ENERGY IN EXCHANGE FOR EDUCATION

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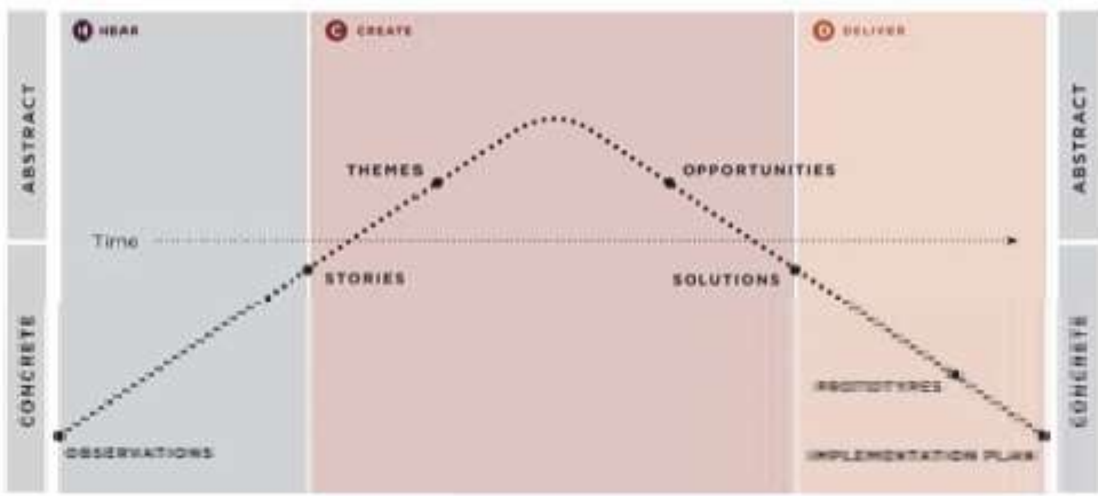
Contents

HUMAN CENTRIC DESIGN

Human Centric Design (HCD) toolkit, made by IDEO, offers techniques, methods, tips, and worksheets to guide community servers to make social innovations via a bottom-up approach. HCD works at the intersection of community desirability, technical feasibility and financial viability – in *that* order. The stages are: Hear (to collect stories and opinions from people in the target community), Create (translate what was heard into frameworks/themes, identify solutions for each and prototype them i.e. moving from an abstract to a concrete stage) and Deliver (realize these solutions through rapid revenue and cost modeling, capability assessment and implementation planning).

The goals of the Hear Phase are: to identify WHO to talk to, HOW to gain empathy from them and HOW to capture stories. The outputs are Stories (qualitative), Observations (deep and broad) and Understanding of the community (especially their extremes). The goals of the Create phase are: Making sense of data, Pattern Recognition from the Hear Phase, Defining opportunities, Creating solutions and prototypes. The activities include Synthesis of data collected (Ideas leading to Directions), Brainstorming among team members (quantity of ideas preferred over practicality), Prototyping (check tangible understanding, impractical ideas get eliminated), Feedback (inspire further iterations). The Deliver phase involves Identifying required capabilities, creating a financial sustainability model, developing an innovation pipeline, planning pilots and measure impact/learning. For more information refer to Document 1: Description of HCD and Plans.

The IDEO way has five steps: Observation, Brainstorming, Prototyping, refining and Implementation. Having dealt with the first 2 steps via the field visits, Prototyping is expected to occur in February followed by Refining. Large-scale implementation will take place in the next school term after the summer holidays.



In the following pages, I document the various Field visits undertaken, the techniques of the Hear stage that they incorporate and the themes/patterns they represent, when integrated. Since prototyping has not yet occurred, I have put in suggestions for solutions of such patterns and for the Deliver Phase as well.

1. Hear Phase

1.1. Identification of a Design Challenge

Challenge: How would we use renewable energy to enhance the quality of education in rural schools?

1.2. Recognize existing knowledge

India's grid system is considerably under-developed, with major sections of its populace still surviving off-grid. As of 2004 there are about 80,000 unelectrified villages in the country. Of these villages, 18,000 could not be electrified through extension of the conventional grid. Most of the schools and homes of students in rural areas thus either have erratic or no electricity. Primary education (till 14 years of age) is free in India by the 86th Amendment Act yet more than 30% of the students drop out before graduating high school. They rarely follow up school work at home.

One of SELCO's ideas to address this challenge comes from Jagadish is to have a system with detachable batteries, a light piece and a solar panel. The solar panels with their charging units will be clustered in the local school. Kids will carry the battery to school, plug it into the charging unit, carry it back home (now charged) and plug the light piece into it to use the light to study. This way the school or its sponsor will bear the cost of the clustered panels thus reducing the cost of the system by 60%. The family will purchase or rent the battery plus lamp (details in the attached Concept paper).

From Jagadish we found out that one of the target communities is located around coffee plantations i.e. forested areas. The clusters are 1-5km away from each other and children have to walk to school. They cannot carry heavy batteries and walking in the absence of light is not culturally possible.

In addition to this information, I also went through the solar lights manufactured by companies named Greenlight Planet, Nest Ltd., Ritika Systems and BP Tata Solar. The specifications of their systems and the feedback collected (submitted alongwith in a folder called IndianSolarLanterns), as well as magazines such as the Solar Quaterly, helped shape some of the project descriptions later.

1.3. Identify people to speak with

I spoke with the following people in the Hear Phase.

