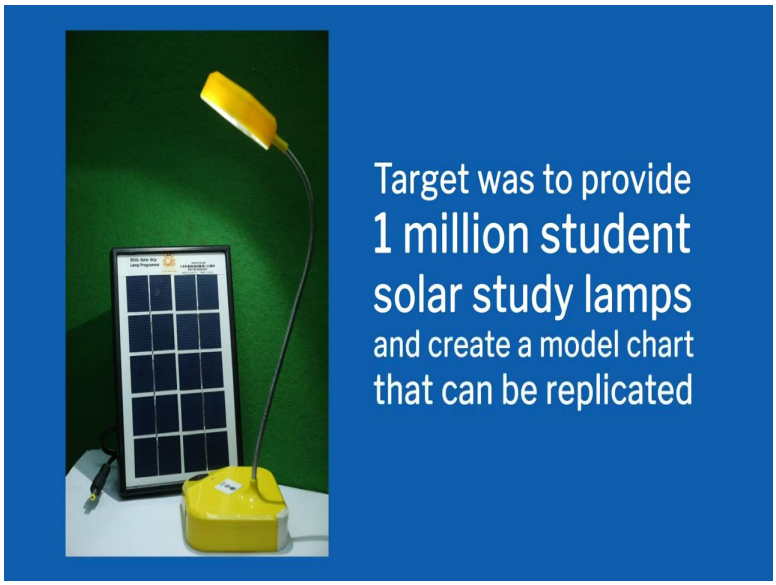

By the way, the program for 1 million, Solar Lamp, you know, that we thought we implemented it from IIT Bombay. 1 million is a big number by, by any standard. And we wanted to do in one year time, so therefore the speed of the whole operation, the scale of the whole operation and the skill that is required in the local community was, was very important aspect of it.