1. NGO representatives working on rural education or workers in education societies.
   1.1. Annapoorna Sarkar at the Academy of Creative Teaching, Bangalore
   Email: annapoornasarkar@gmail.com , Tel: +91-9342693231
   1.2. Dr. M.A. Balasubramanya, CEO at the Swami Vivekananda Youth Movement, Vivekananda Memorial Hospital, Saragur, H.D. Kote Taluka, Karnataka.
   Email: mabsvym@gmail.com, Tel: +91-9686666300
   1.3. Poshili at the Swami Vivekananda Youth Movement
   Tel: +91-9686666322
2. Candidate students (rich-poor families, pro-anti families, A-C grade i.e. good to poor performers, large-small families, large-small distances from school, male-female).
   2.1. Jambu Sawari Government Kannada Primary School, Jaya Prakash Narayan Nagar
   2.2. Sitheswar Swami Government School, Bijapur, Karnataka (interviewee: Annapoorna Sarkar)
   2.3. Karike High School, Bagamandala, Karnataka
   2.4. Kaveri Primary School, Bagamandala, Karnataka
3. Families/guardians of the above students
   3.1. Government Lower Primary School, Balle Hadi, Karnataka (Contact: Poshili)
4. Principals of rural schools
   4.1. Jambu Sawari Government Kannada Primary School, Jaya Prakash Narayan Nagar (grid connected/erratic grid)
   4.2. Government Model School, Devanagondi – Hoskoti Taluka, Karnataka (Erratic grid)
   4.3. Swami Vivekananda Tribal School, Hegar Devan Kote, India (Erratic grid)
   4.4. Government Lower Primary School, Balle Hadi, Karnataka (grid unconnected) (Contacts: Shivanand, Sashikumar)
   4.5. Karike High School, Bagamandala, Karnataka (Erratic grid)
   4.6. Sri Kaveri PU College (by the Kaveri Education Society Management Board), Bagamandala, Karnataka (Erratic grid)
   4.7. Kaveri Primary School, Bagamandala, Karnataka (Erratic grid)

5. Teachers of rural schools (grid connected, erratic grid and unconnected areas)
6. SELCO staff involved with education and energy products
   6.1. Jagadish K at Innovation Lab, SELCO, Bangalore
   6.2. Ravikanth, Sales Manager, SELCO, Bangalore

Other useful contacts, who I will try to meet up if I have enough time, are:

1. Prakash, Resource Manager at the Swami Vivekananda Youth Movement, HD Kote
   Tel: +91-9686666324
2. Swami Vivekananda Youth Movement, JP Nagar Bangalore branch
   Tel: +91-80-26586934 Website: http://www.svym.net/index.htm
3. Subhra Chatterjee at Vikramshila – Education Resource Society of India, Prince Anwar Shah Road, Kolkata
   Tel: +91-33-32926084, +91-33-24229194, +91-33-24224855, +91-33-24229175
   Website: http://www.vikramshila.org/

More candidate sites where education could be a target audience concern in Karnataka are: Jankhandi and Tikhote (both being remote areas with private educational institutions), Bidar, Gulbarga, Salem, Shivamogga and Bijapur. Of course, it is never an upper limit on people to interview.

2.5. Choose Research Methods

Each of the above contacts were researched with a different research method – one of the 7 suggested in the HCD toolkit. The other techniques as planned in the previous document under the topics of Interview Guide and Techniques of the Hear phase are used within these research methods. The methods were executed with a beginner's mindset i.e. putting aside previous knowledge and asking for explanations to observations, experiences, assumptions, questioning the logic and understanding the effect of new information and what stands out. The following paragraphs document the findings with an observer's eye rather than an interpreter's. My PICASA album has photographs of almost all the site visits, to help understand the words better. Ideally, each of these stories should be written on paper in point format by the various field visitors. Patterns and themes are identified later and system designs suggested for each of those themes.

2.5.1. Individual Interviews

1. Interviewee: Poshili, NGO representative of the Swami Vivekananda Youth Movement
   Location: Hegar Devan Kote, Karnataka
   Background: Poshili took me to the tribal belts of Balle Hadi, 80 kms from Mysore and served as a translator too as the tribals trusted her.

   Insights: Children below the age of 6 attend a pre-school, provided free by the Government under the Balwadi scheme. Solar has been tried by the govt. but it didn't work because the kids sold off the hardware. Now electricity is subsidized in tribal areas at Rs 5/month (Bhagya Jyoti and Kutira Jyoti schemes). There are no proper roads to the tribal belts, no electricity connectivity. These areas have 25 degrees celcius year round but has over 900 mm rain in the monsoons – the latter is not good for solar. The students are much better at Hindi and physical work than at English or Math, they even like those subjects better.

2. Interviewee: Shivanand, Principal of Government Lower Primary School

Location: Balle Hadi, Karnataka

Insights: There are 2 classrooms, 500 sq. ft each for 38 students till 5^{th} grade. After graduating from here, students attend Govt. Tribal High School and on an average about 2 continue after that. The houses are located around the school itself and have no power – candles and kerosene are used that cost ~ Rs 2/day under govt. subsidies. Neither student nor parents are interested in studies, daily labor earns them more. Attendance is above 90% for all year except ~ 4 months when everybody but 5-10 of 38 students migrate to Coorg with their parents. Nobody studies there. Parents have never studied so education importance is not known at all (eg. Nobody bought even pencils for their kids the whole of last year, they're dependent only on what government provides free for them), so poverty is not the only problem – reasons to dropout. They live on a day-to-day basis with no large aspirations or dreams. One would have to provide them with the system and check its social feasibility.

The school cannot take the charging unit responsibility because they already have too much to do. They have to take responsibilities of even the high school most of the time (eg. Their census). He suggests putting the charging unit in the Gram Panchayat – the distribution of labor in this place does not sound professional.

3. Interviewee: Jagadish K
   Location: Innovation Lab, SELCO, Bangalore, India

   Insights: 60% cost reduction due to using this system. Kerosene takes Rs 600 in 8 months which is the cost of the battery and the light handed to the student. Bhagamandala is an ecologically important place, no grid connectivity due to being a forest area, positive responses from schools this motivated the SELCO project there, seems to be selling points.
   Solar – good for environment, regular, poverty is the main challenge to sell the lights. Look for partners in book providers, etc. In city cites, a candidate spot is the Banaswadi Slum.

4. Interviewee: Ravikanth, Sales Manager
   Location: SELCO, Bangalore, India

   Insights: SELCO has installed 13 home lighting sets in with 2-4 lights per set for schools (?) but the problem is that charges are too high ~ INR 45000 in installation for 3 hrs of use / day is difficult to sell In rural areas. We need sponsors or donors to take on the initial capital cost. Schools can be divided into public govt schools and private schools (eg Akshaya Foundation) this could call for another division in the table above. He suggested a school in Whitefield, Bangalore whose quality of education is good but the infrastructure is poor. We shall visit this school for a site visit on 4th December when they reopen after New Year. Solar electricity required for (1) bathroom lighting at night so that people use the bathrooms instead of unhygienically using the fields - lanterns versus fixer lights – the latter are much more cost effective because they have much more capacity and a 3 year warranty. Yet people do take lanterns because of fancy in spite of its 2 year lifetime and 6 month warranty. (2) Mosquito repellant lamps – more important than fans.

2.5.2. Group Interviews

1. Interviewee: Principal and Teachers of Government Model School, Devanagondi

Location: Hoskoti Taluka, Karnataka
Background: This school has been supplied with SELCO lights for all classrooms under Hindustan Petroleum Corp. Ltd. Sponsorship. The system took INR 3 lakh to install and requires Rs 500/month to maintain.

Insight: A lot of the student homes have > 4 hours of daily power cuts. Convincing kids/parents to buy SELCO products individually will be the main issue – rental system will be much better than free or purchase. 3 months of the year, before the exams, the school holds tuitions from 6:30-8:30 pm, has 50% attendance in them (because others live >4 km away) with ~ 1:1 gender ratio. The regular school gets over at 5 pm. Almost the whole class goes upto high school but only 50% continue after that. Girls are mostly married off. Some drop out because they don't like to study. While in school, girls are more brilliant and better performers. Their idea of success: Doctor, engineer, lecturer, govt. officers. Average parent salary is INR 1500/month. The electricity bills are ~ INR 100/month, cable subscription ~ INR 100/month, radio batteries ~ INR 15/fortnight. Energy utilization occurs via mobile charging, TV, gas stove, fan, lights, pressing iron. The school has 4-5 new computers given to them by the government but the teachers have not yet been trained to use them. The school does not have grid connectivity either. They also have a DVD player and a satellite television, attached to a solar panel, given by the government to screen UGC programs but that too has not worked for the past year and nobody has responded to their complaints.

2. Interviewee: Principal, students and teachers of Karike High School
   Location: Bagamandala, Karnataka
   Translator: Jagadish K
   NGO partner: SKDRDP - Sri Sethra Dharmastha Rural Development Program (Contact: Mr. Anil Kumar)

   Insights: The school is situated in a very hilly area (>3000ft above sea level and undulating, forested land) and has students coming from upto a 7-10 km radius. The school begins at 9 am ends at 5 pm, so keeping in mind the 5-10 km walking distance, the only time available to study is in the night. The teachers were happy about the SELCO system because now kids would not have an excuse to not do their homework – electricity cuts caused them to default a lot. 72 students of 153 in classes 8^{th} to 10^{th} do not have electric supply and a list is available with Jagadish. Gender ratio was pretty balanced. Performance and attendance were not enquired (contacts with Jagadish). The teachers commented that the kids try to do their homework regularly. The students use kerosene lamps to study and the smoke hurts/burns their eyes . Also the government provides 2 l (@ INR 25) of kerosene per month which is mostly used by parents for house-lighting purposes, so kids don't get much of it. Extra kerosene (over the 2l) costs INR 25 per litre, so purchasing extra usually is not an option. The students gave the feedback that SELCO Light is sufficient to study and were happy about the no smoke no heat. They also agreed that the battery was light enough to carry to school. We did not speak about money matters since the intention of the visit was primarily to see whether the school was a good candidate for prototyping Jagadish's model to check technical feasibility and technical acceptance by students and the school. This school has been selected for prototyping Jagadish's solution.

3. Interviewee: Principal, students and teachers of Sri Kaveri PU College, Kaveri Education Society Management Board
   Location: Bagamandala, Karnataka

Translator: Jagadish K
NGO partner: SKDRDP (Contact: Mr. Anil Kumar)

Insights: The school has 218 high school and 161 junior college students, out of which 41 do not have regular electricity. Due to being a government-aided but private institution, attendance is well over 97%. Performance seems to be reasonable too with a 95% pass percentage in 12th grade and a 10% dropout rate. The kids come to school from upto 7 km away – they walk the distance. The students were enthusiastic but teachers didn't seem quite so. This school has not been selected for prototyping.

4. Students of Jambu Sawari Government Kannada Primary School
   Location: Jaya Prakash Narayan Nagar – within the city limits of Bangalore hence justifiably the most urban school I visited, though catering to very poor kids.

   Insights: While there were a few who wanted to be engineers (one bright spark specifically said civil engineer), there were plenty who were not at all motivated toward math or science. These kids liked handwork like carpetary and wanted to pursue it as a career. The girls' aspirations ranged from doctors to government officers. The gender ratio was balanced. Most of them had severe power cuts at home but this is mainly during summers.

2.5.3. Incontext Immersion

Community: Tribal community in Balle Hadi, 40 km from Hegar Devan Kote and 80 km from Mysore, Karnataka.
Background: Full day trip via car on very unpaved roads. We drove to HD Kote, picked up Poshili and then drove to Balle Hadi. We spoke to the principal of the local school, children, parents and various other members of the community.
Translator: Poshili

Insights: Extremely small huts with 1 or 2 rooms only. Roofs are thatched and walls are mud. The kitchen comprises of a coalwood-using stove, a few vessels and vegetables. Society is very very community driven. There is no concept of marriage and sequential but not simultaneous partners are allowed. If a man defaults in taking care of his children, the community takes care of them. Health is very poor and malnutrition is prevalent – there is no awareness of going to a hospital if someone falls sick, the community takes care of the sick person with indigenous methods. There are no bathrooms, they use the fields instead. The village has 8 solar lamp posts provided by the govt. but most have not worked for over 6 months. In the absence of even grid electrictity, they use kerosene or fuelwood for light.

The people, especially the children, are very shy. Most of the kids I interacted with were named after famous filmstars. They said they liked school. Some members of the village, mostly women, held a meeting with us after setting us on large straw mats. They liked the concept of solar lights and seem ready to pay even double the amount they spend on kerosene per day if a rent was available provided they could own the light after installment payments. They repeatedly asked whether the light would belong to them the way their mobile or radio does – they seemed to prefer that. On the other hand, they were apprehensive about a single down payment of about INR 800. One even asked how her family would get light if they didn't have a school-going child.

The community is against child labor. Nonetheless, in the recent past just 1 student had continued beyond 8th grade. He too dropped out before graduating high school – motivation is a big hurdle. They are visually creative. One hut (of a certain Putappa) which was barely 200 sq. ft and had nothing but a mattress had a self-engineered radio. Utappa's wife said her son had assembled it for her from scrap materials of other broken electronic goods. It was incredible that it worked!

SVYM brought in a moving caravan for Balle Hadi that day which screened a movie based on HIV awareness. I watched parts of it (in Kannada so couldn't follow) with the 50-60 other people who had gathered to watch it with their families. They were shy at first but very welcoming later.

2.5.4. Expert Interviews

1. Interviewee: Annapoorna Sarkar
   Location: Academy for Creative Teaching, Bangalore, India

   Insight: Children don't come to school less for economic reasons and more for cultural reasons. For example, girls from well to do families are not allowed to attend school after coming of age (Non attendance to school due to culture, as shown in the table). The children who do not attend school for economic reasons ought to be given some assurance of employment in order to motivate them, for example they can be guided into art/crafts industry or also into teaching – since government schools are lacking in good teachers. Good computer education in high school needs to be imparted so that they can be absorbed into the IT or marketing industry – this way they have hope for employment over and above daily physical labor. Vocational training is important right from school. In terms of electricity, even those connected to the grid have very erratic supply for example, Gulguli has power cuts of almost 14 hours a day. Another problem is that in a lot of places attendance statistics are made up – kids from affluent families have their parents pay for their attendance (Non attendance to school due to culture, as shown in the table). Grace marks for attendance? Grace marks for good cultural habits?

   On a visit to Sitheswar Swami Government School in Bijapur, she (as a ACT representative) found that school has hours till 3 pm and 5:30 pm for primary and high school. 6 sticks were confiscated from the school and beating children strongly discouraged. Students come to school from pretty far away by Government buses – cycling to school was encouraged though girls seem to cycle much more than boys do hence were healthier. Male:Female ~ 2:1 (cultural reasons plus girls are married off early) but the girls who did attend school were more motivated than the boys, had higher pass percentages in spite of having more home labor. Students are very good at art – should be taught vocationally so that not only do the kids remain interested but also have some job direction like a govt. art teacher, WBSC, compound wall painting, etc.

   Incorporating a radio into energy providing devices could create a distraction for those who are less motivated. Success of any model can be checked by surveys asking about the success of the prototypes to assess how much *our* system has helped metrics like pass percentage, attendance, continuation of higher education, etc. SELCO's products are encouraged because the people here can afford but do not have electricity.

2. Interviewee: Dr. M.A. Balasubramanya, CEO at the Swami Vivekananda Youth Movement
   Location: Vivekananda Memorial Hospital, Saragur, H.D. Kote Taluka, Karnataka.

   Insights: Areas in Sargur and HD Kote have power cuts of >12 hours and 1 phase supply for 8 hrs. If the takers default by a few rupees, the power gets cut and takes months to be restored. The area is connected to the grid only on paper. According to government law, if the child has to walk > 1km, the government opens a primary school, hence the same ills that haunt the community in terms of energy haunt the school as well. The system being developed must be robust in heavy rainfall and cloudy times too. SVYM Hospital has a 2.2 kW power generating unit based on solar which cost 14 lakh but that falters in the monsoons. Solar water heaters hardly function 15-30 mins for those 4 months of the year.

   SVYM runs 2 schools, one on the hospital campus (5-6 years old and has 600 students) and one about 25 km away (mostly catering to tribal students and 380 of the total 419 students are first generation learners). Their residential schools have solar lighting for yards and homes and diesel generators to take care of other energy needs eg. Kitchen lights, lab supply. 12th grade pass percentage is 97% - school of excellency.

   To bring such a system into large-scale use within the tribal belts of HD Kote would require a community partner which can engage within the target audience because tribal zones take a very long time to trust outsiders and are prone to misinterpretation. They have a very high sense of pride in spite of their economic conditions. They don't have basic health awareness, let alone energy. Most of the government provided systems in the villages do not work so convincing them of the maintenance dependability of SELCO should be priority. Also, the financial model has to be very strong to support solar's case when other environment friendly options using available resources (eg. Smoke-free choolah which haves 78% fuelwood/day, developed by IISc) are available. Will schools be ready to handle simultaneous charging for 300-350 students?

2.5.5. Seek Inspiration at New Places

Subhra Chatterjee of Vikramshila – Education Resource Society of India
Location: Prince Anwar Shah Road, Kolkata

Insights: Was not in town. But contacts have been established – the society runs an urban and a rural school. The administrator in charge of the rural school would be most willing to speak to SELCO (especially since they were looking into solar solutions already).

2. Create Phase

Indian society is segregated among extremes and the Hear Phase brought me to the same conclusion for our problem too. It is essential to understand this design challenge within an extreme of audiences so they can be grouped into categories with similar energy-education needs. Table 1 shows these categories. The target audience is divided into 2 groups of regular OR irregular grid. Each of the 2 groups subdivides into those who attend OR do not attend school. Each of those groups subdivides into those who study at home and those who don't – and the reasons for all the above.

Given our capacity as a solar energy company trying to improve education, we can effect relatively less changes among the audiences connected to regular grid electricity – hence, not required. The audiences with erratic or no supply are ones we can try to affect with our programs. Among them are children who do not go to school at all and those who go to school but do or do not study at home. The potential reasons for the above choices are inserted as boxes within the table. SELCO's present idea (ref: Jagadish) addresses box 4.3 i.e. those students who attend school and cannot study at home due to lack to resources. HCD brings forth some of the other problems that could be looked into to see if an energy provider company can provide solutions.

<table>
<tr><td></td><td>Grid Electricity Connected and Regular Supply</td><td colspan="5">Grid Electricity Connected and very erratic Supply/Grid Electricity Unconnected</td></tr>
<tr><td>Attendance to school</td><td>Not Required</td><td colspan="4">1.Yes</td><td>2. No
2.1.Economics 2.2.Culture</td></tr>
<tr><td rowspan="2">Studying at Home</td><td rowspan="2">Not Required</td><td rowspan="2">3.Yes</td><td colspan="3">4.No</td><td rowspan="2">Not required</td></tr>
<tr><td>4.1.Self Motivation</td><td>4.2.Economics – work elsewhere</td><td>4.3.Lack of Resources</td></tr>
</table>

Table 1

2.1. Themes

Some key themes as noted from the field visits have been cited below in the left column and a possible solution or an addressing to that theme on the right. According to HCD, as more people modify this document, the following table can be modified. Ideally the concerns must be arranged in order of 'levels' i.e. we start at lower levels (such as small concerns regarding attendance) and go to higher levels (such as larger quality of education, etc.).

THEMES/INSIGHTS	SOLUTIONS
Rural social life priorities: Communication (India is the world's second largest mobile phone user, whether or not a home has light, they certainly have cellphones), entertainment (if a family can manage 2 square meals a day, they are sure to own a battery operated radio. If they have electricity privileges, they even have a TV and a cable subscription), food, time, labor efficiency. Lights, however, are considered a luxury. Refer factors and forces exercise in the Appendix	For those who do not attend school, SELCO can act as an energy provider. Just like the midday meal system increased attendance because the child was bringing in food for the family by eating a meal on his own account, via linking school and home via solar energy, the child could bring home energy by just attending school. Here solar energy is not just lights but any kind of low wattage energy the community needs. Different types of combinations could be made: only lights, lights with mobile chargers, lights with mosquito repellants, lights with radio (the combinations or multiple of them have to be decided depending on the community, i.e.

	which of the categories in the above table they fall into). Advertising our system as an energy provider via the school-going child may increase its sales. Introducing cleaner, healthier light in this way could force the community to raise their standard of living and soon they would be ready to buy only lights – similar to the way mobile phones took India by a wave, and as the demand increased, sales increased, prices dropped and so on in feedback.
Entertainment is so prevalent that even in poorest of families can spend INR 15/fortnight on batteries to power their radios. These very same families refuse to spend money to buy pencils for their kids – the do not want to spend any more than what the government provides for free as education.	In such communities, using a radio is a very good selling incentive over and above light for home. However, battery must be divided into a fixed ratio for energy for light vs radio to prevent parents from using up all the charge for only the radio. The system must be engineered to sell itself but at the same time, force the use of healthy lights by the community.
The times the govt. tried distributing free solar lights, the takers sold them all off and remained light-less.	Other than for ONLY checking technical working of the system, giving the system out for free will not prototype real world conditions at all. If SELCO is confident about its product technically working, the prototype should be charged nominally in order to see how smoothly the whole scheme functions in terms of return to (even if small) investment for teachers, parents and students.
Electricity is lacking mostly everywhere. The ills that govern a community govern the school itself too, since primary schools are installed if a child has to walk > 1 km. Computers and hence, the huge advantage of using internet for education, are not being exploited yet.	How much of the electricity-needing products can solar energy power? Now we can think of mostly lights, mobile chargers and a maximum of low power generators. More innovations are required to find products that can substitute a high-power computer in order to be able to access the internet and showcase it via a low-power device. The low-power projector scheme could take care of the showcasing part but combining it with broadband internet would be a quantum leap.
In rural India, trust and relationship faith are very important. The older ones in the community are most trusted, while the political strongholds are feared more than relied upon or respected. Refer Appendix for Community characters. They also trust known sellers more than unknown ones before making a purchase. Refer to journey of an offering exercise in Appendix.	If SELCO is not in deep direct participation with its customer group, it could partner up those who are. Since this is community driven, NGO partners to convince people of the applicability of our specific design to the target community are required.

The government defaults in more than 90% of the solar maintenance cases, which has turned communities skeptical.	Communities must be convinced of SELCO's follow-up and maintenance capabilities in order to get into an intricate collaboration.
People have observed that solar heaters hardly work in the monsoons and have similar questions about the lights.	Communities must be convinced of solar sustenance even in the monsoon months when there is little sun – their money must be defended.
If the system does become popular, what would students do when there are summer holidays and they donot have access to the charging unit? Note: Summer months have the maximum number of power cuts.	This is more higher level because it addresses making a common charging unit a better incentive thus a cheaper alternative an incentive for solar power rather than just stick to education. If the scheme for a common charging unit works for education, it could be implemented in other areas with an incentive to reduce costs. A potential place could be the Gram Panchayat.
If lamps and chargers were to be disconnected, what would the students do with the lamps once they graduate from school and they do not have access to the charging unit?	Resale of the lamps after students graduate could be an option – financial model.
How will success be measured? If the design challenge is as broad as ours is then key metrics would be attendance, pass percentage, number of students continuing education, employment. However, just coming to school and having resources to study at home will not improve the above metrics (for eg. Those who are not motivated enough to study i.e. Row 3, Col 4+5, selling them lights to study will not help) – partnership with education societies and other stakeholders would be required to address such a holistic improvement. Also, the private schools on Bagamandala had about 97% attendance. Naturally, there is little scope of improvement in such a metric so it can hardly be used to judge success. Technical success – only a subset of IDEO's design definition - can be measured directly by number of sales, feedback via surveys.	We could start with metrics such as sales to check technical feasibility, move onto schools which have attendance or a direct metric issue to check cultural improvement and then move on to metrics like performance and attitude toward education (checked via pass percentages and surveys).
Most of rural India lives on a day-to-day basis and become daily laborers. Only villages on the outskirts of cities have large dreams of becoming government officials or doctors. Refer Aspirations exercise from Appendix. Large down payments for a new system like this is not being well-received. Also, the tribals were skeptical	1. A robust financial model putting together rental/installment payment is required, one which allows some sort of ownership of the system by the community too. It has to account for and convince the audience of the fact that even if they own the lamp, it's not going

rentals too much and wanted ownership. Nonetheless, Subsidized govt. kerosene costs INR 25/2litre and INR 25 for each additional litre. Villagers were ready to pay double that rent for solar lights, provided reliable.	to be much use when the kid's out of school or during summer holidays. 2. SELCO could tie up for the maintenance of the defunct government solar infrastructure which seems prevalent in most rural regions, even in the most backward ones, and hence save on installment costs.
Energy consumption of households is mainly for cooking, entertainment (TV/radio), mobile communication and battery operated torches. Some villages do not have bathrooms not only because there's no provision to clean up but also because there's no light to use the bathroom at night. Refer Resource flow exercise in Appendix.	Introducing lights with such energy options (mobile charger, radio) would increase incentive to buy SELCO products. Care must be taken for introducing the radio option in areas where educational motivation is already less because it would become more of a distraction than a use. Solar lamps can be carried to bathrooms too, more hygienic an option.
While few teachers are enthusiastic. Most schools may see any solar linkage system as a responsibility burden (Karike teachers were concerned about the panels getting stolen, Balle Hadi teachers said an absolute no to more responsibilities above what they already have).	It is important to prove the advantages of the system in a community where the metrics will clearly stand out. This system can be initially implemented via sponsors to provide incentive for the school and maybe a free light for the teachers to provide incentive to them. Thereafter, the government can be requested for funds and external pressure on schools to take responsibility of such a system. The panels would probably have to be locked within rooms at night.
Most rural schools had teachers who were not very technically trained and also shortage of teachers. Jambhu Sawari and Hoskute Taluka had computers that were unused due to no trained personnel to use them.	The solar projector system will require well trained teachers in computer systems and projectors. Thus, the groundwork for this system would depend on the community knowledge. Training kids to vocationally become such teachers would also be an incentive by providing job assurance.
While SELCO can very partially motivate students/parents to attend school by providing them energy to tale back home, lack of motivation has more impending causes such as dislike for math, lack of parental interest (because most kids are first generation learners) and a lack of well trained teachers in most schools.	To beat culture, educational NGO partnership is required, although again this comes on a later level. The following could increase motivation toward education: job assurance, vocational training in the physical activity (eg. handicrafts) of their choice so that they are in a better position to pursue what they like after school, vocational training in IT/marketing so that they can fish for better jobs than daily labor (sp. For students who donot like conventional science). Students can be trained to become teachers later – job assurance since there are so many vacancies in the govt rural school teaching field

	anyway. The solar projector program specially requires such a partnership. Portable solar projectors are also an option to be taken village to village by NGO partners to popularize the concept (by showcasing educational videos, ppts, etc.) before schools invest in permanent ones.

2.2. Project Suggestions

We must engineer the system such as to provide cheaper energy – whatever kind the household needs PLUS lights – to homes in exchange for sending their kids to school. Basically the reasons/economics of NOT sending kids to school or allowing them to study as enumerated in Table 1 must be weighed out by the interests in cheaper, better and easier energy. How well SELCO can do this and convince their audience that they are doing it, is the heart of the problem.

- Types of battery systems required would be : (1) Double lights with regular charging facility, one advertised as use for kitchen or bathroom torch purposes and another hopefully used to study – each could have different lumen rating. (2) Light with light and mobile charging facility where-in the charged battery should be fixedly split in > 1:1 ratio of KWH. (3) Light and low-wattage mosquito repellants with charging facility for both where-in the charged battery should be fixedly split in > 1:1 ratio of KWH. Let customers choose which they want.
- Another system: Light and rechargeable radio batteries (NOT the radio) with the wattage fixedly split such that the light runs *much longer* than the radio batteries per day. Even if this system costs more, they'd pay because they spend money on radio batteries (we are assuming these customers have a radio and use it) whether or not they have electricity. We do not provide the radio to save costs on us and ensure that we are not introducing a distraction into families that weren't distracted by the radio.
- Keep an option for scalability for all the above, i.e. to switch between the lumen value of the lights; to incorporate radio-battery chargers, 2 lights and mobile chargers in the same design; etc.
- Make the batteries robust and *water-tight* so that kids can carry them to school without damaging them. Bright but serious colored systems (eg. mustard) are preferred.
- Lights must have a base or a stable base. Consider adding a diffuser for higher lumen lights.
- All the batteries must have charging lights to indicate when it has fully charged when at school. Overcharge and discharge protection required.
- Systems should be such that batteries get charged even on rainy days.
- The solar panels must be locked at night.
- Financial model can be either a full down-payment or installments of about price_of_lamp/lifetime_of_lamp scaled by the period in which the rent is collected, NPV corrected. Both have pros and cons.
    1. Installments run the risk that the child may default and sell the lamp.
    2. Installments run the advantage that the rent leads to ownership once the full price is recovered if lifetime<schoolyears and if not, the kid can return the lamp to the school and another kid may use it at the same rate for the leftover lifetime. No resale is required.

Installments also negates the requirement to buy the whole thing which most people are not ready to pay. They prefer comparing solar rent to kerosene rent on a monthly basis.

3. Down-payment run the risk of those living on a day-to-day basis not buying at all
4. Down-payment saves the risk of the child defaulting and selling the lamp. The resale value once the child graduates could be (time_of_lifetime_left/lifetime)*original_price, corrected to NPV.

Which is best can be figured out by asking, during technical prototyping, how the specific customers would like to pay. The best option would be a microfinance scheme (like the Gramin Bank) if the customers are willing.

If families migrate or kids graduate, we assume that they don't get solar light anymore because the present scheme is – if you let your kid study, you get energy. This scheme can be improved to include more common areas as charging stations if successful but now it is only education-relevant.

- For each community, an NGO partner is required to convince of maintenance capabilities
- For summer months, the charging panels should be moved by SELCO to the Gram Panchayat or the Local Police Station or any such secure common area. This takes care of security of the panels in summer, defends SELCO's promise to provide solar energy to the family till the child attends school/studies, does not waste the free availability of solar and ensures SELCO's involvement in maintenance at least once a year.
- In the maintenance check, accounts must be reviewed and personal paper-vote feedback (this is more effective than a group meeting where everyone ends up agreeing to everything) taken from students especially for the installment schemes to prevent any double dealings.
- Incentive for school = free lights to teachers, solar electricity for the school because we assume that if kids don't have regular supply, neither does the school. This should provide motivation for the school till regulations arrive.
- Is it possible to tie up with the government to use their solar panels – now mostly defunct? It seems like a terrible waste of resources to install and not maintain them!
- The possible learning plan metrics or track indicators could be:

1. Sales of the products (Level 1 - technical)
2. Surveys of acceptance among students, school, parental community (Level 1 - technical) Preferred: Personal paper vote system asking the number of days they used the light to study, for how many hours, how has their family responded to the other energy incentives, how long do they use it, if they were to change the way the battery is split how would they, how would they pay for this system – installment vs partial vs full payment, etc.
3. Attendance to school (Level 2 – personal cultural)
4. Pass statistics and performance in standard board exams (Level 2 – personal cultural)
5. Continuation higher education (Level 3 – community cultural)
6. Nature of the jobs pursued after completion of education (Level 3 – community cultural)

These solutions are simply immediate suggestions – there can be much more gleaned from the Table 2 as the Deliver phase progresses. For example, internet is almost an infinite knowledge resource. Wireless services have spread far into villages, as is obvious from the cellphone connectivity. Low wattage (~5W), computationally-less-intense, low cost (<INR 8000) laptops/computers (eg. One Laptop per Child @ http://laptop.org/en/) are now available in the market. Wireless providers who already have a market in rural India would be looking to expand the scope of their operations from simple voice cellphones to broadband internet (eg. Airtel/IDEA), but are crippled by the fact that these regions do not have the hardware necessary to buy this new technology. Thus, it is in the interest of wireless providers

to provide such regions with subsidized computers and the electricity necessary to run them – very similar to a decade back, when wireless providers would provide subsidized cellphones to rural customers to expand their customer base. If SELCO could tie up with wireless providers and low power, low cost computer providers, then schools could buy a package of 3-4 computers, solar panels and a wireless broadband connection at a much cheaper rate than the sum of the individual parts. The solar panels could serve the dual purpose to electrifying the school, running the computers and a charging system for detachable lights (to take home). By increasing the scope of the project, the marginal benefit for SELCO/wireless-company/computer-company would increase and the marginal cost of the solar system for the school would come down.

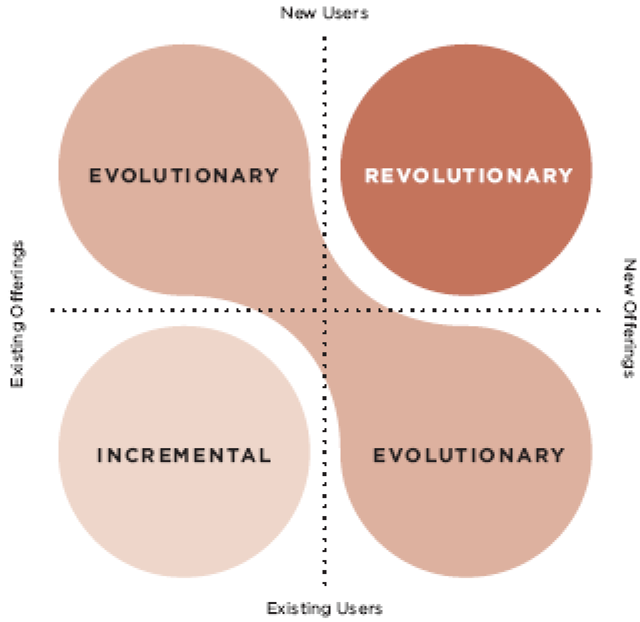
The above solutions could be incorporated into prototypes and released in communities where the technical, financial and cultural feasibility (in this order because each mandates the former's feasibility) can be seen and metrics measured. All of them need not be released simultaneously and choosing which community to release what product to check which feasibility could affect the success of the prototyping. For example, (1) the financial model for a tribal region would be very different from that for a village bordering a city, (2) the cultural acceptance of solar lights + mobile charger will be very different in those villages where mobile phones are prevalent from those villages where they are not, and perhaps an extra lamp is more required. Feedback can be collected via Field visits similar to the ones in the Hear Phase at various stages of the pilot as documented on a chart (shown in the Appendix).

3. Deliver Phase

The deliver phase comprises: making a Sustainable revenue model, Identifying capabilities for delivering those solutions, making a Pipeline of solutions and an Implementation timeline, implementing Mini-pilots and iterating on the best solutions and finally making a Learning Plan via track indicators and outcome evaluations. Since prototyping has not yet occurred for the proposed solutions and some are expected to happen this March, the Deliver phase is scheduled for later this year.

The solutions from the Create phase are plotted onto the ideas chart to see which portions need more brainstorming. Jagadish's idea and the solar projector program lies in the Evolutionary quadrant for existing users and new offerings. If there are solutions with known offerings, they ought to be analysed based on investment strategies, risks, priorities, etc. If there are solutions that can be combined into a single product, that is more economical.

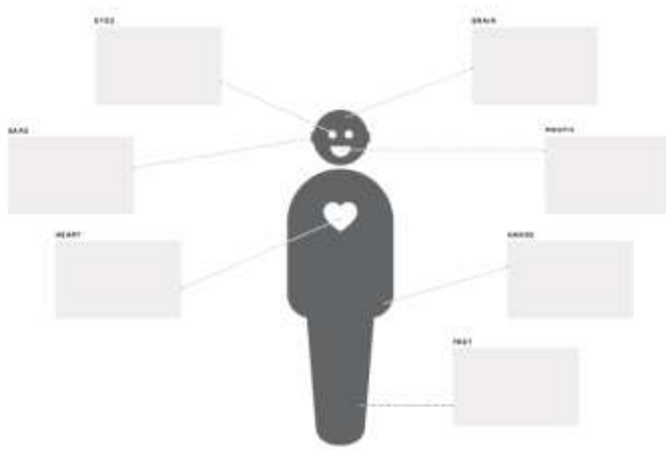
Cross-checking and feedback is best done by someone who is new to SELCO and open to the communities working in close collaboration with one who is technically aware of SELCO's offerings. This removes the bias from both sides – community needs vs SELCO's availability. Preferably, there should be a gender mix or at least a consistent opinion from other genders.



Appendix

The Field Guide techniques/graphics that I used for the Hear phase are:

1. Community Characters, i.e. who the ears, eyes, mouth of the community are, how they sense information? This allowed right points of contact.



2. Individual and Group Resource Flows, i.e. what brings energy and money into the comminuty and what takes it out of the community. What is the maximum among them and what factors control them?

3. Journey of an offering exercise i.e. the kind of environment they are comfortable with seeing a potential purchase, how they believe a product to be trustworthy and the monetary dynamics that governs the purchase.
4. Factors and Forces, i.e. what affects the happiness, wealth, prosperity of the community and what pulls it out?

5. Aspirations Exercise i.e. what they perceive success socially or individually, dreams for the future. This governs what they think about before making a purchase. Finally I made a highlights chart on the memorable quotes (surprising facts), things that matter most to participants, main themes and new topics for the next interview.
6. For the pilot, the following format is used (Pg 97 of the toolkit)

MINI-PILOT PLANNING WORKSHEET

SOLUTION NAME:	CHECK-IN DATE	CHECK-IN DATE	CHECK-IN DATE
TEAM MEMBERS:			
» CONTEXT (WHO, WHERE, WHEN) & TIME What's a low-cost, low-investment way to try out this solution? What can you do in 2 weeks?	» KEY LEARNINGS:	» KEY LEARNINGS:	» KEY LEARNINGS:
» RESOURCES: What resources (people, funds, permissions) would you need to try this out?	» NEW RESOURCES:	» NEW RESOURCES:	» NEW RESOURCES:
» QUESTIONS TO ANSWER: What key questions do you have about this concept and its desirability for your customer?	» NEW QUESTIONS:	» NEW QUESTIONS:	» NEW QUESTIONS:
» HOW TO MEASURE SUCCESS: How will you know if your solution was successful? Successful for whom?	» NEW MEASURES:	» NEW MEASURES:	» NEW MEASURES: