CASE STUDIES ON DECENTRALIZED RENEWABLE ENERGY PROJECTS
FINANCING FOR DECENTRALIZED RENEWABLE ENERGY
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CIP – Case studies on Centre for innovation for the poor

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Migrant Slum Workers (Manipal, Karnataka)
This case study is about 78 migrant families availing solar lighting systems through financing from a local financial institution. The case highlights the need for finance and the many a time the risk averseness of financial institutions to finance very poor clients. The 78 households perceived as high risk were brought into the formal banking system using a risk guarantee mechanism (that enabled the local FI to finance the poor) and flexible collection model based on cash flows.

Financial model& Scheme
- Financed by Hamsa Chaitanya Cooperative Society
- First 4 h there was 100% guarantee (4 installments of Rs. 8000) of Rs. 32,000 as each family had to pay Rs. 2000 margin money. Weekly collection of Rs. 200 minimum and all paid within 6-8months. Now, total 78 systems for loan amounts of Rs.8000-15000 per system @ 16% interest for a period of 6-12 months.

Project nuances
- The community asked to leave in 2009 which meant that systems had to be reinstalled. Repayment never faltered and SELCO did the reinstallation without passing the cost to the customer.
- Convincing customers took 1 year of persistent weekly visits by branch to build trust. They had been duped in the past by people offering services like insurance, SHG services etc.
- Not a single marketing material was used. All sales were through word of mouth.

Impact
- Loans extended by the same FI for personal reasons like purchasing vehicle for transport business, marriages, land purchase etc.
- A medical loan of Rs.100,000 was extended to assist a family in meeting emergency costs without any need for paperwork.
- Community is more aware of basic financial planning. Over 200 savings accounts have been opened by residents.
- Savings from purchase of kerosene for lighting and also creation of a long term asset

design a loan product that was tailored to the cash flows of the end user and was not constrained by the usual documentation requirements of other financial institutions like nationalized banks or regional rural banks such as land entitlements. Further the managers of the cooperative society personally visited the site to understand the community dynamics and were confident of the people’s ability to pay when they learned of their fairly regular incomes and that their livelihoods were tied into construction work around Manipal area. While there was an element of risk as the customers were migrants the financial institution based on its visit and subsequent discussions felt confident to lend to the community.

Key Aspects
- Flexibility of the banker to customize financing (collection based on cash flow). The bank timed collection of payment from the customer on the day they receive their pay thereby ensuring less chances of default. This was also appreciated by the community who wanted to pay when they had money on hand.
- Collection agent (pygmy) was hired by bank to go to community for payment rather than have people come to the bank every week. The banker understood this was not a convenient practice for them.
- A guarantee fund that was reduced in installments against the outstanding amount for the first few customers as a mechanism to reassure the bankers of community’s ability to pay regularly.
- Other than a guarantee for the first 4 customers there was no further subsidy component used and Hamsa Cooperative Society went on to finance over 70 customers without any such risk management mechanism.
- Availability of flexible funding with SELCO to put down a risk guarantee fund.
- A champion bank manager who was willing to take the risk and a good interpersonal relationship subsequently developed by SELCO staff and him.

Learnings
- Long gestation period to convince the customer
- Replication attempts in a slum community in Peenya with 65 families is experiencing difficulties because the financial partner is not committed to collections despite the community’s promptness in payment as demonstrated through direct collections with SELCO staff.
Case Study: Group Lending Model to avail Solar Home Lights

Benefits
1. Ensures on-time payment
2. Easier replication due to simple model
3. Increased savings and creation of a long term asset

Financial Model & Scheme
- Funded by Kaveri Grameena Bank
- 5 to 7 members form a group and pay in installments.
- Each member made payment of 20% of the total cost.
- Recovery period of 2 to 3 years.
- Two members handle collections per group.

System Design
- 6 lights system with fan and mobile charging
- 75W model.
- Astra lights installed
- Two 11W lights and four 7W lights
- One fan of 14W
- Warranty of panels (5yrs), batteries (5 yrs), electronics (5yrs), lamps (1 yr).

Initial Pilot with 1 Urban group of families
(Mahadevkindigahalli)

Cauvery Kalpatharu Grameena Bank
- Identified the socio-economic needs of the households with erratic power supply.

Energy Enterprise
- Demonstrated the benefits and build the relationship with the community.
- Provided lighting solutions with the simplified model.
Revolution Fund with a Community Building Partner

In the absence of an institutional financial partner like a bank, community partners can play a critical role in facilitating financing through innovative financial mechanisms. Tribal communities in remote locations are viewed as largely unbankable and thus this case study demonstrates a model through which a community and technical partner come together to provide a holistic solution-financing plus technical product and in addition demonstrates in particular how a financial mechanism like a revolving fund can be successfully used to plug in access to credit for remote communities to purchase long term energy solutions.

Community partner, BNGVN impressed upon SELCO the need for solar lighting solutions in its remote areas of operations in Maharashtra. Villages are in the backyard of large hydropower plants whose power is diverted to mainly urban areas leaving these regions displaced by the construction or without any access to the power generated in their own vicinity. These families are from mainly backward hilly tribal areas of Maharashtra that have little to no electricity. The average family size is 5 members with an annual income ranging from Rs.10,000 to Rs.25,000. These families are from mainly backward hilly tribal areas of Maharashtra that have little to no electricity. Most are small farmers who barely make ends meet and at times of sparse yields they migrate into cities to look for daily wage employment to sustain their families. Their main source of lighting is from kerosene lamps.

Through three field visits by SELCO staff over a period of 6 months it was determined that stand alone solar home lighting solutions was a feasible option to meet their basic energy needs-lighting and mobile charging. Absence of a financial institution like a bank in the region willing to finance these perceived high risk customers has lead BNGVN to offer finance services in the region for various purposes. However they had not financed this particular set of customers previously.

Two important developments lead to the replication of a financial process to enhance affordability of end users:

- BNGVN heard of SELCO’s past project (refer Case Study 4, Basket Weaver Revolving Fund) with a similar community-building partner using a revolving fund to finance un-bankable end users
- Available soft funding was used to demonstrate the viability of this financial model through a pilot in the region, which would then be used to convince future uptake by financial institutions.

Thus a revolving fund was set up that extended financing to households at very affordable interest rates for loan periods of up to 18 months. The collected money is put back into the revolving fund – thus enabling more households to avail financing. By setting up a long term revolving fund it creates a channel of end user financing that is essential for financing even beyond energy loans. The partners intend to also tap into other financial institutions in the area to convince them to also extend financing to these customers, thus, establishing an ecosystem of appropriate technology and financial support for the customer.

**Key outcomes**

- A scalable and replicable revolving fund (depending on context of end users and financial institution) for solar home lighting systems.
- A fund that can be customized to the local needs in terms cash flows
- Localization can also help in restructuring bad debts in a more socially ethical manner
- Better utilization of philanthropy from traditional donations to smarter use of limited flexible funding

**Key Aspects**

- Revolving Fund through a community partner as a viable financial model in absence of formal bank ecosystem
- Clear Division of Roles between technical and financial partners
- Setting up a Loan Monitoring Team to oversee the regular repayments and maintenance of the revolving fund. The team comprises a member from both partners and a financial advisor to ensure financial discipline and build up of a robust financial process.
- Needs Assessment 1 to 3 months prior to commencement of project assists in understanding willingness to pay, cash flows and prospective customers over the next few months to ease efforts in maintaining regular repayments to the revolving fund.
- Experienced partner in collections in this sort of remote hilly terrain to make the collection process as efficient as possible and lower transaction costs of multiple trips. Absence of roads or terrain navigable by automobiles makes human resource efforts quite substantial.
- Customized technical training keeping in mind three main aspects-
  - rugged terrain, local dialects and design of houses.
  - Knowledge of easy pathways and ability to withstand the tedious journey is critical. In addition with over 11 dialects spoken in the identified tribal areas for this project knowledge of this language reinforces trust and ease of communication with customers. Finally Houses in the area are self made, patched together from mud and brick with hay cover for the roof.

Such designs also require local knowledge of sturdiness of building.

- Simultaneous engagement with local banks to keep them updated on the viability of the concept and thus also begins institutionalizing such a mechanism through banks for seemingly “unbankable” customers.

**Impact**

- Savings in purchasing kerosene at Rs.30/litre and from related expenses in procuring the kerosene from the markets
- Increase in income by 10% for shopkeepers, log sellers, bamboo craftmakers
- Improved conditions to study with a brighter light and with few students confident to appear from exams due to better ability to study/prep.
- Solar has become the primary source of light even in villages with grid connectivity

**CIP - Center for Innovation for the Poor**

Revolution Fund in the absence of a local financial institution.

**CASE STUDY**

_BhaginivrideitiGraminVigyanNiketan_ (BNGVN), Maharashtra at an awards ceremony in 2011 and subsequently facilitated site visits

**Identification**

Harish Hande had met the founder of _BhaginivrideitiGraminVigyanNiketan_ (BNGVN), Maharashtra at an awards ceremony in 2011 and subsequently facilitated site visits.

**Problem Statement**

Remote hilly areas have little to no access to grid connectivity or any form of reliable clean energy. Absence of electricity has set back the community crippling education, health, livelihoods and basic quality of life. Thus as a first step the community demanded basic lighting and as a next level to meet other needs of education or health of livelihood related applications. Present needs are met through kerosene lights and candles.

**System Design**

Most customers bought a 1-3 LED/CFL light i.e.1.2 W-3.6W LED or 5-7W CFL combinations, 10-25W panels, 15-20Ah all with mobile phone charging facility.
**Due Diligence**
Potential customers interested in purchasing a system stemming from awareness programs are assessed through presentation of identification, face to face interviews, pre-loan documentation form.

**Loan Approved**
A down payment of Rs. 400 is collected per customer as a commitment to purchasing the system along with detailed loan documentation form. (refer Annex 1)

**Installation**
Systems are installed and customer acknowledgement form, installation certificate, warranty card provide proof of installations. (refer Annex 2, 3, 4)

**RF Bank A/C**
Downpayments and the regular collections thereafter collected by field coordinators are deposited into a bank account.

**Monitoring and evaluation**
A loan management team consisting of managers from all three partners meet every month to discuss progress and troubleshoot any delays in the operations of the fund.

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**Case Study: Revolving fund in the absence of a local financial institution**

**Benefits**
1. Customized technical training for remote areas
2. Access to credit for tribal communities
3. Better utilization of philanthropy from traditional donors to smarter use of revolving funding

**Technical**
Financial Model
- Cost of system: Rs. 9000
- Interest rate: 4% per month (if not paid on time for 6 months, subject to default)
- Loan term: 12 months
- Transaction cost: 2% on disbursed amount and collections

**Sustainability**
Local Organization
- Initial pilot with Tribal Households
- System Design:
  - 3x12W LED lights
  - 1x30W LED luminaire
  - 5x20W LED luminaire
  - 1x20W solar power system
- Energy Efficiency
  - Identified solar home lighting solution as a feasible option.

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**Financial**
Local Organization (Non-Profit)
- Collection of sales proceeds and direct them towards the solar fund, which can be used for future lending.
Case Study: Nomadic Tablmarkers (Thannisandra, Bangalore)

Case Study number: 1
Initiated: in 2013
Key terms: Insecure Livelihoods, energy access, financial sustainability, Urban, Nomadic, slums

Nomadic Tablmarkers (drum) makers in Thannisandra, Bangalore
50 families originally from a small village in North India travel across India as a group making and selling drums. The trade has existed in their families for multiple generations and remains the only source of livelihood. This case study documents the process involved to develop an energy delivery mechanism designed for the nomadic nature of the table-makers. Reliable lighting was a critical need as it provided them with four extra hours of work and better quality of life in the evening. But constant threat of being evicted prevented them from having a reliable access to lighting and other energy services. Through appropriate system design, infrastructure subsidy, community ownership and a financial model that matches their income flow, tabla makers now pay minimal installments toward owning a central charging station that can move with them. This project illustrates the strong linkage between energy, design, innovation and livelihoods, especially for vulnerable communities.

Identification
Through a local social worker who has worked with a SELCO Foundation partnering entity in other established energy centres

Problem Statement
Primarily users needed dependable lighting systems that could a) protect children and their material in the dark and b) help them work after sunset to meet the demand in peak season. There was a need to devise a technical and financial product that would be portable, lightweight and cost effective.

System Design
3 Watt LED bulbs and portable battery packs are charged centrally for 30 households within 24 hours daily. System has been designed and installed on a cart with wheels keeping in mind migrant nature of the community.

Since travelling has always been in their nature, the community has not established any proper ownership in terms of land/homes. They do have homes back in their village where all of the older people in the community (who cannot travel) settle down. However and in and around the village their skill has no potential to generate income. All year around they travel and live on any piece of empty land they can find and around cities. Due to the temporary, insecure nature of their settlement - their homes are often made of found tarpaulin sheets and second hand casuarina poles (sometimes even lesser than that).

Children and young adults who may wish to study have no opportunity for education or vocational training of any kind. Although it is mostly the men who make and sell drums, male children join the trade as early as the age of 9 or 10. Women and girl children have had little religious education through free madrassas’ (Islamic schools) wherever they find them. Average size of a family is 5-6 members and women spend their day looking after households and children.

As the musical instruments that they make typically have a narrow/niche customer segment they have started to make low cost drums for general people who may or may not be musicians. During festival time they have high sales and travel to areas where there are better market opportunities. In off seasons their business is minimal and if they are lucky they manage to sell one drum (Rs 100 a day). Their annual income is on an average is approximately Rs 50,000. Although there are a few families who have bank accounts - basic financial literacy and concept of saving does not exist. Large chunk of their income is spent on festivals, marriages and funerals. Capital for material and resources for making drums is a closely followed expenditure.

Financial model & Scheme
An initial deposit (Rs 200) and a community owned model where representatives from the community itself collect monthly installments of Rs 100, Rs 300 and Rs 500 will enable complete ownership of systems costing Rs 4000 per point in 2 years. The system comes with a 5 year warranty and each battery replacement after that will cost Rs 250.

Project nuances
Community meets and need assessments naturally led to identifying the ownership model as a community-owned system. There is no operator fee or entrepreneur profit to be made from the centre. Complete ownership of the systems through collective financing gives them the flexibility of using the system wherever and whenever they travel. Since a central charging station is more reliable, initially portability was not something we anticipated would be easy, however representatives from the community have been trained on orientation and placement of the cart, security and trouble shooting.

Impact
Livelihoods: Direct increase in income by over 10%-20%
Wellbeing - Comfort, safety, education, improved lifestyle
Switch from kerosene to solar (300 liters of kerosene = years of solar energy)
Financial savings - Rs 100 per month (they do not work under kerosene after dark)
Environmental impact: Every year replaces carbon sequestered by 11.62 tree seedlings grown for 10 years

Learnings
- Assistance with branding, marketing, financial management and costing of products was essential to enable the community to package their products effectively

Key Aspects
- The cart model was designed keeping in mind land insecurity and to adapt to their constant risk of being evicted
- Since risks of shade, efficiency, security, maintenance, collections that can compromise the sustainability of the project would be too high with individual home systems; a collectively owned model was more feasible.
- In peak seasons, they will now be able to meet the demand as they can sell during the day and focus on making more drums at night. Since they are free from paying large amounts towards kerosene they are able to put that saving in purchasing raw materials to more business.
- Market linkages were established for the community since they were also making more drums through a stall in a prominent public fair. As a result they have established contacts with musical stores and set up stalls in 2 other fairs increasing their sales.
- Exit strategy if the community moves back to the village at any point before repayment of the entire system, the system will be given back to the foundation and the refundable deposit will be returned to the community.
Linkages through appropriate system design, infrastructure subsidy, community ownership and a financial model that matches their income flow and nature of occupation, has been essential factors to address the needs of this vulnerable community.
CIP: Center for Innovation for the Poor
Financial Scheme to avail Energy Access Solutions

Case Study: Financial Scheme to avail Energy Access Solutions (Sampoorna Gram Loan Scheme)

Case Study: 8

Key terms: Multipurpose loans, socio-economic needs, CKGB/Regional Rural bank, Self Help Groups, awareness creation

This case study illustrates the concept and usage of a multipurpose loan scheme initiated by a regional rural bank operating in various districts across southern Karnataka. Through this scheme, each household is provided with loans to meet various socio-economic needs such as energy, sanitation, insurance and productive use. The larger goal is to be able to meet all essential credit needs of the household, thus increasing awareness of the bank’s role and building trust with village households.

Identification

In this particular village, the project was initiated by the local bank branch in Belagumba Village Headquarters. The potential for solar-based lighting was then identified by a proactive Business Associate of the Hassan branch who has been capitalizing on this scheme in other villages in the area.

Problem Statement

A number of villages in rural and remote areas still lack facilities to address basic social needs, including supply chains and credit linkages. Households in this village were connected with intermittent grid supply and were dependent on firewood to meet cooking needs.

System Design

The solar system component of the larger loan includes 25W panel, 30 Ah Battery, 1 CFL light, 2 LED lights. The total system cost was Rs. 13500.

Through the initial survey process, 40 households were identified for solar home lighting systems in the village cluster in Belagumba. Each household on average owns about 2 acres of land. They cultivate ragi, coconut and corn and earn about Rs. 25000 every year (after deducting costs incurred). Those with small dairy farms of 1-2 cows earn an additional Rs. 25000 per annum.

The bank usually identifies the organization to provide product and maintenance services for needs like lighting and cooking gas. In this project, based on experiences in neighbouring villages, the SELCO associate played a role in proposing this village also be a part of the scheme. Here is a list of activities that are most often financed by the bank under this scheme:

- Dairy farming- purchase of cattle
- Solar energy system- Lights with mobile charging unit
- Clean cooking - LPG stove, cylinder supply and pressure cooker
- Sanitation- cement structure with latrine
- Life insurance- State Bank of India scheme

Based on the survey conducted in this project, households expressed interest in 2 or more of these most commonly, solar energy, cooking, dairy farming and in few cases toilet construction as well.

Once the survey is completed and there is a buy-in from households, an awareness programme is conducted by the bank branch to outline the intent behind and benefit availed from the loans. Following this, a MoU is signed by the bank with potential product and service providers to ensure there is guarantee of servicing and loans are disbursed. The solar energy system is given as a loan to the user. In the case of clean cooking, households purchase the stove, gas cylinder and pressure cooker use the receipt to avail of the loan. For sanitation, the loan given is not more than Rs. 15000, based on the condition that there is space available and the house is owned by the person taking the loan. The SBI insurance, in cases where it is availed, also becomes a form of security for the bank.

Impact

Easy financing for socio-economic needs
Households are able to access hassle free loans to meet social infrastructure needs, with no collateral and minimal procedures. Credit is available for facilities that are critical for women in the household (cooking energy, sanitation, lighting), which are unlikely products for bank financing. Households also have access to productive loans for cattle. In some cases, loans were also given for life insurance which acts as a safety net for households to fall back upon in cases of death or accidents.

Improved awareness on facilities, their usage:
It acted as a good platform to expose people to the usage of alternate renewable energy sources and sanitation.

Increased trust and stronger banking relations:
The benefit of implementing such a scheme is also felt by the bank. By helping the household meet its basic needs, the bank is seen as working for the welfare of the people. This is seen to increase trust amongst villagers and their willingness to engage with the bank improves. The bank has witnessed an increase in deposits after scheme implementation with more SHGs opening accounts or accessing other loans from the bank.

Key aspects

- Bank initiated scheme with no requirement of collateral (usually farmers have taken crop loans where they have already put their land down as collateral). In some cases, margin money is also waived and the entire amount is provided as a loan. This scheme was initiated by a lady Bank Manager- some opine that the gender perspective could have influenced the addition of household based credit needs to the portfolio.

- Multiple issues, reduced transaction costs: The goal with this scheme is to address all the socio-economic needs of households in the village. This will ideally facilitate better standard of living and greater productivity, ensuring repayment. The cluster approach is useful in dealing with maintenance of systems. In addition, it also greatly reduces the transaction costs for the bank both in terms of loan disbursement and collections.

- Motivations behind financing: An increased sense of trust amongst community members by addressing their essential social and lifestyle needs. The bank establishes itself as the ‘go to’ organization for credit requirements and an entity for the people. In a number of cases, JLG as well as SHG models were used for financing. Larger number of loans bundled together.

Risks and Mitigations

- Largely dependent on individual interest, with no penalty for non-compliance: The guidelines of the bank lay down that every branch must implement the scheme in at least 1 village per year. But in most instances it has only happened with pro-active bank managers involved. This scheme operates without a penalty for non-performance or non-achievement on the bank’s end, which could hamper institutionalization.

- Lack of monitoring: there is no specific entity within the village to ensure that the products sold are functioning well and to monitor, evaluate the actual implementation of other activities that credit was taken for.

- External influences: If there is a general announcement of loan waivers in agriculture, it could seriously affect the mindset towards repayment of these loans as well. Since they are tied to the same bank and are taken by the same individuals who have taken loans for agricultural purposes, it brings in a perception that defaults will be overlooked. Important to have one of the loans linked to an income generation activity.

- Future potential: It has the potential to be taken to different states and publicized. Other portfolios can also be added to this: eg. loan to construct house, smaller requirements within the household and so on. Based on the experience within erstwhile CKGB, it has also been adopted by the sponsor banks- State bank of Mysore.

Another concept similar to the Sampoorna Grama concept is the 100% solar village concept. The motivations of the bank remain the same; however operationally the schemes differ in terms of what the loans are given for. In the case of a 100% solar village, more than 80% of households in the village must be provided a loan to access a solar home energy system. In some sense, the 100% solar
village is a part of the larger Sampoorna Grama concept where awareness creation on solar, identification of a supplier and the larger benefits to the bank are similar.

The Sampoorna Grama also differs from the concept of adoption of a village by a bank, where the bank will take care of the financial needs of the people in the adopted village. A borrower in need approaches the bank to help meet his financial requirements. But there is no involvement of the community as a whole which can allow for enhancement of belief in the banking system and result in improvement rations between a banker and the village.

INNOVATION

Multipurpose loans for socio-economic needs
Cluster approach for awareness and after sales service

**Case Study:**

**Financial scheme to avail energy access solutions (Belagumga)**

**Benefits**

1. Including livelihood component in the bank reduced the risk of defaults
2. Increased confidence in banks being able to meet communities’ basic social needs
3. Improved awareness on renewable energy sources and their usage

**Energy Enterprise**

- Conduct awareness programme brochure and workshops
- Conduct risk management programme
- Conducted awareness programme brochure

**System Design**

- Solar system components
  - Solar panel
  - Battery
  - Inverter
  - LED lights

**Financial Model**

- Accessibility of loans with no collateral and financial procedures
- Cluster approach for the management of systems such as loan disbursement and collections

**Technical**

- Technical and financial components
- Technical and financial components
- Technical and financial components

**Sustainability**

- Social benefits
- Social benefits
- Social benefits

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Households with solar system sanctioned for health and insurance

KC Bank

Sampoorna Grama

Belagumga

Belagumga
Case Study: Differential Rate of Interest (DRI)

Key terms: Solar, end user financing, financial inclusion, banks, IOB, Canara, SBM.

End user financing scheme, differential rate of interest

In 2013, residents of Belgaum district bought solar home lighting systems with the aid of a Government of India scheme called Differential Rate of Interest (DRI) that offers loans at 4 percent rate of interest for specified low income groups. This case story captures how pro poor schemes can be tapped to encourage lending for energy access solutions that have direct impacts on the quality of life and it also demonstrates how loans with simple procedures can catalyze end user financing.

Identification

After a lighting awareness camp in the area there was an interest to finance systems so this was jointly pursued by SELCO and Canara Bank branch manager.

Problem Statement

There is irregular supply of electricity from the grid. Some houses are not connected to the grid at all. It is a lengthier process to take solar loans as they require a lot of paperwork especially to avail the subsidy offered by Ministry of New and Renewable Energy. Furthermore, the rate of interest is higher than the 4 percent offered by the Differential Rate of Interest scheme.

System Design

Most customers bought a 2 LED light system, with a 2.4 watt bulb, 15 Ah battery and 12 watt panel. This system includes mobile charging facility.

In Belgaum district, two communities were financed by Canara bank for 15 and 10 units respectively. In one case the houses have access to electricity but its highly irregular while in the other the location of community deep within interior forests leaves them without any access to regular grid. Primary occupation ranges from daily wage laborers, to small farmers, tenant farmers cultivating land on lease.

In absence of regular electricity, the villagers are forced to depend on alternative sources of energy such as kerosene or battery charged lights. Hence solar energy presents itself as a viable source as it has the capacity to provide 4 hours of regular light. In May 2013, while helping some of villagers buy solar home lighting system SELCO discovered that there was a low interest government scheme available that could be explored to help villagers purchase energy solutions.

DRI scheme was announced by the Government of India in 1972 to provide loans at 4 percent interest rate to poor families for productive activities. Families whose collective income is below Rs 24,000 in urban areas and Rs 18,000 in rural areas, can avail a loan up to Rs 15,000. There is no margin money requirement but it has to be implemented through the Scheduled Commercial banks. By comparison, the scheme under Jawaharlal Nehru National Solar Mission (JNNSM)** generally availed by the customers gives a subsidy till 40 percent of the benchmark cost. There is a compulsory requirement of 20 percent margin money and the interest rate is the prevailing market rate, generally 12.5 percent (contd. next page).

Impact

65 loans have been disbursed under DRI

Three banks have utilized the scheme for solar loans

Easy financing - Households are able to access affordable loans at much lower rates of 4% to meet social infrastructure needs as compared to normal lending rates which are as much as 3-4 time higher. Banking habits - Lending through formal banking channels has enabled the unbanked population to experience the benefits of formal banking that could potentially catalyze other banking activities like savings as well.

Targeted group: The beneficiaries, whose income is below Rs. 24,000 in urban areas and Rs. 18,000 in rural areas, can avail a loan up to Rs. 15,000. The scheme encourages financial inclusion of lower income group by bringing them into the banking fold. Further the scheme has also benefited Scheduled Caste/Scheduled Tribe groups that can avail the facility irrespective of the levels of household income.

• Hassle free: The DRI scheme is a hassle free scheme which requires the hypothecation of assets created out of the loan only and with less paperwork. Moreover there is no margin money or collateral requirement for the scheme.

• Cost factor: DRI is a good scheme to take for a two LED home lighting system however, further analysis has revealed that there is not too much of a cost saving for a smaller or bigger light system. Nevertheless, certain terms such as no paperwork were important to encourage people to come forward and avail a loan.

Risks and mitigations

• The specifics of the scheme are vague on what constitutes as “productive activity.” Hence it’s up to the branch manager’s discretion to approve solar loans.

• Earlier there used to be a mandate that 1 percent of the loans disbursed by the local bank branch should be through DRI. This has now been done away with, leaving the managers with even less incentive to finance. Bringing back this sort of target may be important to maintain motivation to use this loan.

• Repayment based on cash flows: The beneficiaries have complained that the monthly mode of payment does not suit them. For instance being farmers, they would prefer paying on a bi-annual basis. Thus flexibility to account for varied cash flows can help in quicker repayment.

• The presence of the more popularized JNNSM scheme can deter bankers from tapping into other loans although there is no mandate to only extend loans through the former. Continued interaction with bank presenting information restating the same helps in persuasion.

The manager of Canara Bank agreed that in comparison the DRI scheme speeded disbursement for needy segments as there was no subsidy release component. Hence around 25 people were able to avail a loan under the scheme. Due to the financial inclusive terms of the scheme that included less paperwork, people accessed the loan with little difficulty.

The success of using this scheme in this district prompted SELCO to inform eligible users and bank managers to utilize the scheme were possible. As a result over 65 loans have been disbursed under DRI for solar loans by two other banks- Indian Overseas Bank and State Bank of Mysore.

Key aspects

• Financial inclusive terms: To get this scheme, less paperwork was required. They only had to show their passbooks. The loan was approved within a month.

• A champion: Customers who for the first time have to deal with a bank can be apprehensive and thus the presence of champion bankers helps take the initiative to understand and utilize the most appropriate scheme.

**JNNSM was launched in 2010 as one of the initiatives of the National Action Plan on Climate Change to balance India’s energy security with ecologically sustainable growth. Under this, the target of deploying 20,000 MW of grid connected solar power by 2022 was set.
Customer standing on top of his roof with panel in the background.

Customer showing his light purchased through DRI.

Inside Canara Bank through which the DRI was disbursed.

Case Study: Differential Rate of Interest (DRI)

Benefits
- Long term credit, reduced interest burden for low-income families
- Capitalized on existing schemes to provide low interest rate

Sustainable
- Improved incentives on Banking habits and renewable energy sources and their usage

Financial
- Disbursed Solar energy was the most suitable option to provide 4 hours of regular light
- Discovered through implementing appropriate scheme for Solar loans

Technical
- Initial pilot process of energy was the most suitable option for Solar

Social
- Triggered an action among the urban managers to utilize the scheme.

Introduced with other groups and also benefited with Tribal groups.
CIP - Centre for Innovation for the Poor
Effective Collection Mechanism

Case Study: Effective Collection Mechanism, SKDRDP
Case Study number: 015
Initiated in: 2013
Key terms: SKDRDP, Chikkodi, SHG, collection, repayment, micro lending, business correspondent

Collection Mechanism

Starting 2012, SELCO has partnered with micro lender Shri Kshetra Dharmasthala Rural Development Project (SKDRDP) towards financing solar home systems (SHS) in the Chikkodi taluk of Belgaum district. Close to 400 households that were constrained by irregular power supply and lack of formal banking assistance now benefit from the scheme. The standout feature of this self help group (SHG) model of lending has been the collection mechanism which has yielded a near zero default record. The case study highlights that establishing collective responsibility, imparting banking habits, and systematic monitoring of repayments are key to lending to poor households. Also, the involvement of a religious institution backed lender adds credibility to the scheme and prevents defaults.

Identification

The ground level workers of SKDRDP called Sevapratheeshthi’s identify SHGs with 8-10 members that require lighting systems. Typically minded groups like vegetable vendors or street hawkers living in close vicinity to each other avail such schemes as it facilitates easier monitoring of loans.

Problem Statement

Banks are reluctant to lend to poor households in Chikkodi for solar home systems owing to worry over defaults and the high transaction costs associated with small sized loans. Though many households are connected by intermittent or no grid supply, the lower awareness of solar systems makes the transition from kerosene and firewood to solar a challenge.

Technical Specifications

The solar home system components include 2 or 4 LED light installation with a 25-60 W panel and 60Ah battery costing between Rs 15000-21000.

Chikkodi taluk in the North-Western part of Karnataka is an agrarian economy relying mainly on sugar cane, tobacco, wheat and groundnuts for its income. Many poor households use traditional sources of energy like firewood and kerosene to make their ends meet as the grid connectivity is unreliable and intermittent. This has negative consequences on the quality of life and security of households.

Initiated in 1982 by Virendra Hegde, the religious head of the Dharamshala Temple, SKDRDP today spreads across 25 districts in Karnataka and one district in Kasaragod, Kerala. It has tie-ups with more than 12-13 banks including – SBI, Vijaya Bank, Canara Bank, Corporation Bank. SELCO has been working with SKDRDP for 15 years in various parts of Karnataka. In 2012 they to decided work together in Chikkodi as bankers there were reluctant to lend to households for solar home systems.

Under the BC model interest rates depend on the bank that SKDRDP represents, usually ranging between 13-15%. The rates are little higher at around 18% in the case SKDRDP’s lends from its own funds as the interest rates includes the cost of funds as well as transaction costs attached to it. The Sevapratheeshthi identify and submit loan proposals which are finally sanctioned by the project officer.

So far in 2014, SELCO’s Chikkodi project office installed 80 solar home systems through the SKDRDP tie-up. This is in addition to the 300 households financed in 2013. The first one year of the partnership in Chikkodi was focused on identifying and forming SHGs.

The potential to replicate the model in both India and other developing countries is enormous with SHGs functioning in different parts of the world. Bangladesh has already demonstrated how SHGs can be utilised in micro finance in regions where banks are reluctant to finance small sized loans. SELCO is looking at similar tie-ups in other parts of Karnataka as well by exploring partnerships with Initiative for Development Foundation in Tumkur and MVRADA in Gulbarga.

Financial Model

SKDRDP operates via two models – (i) as a business correspondent (BC) for banks and (ii) lending through the funds raised by its own trust or bank borrowings. Once the loans for solar are disbursed to SHGs, they meet with the Sevapratheeshthi’s on a weekly basis to pay loan instalments. At the same time they also collect repayments for other types of loans. The Sevapratheeshthi also constantly monitor the actual utilisation of all types of loans to prevent diversion. The duration of solar loan is for 3 years as compared to other loans of 1-2 years since SKDRDP is keen on promoting this service.

Project Nuances

Before the loans are granted, SKDRDP spends considerable time and effort training the SHGs on banking habits and maintaining books of accounts. There are as many as 18 training sessions given to each SHG at the field level in a year. The SHG members are also careful on loan repayments as a religious institution is attached to it.

SELCO can participate in the weekly meeting if there is a demand for demonstration purpose only.

Impact

Wellbeing – In comparison to polluting fuel sources like kerosene many households now have access to cleaner energy having a positive impact on their health. The children are able to study longer hours and it is much safer for households after dark.

Easy financing – Accessing loans through this scheme are hassle free as compared to conventional banks. Banks are also confident of lending through a religious backed institution.

Community bonding gender – The SHG scheme is premised on collective security and dependence enabling stronger bonds within the group. There are also instances where women have taken a lead role in SHGs negating the gender imbalance that can sometimes have adverse consequences on household choices.

Key aspects

- Collective security - Once the loans are disbursed the SHGs have weekly meetings with the Sevapratheeshthi’s where instalments are collected. The scheme has an inherent mechanism to check against defaults as members prod each other to make payments on time.
- Rigorous checks - The activities of the Sevapratheeshthi’s are supervised by a monitoring officer, who in turn reports to the project officer of the Chikkodi taluk. There are also auditors who run an audit of the books of accounts of the different SHGs on a quarterly basis.
- Banking habits - Apart from offering an easy access to finance the SHG scheme also requires SHG members to deposit a nominal sum to promote thrift and banking habits.
- Socio economic benefits - Households adopting the systems have reported a cleaner housing environment, children are able to study late hours and some families are able to advance secondary sources of livelihood.

Risks and lessons

- Free riders - The limitation of the system is that there might be people in the group who might try to take a free ride on the contribution of the group without keeping their obligations.
- Bankers unappreciative of SKDRDP’S popularity - There are also reported incidents of bankers not appreciating the rising popularity of SKDRDP thereby potentially creating hurdles to lending in the future.
- Dependence on reliable partner – The success of the model relies heavily upon finding the right ground partner, in this case SKDRDP. Some other MFI’s in the past have come under criticism for their coercive practices.
- Regulation – If religious authorities and trusts could lend their funds and names to similar initiatives the credibility of the model will grow multi fold.
SKDRDP clients with solar home lighting
Five thousand, five hundred clean cookstoves through biogas
Chickballapur district, Karnataka

In 2005, Nagarathnamma’s kitchen looked like her mother’s had when she was a child, and her grandmother’s before that. The women cooked in a mud stove in the corner of the kitchen, pushing sticks into its ember. It was a laborious process. “We had to go to the forest, get firewood and then cook,” Nagarathnamma remembers. “An entire day was wasted. We used to get eye pains, we used to cough…”

The wall above where her stove used to be is still blackened with soot, deposited by the thick day-to-day smoke that would fill her two-room house. Nagarathnamma lives in Vadgi, a small village in Chickballapur district, near the Andhra Pradesh border in Karnataka.

In 2006, a biogas unit was installed on Nagarathnamma’s property. It’s a domed chamber buried under her yard, with a trapdoor at the top where she loads in the dung from the family’s one cow, mixed with water. The dung digests in the anaerobic chamber, producing gas, and a nutrient-rich slurry. The gas is piped to the kitchen, where it burns clearly on an adapted stove, replacing her need for wood as a fuel. The slurry from the dome digesters is pushed out of its side, and makes a nutrient-rich fertilizer for the family’s yearly crop.

“Not only are those [firewood-collecting] days free, but it is much easier to cook,” Nagarathnamma says, reflecting on the benefits of the biogas unit. “It’s much easier to send the children to school in the mornings. We run a small shop and I spend my time there, I can run it more easily now.” She no longer has to spend hours scrubbing black marks from her cooking vessels. Through the biogas unit the cow, already heavily depended upon in villages for its milk, becomes an even more important source of income. Its dung creates not just clean, free cooking fuel, but the time in which women are free to do other things.

“Simply put, your life is easier,” says Ram Esteves. His non-governmental organisation, ADATS, orchestrated the construction of Nagarathnamma’s biogas unit as one of forty-two others in Vadgi’s villages. In total, ADATS set up 5,490 of these units across Chickballapur district between 2006 and 2008.

Ram points out the implications of having to fetch firewood were often offensive, as well as inconvenient. “The women walk ten or fifteen kilometres and there’s a lot of sexual exploitation that happens at the hands of the forest guards,” he says. “Then they come back staggering with huge headloads of fuel. It is horrible. So demeaning. So it’s not just the practical gender aspect, but I would say to do with self-respect, dignity and all of those things. There’s a lot of symbolism in these biogas stoves for these women.”

“I can’t go back to the earlier difficulties now,” agrees Nagarathnamma. She says the unit has so improved her life she’d be willing to take a bank loan to replace it, if a breakdown forced her to.

Cattle dung biogas is readily acknowledged to be a highly effective renewable energy system for parts of rural India. However, the cost of building the unit is still beyond the budget of most rural families, especially a family of daily wage labourers. The unit in Nagarathnamma’s yard cost Rs. 11,000. To construct all 5,490 units, the project spent Rs. 61.5 million. “You can’t touch those kind of numbers with donor funds,” says Ram.

This giant project is known as the Bagappa Biogas CDM Project, after the central town where ADATS is headquartered, and because it was financed by a commercial transaction through the forward sale of carbon credits.

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See diagram, page 29
See Agricultural Development and Training Society, www.adats.com
See “Uses of capital” in fact box, page 30

Image: Cow dung digests anaerobically to form a clean-burning gas that is considered carbon neutral.
Biogas units can generate these credits because they replace the use of kerosene and non-renewable wood for cooking, and so cooking food on a biogas flame means less carbon dioxide emitted into the atmosphere. ADATS received $1.1 million by selling these reductions under a clean development mechanism, or CDM, which is aimed to direct investment towards sustainable development in developing countries, whilst also reducing greenhouse gas emissions. This amount was for all the carbon credits the biogas units would create the first seven years of the project. In line with the Kyoto Protocol, each tonne of CO₂ emission prevented is traded through certified emission reduction (CER) certificates, which are verified by the UNFCCC.

Individuals or companies in industrialised nations can buy these certificates to help them achieve their own emission reduction targets. Any further sales of carbon credits beyond this seven-year period ADATS has pledged entirely to women like Nagaratnamma, as income.

The plan for Bagepalli’s biogas project was passed to ADATS by a group of climate activist-friends.

“We didn’t know head from tail of biogas unit all the time,” admits Ram. “We had to learn what the hell this was about.”

Coolie Runnings

Implementing and maintaining such a giant project is a huge challenge, yet the Bagepalli Biogas CDM Project is in its fifth year and shows no sign of failure. The success is almost undoubtedly founded in the strong social organisation that had already been created in Chikkaballapur district. In the form of ADATS and village-group called the Coolie Sangha.

ADATS is highly organised, and long-established. In 1985 they seeded the Coolie Sangha, an independent community organisation whose name roughly translates as the organisation of daily wage-labourers. The Coolie Sangha has nearly 40,000 member families across 802 villages, all poor farmers with little or no land, living in Bagepalli and four other blocks of the district. Funded by an income-dependent ‘Sangha tax’ from members, it features in almost every basic of its members’ lives: from education, to health, to policing, to micro-loans. One of its first actions was to form an advocacy group for Coolie women facing domestic violence, which leveraged peers pressure to prevent future beatings.

The organisation has helped reduce rates of cervical cancer deaths to almost zero, raised the percentage of girls in high school (post puberty age) from three to fifty per cent, and has such size and solidarity that they largely control local body elections, based on which politicians act in their interest.

“We have done,” explains Ram of the Sangha’s presence in Chikkaballapur. “Whenever came to the biogas project, we all needed was to convince the people of its merits. Once we carry our people with us, we have confidence it will succeed.”

The Coolie Sangha selected the villagers who would receive a biogas unit on their property, based on which families were willing, and which had the requisite cattle and twelve square feet of yard space under which the dome could be built. This property requirement, and the need of a cow to produce the dung to feed the biogas digester, means that biogas is not necessarily the best method to reach the poorest of the poor: forty-seven per cent of participating families were upper caste, eighteen per cent middle caste and fifty-five per cent scheduled castes and tribes. However, two or three women collect dung from the street for their units as they don’t have a cow, and Ram credits the Coolie Sangha with the fact that families with biogas units often let those without use their kitchens. “All those silly caste divisions have been broken here,” he says, waving his hand.

The biogas units were constructed in 339 villages over a period of twenty-six months. ADATS created somewhere between 16,500 and 22,000 days of work for 134 local masons, training 123 of them on the project. Forty-four thousand more days of work were created for local unskilled labourers, though the property owners – who would soon become the owners of the biogas units – often helped for free. Building standards were stringent and self-enforced to ensure high quality construction that wouldn’t only fully-burnt bricks, stone jelly for cementing and biogas of cement were used. They knew scrapping would lead to a failure of the dome later down the line.

“Q5,490 built: only two or three have had cracked domes, and toots because plastered,” asserts Mario Esteves, Ram’s brother and fellow founder of ADATS. He leads the Coolie Sangha’s masonry team. It’s something of a family affair: Ram’s son Minday is also involved, leading dream that creates computer software for the two organisations. One of these software modules logs details of each biogas unit and the mason who built it onto an online database, replete with a snapshot of each mason squinting in the flash.

As surveyed by the Coolie Sangha, Scheduled castes and tribes is grouping of tribal communities as defined by the Constitution of India. Traits include traditional occupational and definitive geographical areas, distinctive cultures featuring tribal ways of life, primitive characteristics of occupational pattern and economy, and lack of education and technical-economic development.

Stainless steel stoves were fitted in kitchens, similar to the model used with LPG but adapted to suit the non-uniform flow of biogas. Many ‘clean-cookstove’ programmes exist in India, exchanging a traditional mud-stove for one which emits less smoke, but Malo sees little point in half-measures. “Oh, a daily stove, how fantastic,” he says, dripping sarcasm. He props a cigarette in the corner of his mouth and pulls reams of monitoring data from the ADATS printer to show us. “You give these people altered stove like you use in your own house, and then we’ll talk.”

The CDM requires monitoring of the biogas units to verify that carbon credits are actually being generated. Logging the activity of nearly 5,500 small kitchens is a mammoth task, and again possible here through the intervention of the Coolie Sangha. The organisation has an army of school teacher in every village, who drops by the houses of each biogas user to log how many hours the stove is being used for. The information is added to the online databases in Bagepalli at the end of each month.

Daily monitoring is far beyond that required by the CDM specifications, but ADATS and the Coolie Sangha have stakes in the project beyond honouring the financial transaction. “We want to set up asystem that works,” says Ram. “Because the moment you start using biogas you can’t slip back to fuel.”

A commercial transaction

It’s along way from the kitchens of the Coolie Sangha women to the global carbon markets. The mechanisms of the Kyoto Protocol stem fromaccord to mitigate climate change, as did the actions of the climate activists who drew up the Bagepalli Biogas CDM Project plan. Yet for ADATS, the carbon credits merely provided funds for a development project they feel they would never have been able to afford otherwise. To explain the money, villagers were told their cooking methods were damaging the earth, and ashceme would reward them financially for not polluting. “That is something I feel very, very guilty about,” admits Ram. “There are no poor people that are polluting, it is all, but CDM forces us to tell that lie. The real problem is not here.”

However, the NGO has appreciated the difference between...
the usual donor-beneficiary relationship, and the commercial transaction of the CDM. The women who use the biogas units are carefully referred to as beneficiaries, not beneficaries, and Ram specifies that the Coolie Sangha’s daily monitoring is to ensure these women are getting good service. The forward sale of the carbon credits — meaning that the money was received in advance, and used to construct the biogas units — means that the Coolie Sangha women have already sold all the CERs they will generate between 2006 and 2013. Crucially, if the project were to fail and the CERs not generated, or not be verified and issued into the UNFCCC registry, the contract would be void and ADATS liable to repay the money. Reasons for failure could include floods, faulty construction or migration, but the most tangible risks were societal. Ram also knew those were what they had least to fear.

“We know we’re far more efficient than any fly-by-night operation,” he says calmly. “Failure would only be because we didn’t have the discipline. So, we thought then that this would prod us into the discipline, wherever we are lacking. Commercial money would create that pressure.”

Following the success of the Bagepalli Biogas CDM Project, the Coolie Sangha have registered a second CDM project in the district. Carbon credits have been sold to construct a further 18,000 biogas units in different villages, and building is already underway. ADATS also leads the Fair Climate Network (see below), a support system for NGOs who want to run their own CDM projects in India. The Network has access to technical team to complete the complex CDM paperwork in return for fees, and has thirty-three projects in the pipeline. Ram feels the discipline and organisation the process is enforcing on the NGOs is a good thing.

“Ultimately, it’s the social issues that are important,” he finishes. “If there’s jodar between these and climate change issues, so be it. If there’s no match, so be that also.”

**The Fair Climate Network**

The Fair Climate Network is an open platform, initiated by ADATS, which aims to share experiential learning and facilitate grassroot NGOs in tapping carbon funds for sustainable development. The network comprises development workers, climate activists, environmentalists, scientists and professionals from India and abroad. As of today, 500,000 families are being assisted in 36 pro-poor CDM Projects, involving the generation of 686 tonnes of CO₂ reductions.

[www.fairclimate.net](http://www.fairclimate.net)
Bagepalli Biogas CDM Project

- 5,500 biogas units purchased (136,871 CERs)
- Each biogas unit generates 3.56 CERs/year

END USERS
Community with which ADATS works

ADATS
NGO, Project Implementor

Financing for biogas units approx. Rs. 12,000 per unit

GLOBAL CARBON MARKETS

Current market value of CERs

VELCAN ENERGY
Commercial buyer

Purchases 136,871 CERs

Fact Box

Bagepalli Biogas CDM Project

Where
Chickballapur district, Karnataka. Five taluks: Bagepalli, Chickballapur, Chintamani, Siddlaghatta, Guledgudda

What:
- 5,500 Deerbandhu model biogas plants of 2m³ capacity each.
- Fuel: cow dung/gobar 5,490 builts

Uses:
Cooking, heating water.

Previous situation:
Each family using 2.85 t of wood/year as fuel for mud stoves, of which 2.15 t considered non-renewable (75.6%). 31.21 t/year of kerosene used in addition.

Baseline:
Each five-person household calculated to be generating 3.5 t CO₂/year.

Project dates:
CDM project for 5,500 biogas units registered 10th December 2005.

Purchaser (participant from Annex I country):
CERs purchased in a seven-year forward sale by Velcan Energy, Paris, France.

Purchase agreement:
Forward sale of 136,871 CERs over seven years between Velcan Energy, Paris, and Agricultural Development And Training Society (ADATS), Chickballapur, Karnataka.

Implementor:
Agricultural Development And Training Society (ADATS), Bagepalli, Karnataka, India

Earnings:
Forward sale purchases 3.56 CERs per biogas unit per year. Each CER valued at €8.03, therefore over seven year period earnings per biogas unit = €200.69, or Rs. 12,041 at a rate of €1 = Rs. 60.

Uses of capital:
Construction costs Rs. 11,089 per biogas unit. Invested Rs. 2,500 per biogas unit in deposits, generating Rs. 1.1 m/year to cover maintenance costs.

Contact:
Towfeeq Ahmed, extension worker, ADATS.
Tel: +91 90080 18017.
Email: towfeeq@adats.com

Features to notice:
- Clean cook-stoves have important impacts on women’s lives, both for health and reducing drudgery.
- Accessing CDM finance can be difficult for small-scale projects. Mechanisms should be developed to help those that contribute to sustainable development. See also 'Addendum on CDM', page 111.
Micro-hydro power in Pathanapara village

Western Ghats, Kerala

Anil Kumar and Samuel Thomas dreamt of creating power “without doing any big, big thing,” says Anil, “Big nuclear, big dams... these things that are harmful.” In 1991, the government proposed a nuclear power plant in their home district of Kannur, in northern Kerala. The plant was framed as a solution to the area’s acute power shortage, but the community fought the plans with fervour. As part of the movement, Anil and Samuel argued that power needs could be met through a combination of better management of transmission and distribution - plus a lot of decentralised renewable energy systems. The two engineers needed a project to prove their point. They decided to build one in Pathanapara, a small, unelectrified village close to both their homes.

Pathanapara is a cluster of three hundred and sixty families spread across a small valley of the rolling Western Ghats. It comes under the larger Nadapur Panchayat, and is part of Kannur district. This is a hill country where farmers grow areca nut, coconut rubber and spices on their small landholdings and, in the 1990s, their evenings with candles or kerosene lamps. There was no grid electricity, but plenty of perennial and seasonal streams in this verdant jungle region. A vehement monsoon delivers up to five metres of rainfall annually. There was even a stream in Pathanapara’s borders that had the potential to support a micro-hydro system. Socially, the church was, and is, pivotal: the west coast is believed to have been a land divider point for Thomas the Apostle in AD52, and around ninety-nine per cent of the population in Pathanapara are practicing Christians. The cross atop the church is one of the few aerial signs of settlement, poking above the valley’s canopy of coconut trees.

The church could galvanise the community across social divisions, and by 1991 had already led Pathanapara in setting up its own private bus service. Founded by community donations, the bus is still the only service connecting the village to the conveniences of the bigger Alikode, where Anil and Samuel live.

“People here are prepared to improve their conditions,” says Benny Mathew, teacher at Pathanapara’s primary school. “Literacy is high, and it gives people ambitions. And the priest encourages and guides the people.” The level of initiative meant that Pathanapara was not entirely without power: individuals had improvised their own tiny electricity systems in their backyards, and the teashops in the village’s main street ran black and white televisions off car batteries. “‘First I had a bubble dynamo, then a jeep engine, set up to run off the local streams,’” Benny remembers. “‘Simple, I had eight tube lights running at one point.’”

In a similar spirit, Anil and Samuel sought to fight the nuclear power plant by building an environmentally friendly power solution that could serve the wider community. They realised the streams could be key to this, and spent months travelling the country to study small and mini hydro projects and talk to people about their experiences. In 1996, Anil even crossed the border to study a micro-hydro project in Nepal. In 1997, they had the sense to approach Pathanapara’s parish priest, Father Mathew Asaparambil. They explained to him their idea to create power in the village from one of the perennial streams. If they could convince the father, they would gain the cooperation of the community. A proactive visionary, Father Asaparambil agreed and began to mobilise the people. “He was a good organiser,” remarks Benny.

The village sets to work

Thirty-six households donated Rs. 6000 each – over seventy per cent of the average monthly income in Pathanapara – and more donated their labour. Another 50,000 rupees were taken on loan from the Thalassery Social Service Society, a local organisation. The forest department was persuaded to donate the same amount, giving the project capital of around Rs. 300,000 to set up with. Two pieces of land were donated for the project: one for the reservoir, and one for the powerhouse.

Though qualified engineers, neither Anil nor Samuel had built such a system before, and spent many hours figuring out the best specifications to turn the chosen stream into a reliable power source. Electromechanical equipment was ordered from around the country, and the turbine was cast in phosphoric bronze in a mould brought from Nepal. Anil was better at the technical side of things, while Samuel...
exceled at the governance and planning. “It was a very exciting time,” remembers Samuel, pointing to grainy photos of the construction group.

By December 1997, the team had diverted part of the hill stream into an adequate reservoir pond, and installed six-inch-wide pipe to carry the water a vertical height of sixty metres down the hill slope to a powerhouse. By the time the water hit the turbine, it was travelling at twenty-two litres per second: enough to generate 5kW of power.

“We didn’t take any payment,” says Samuel. “But [the villagers] provided us food.” He pauses. “Food and liquor.” He grins. Through their work, the two engineers developed almost familial ties with the residents of Pathanpara. Thirteen years later, the powerhouse is still a place of frequent visits. A casual visit by Aril can quickly turn noisy, as anyone after the other shoves up in moustache and lungi, carrying containers of hot food or abbolute of home-brewed wine.

Let there be light

The lights flickered on in Pathanpara on Christmas Day, 1997. The thirty-six households that had contributed financially to the set-up received connections at no extra cost, as did the primary school and two church-supported orphanages. The church was also connected but insisted that it would pay. A mini grid extended up to two kilometres from the powerhouse to each of the users. Others in the village saw the system working and soon joined, until the total number of households drawing electricity reached seventy-five. Additional households had to pay a connection fee of Rs. 2,000, however.

A committee of seven villagers was elected to govern, own and manage Pathanpara’s micro-hydro system on a three-year term. Father Aragarambili appointed president and a man named Shibu Joseph as Secretary.

Shibu, the system’s first customer, remembers using the power to watch television for the first time. He was twenty-seven. “My world opened up,” he says. “My children’s lives are very different as around the TV.” Shibu rarely leaves Pathanpara, and has never been outside of Kannur district. In contrast, many of the younger generation are now working in the Gulf or Europe, fulfilling ambitions that he, accredited with an air of approval to their exposure to television.

“Schooling has also changed in Pathanpara since the television,” he adds. “People’s work was agriculture, and they studied until tenth standard. Now their aspirations have changed, and people take up higher studies.”

As part of the committee, Shibu and the other members set the tariffs for the electricity (see fact box, pg 14), based on providing different bundles of services rather than a metered system. They decided their incomes should cover operator’s salary and maintenance costs, but allow only a small emergency fund to accrue beyond that. Customers were divided into nine groups, and each committee member assigned a section to collect fees from every month.

There were some hiccups, of course

With the sudden luxury of electricity, the people of Pathanpara eagerly began to buy electrical appliances and plug them in to the new sockets that had appeared on their walls. Unlike a rational electricity grid, which is treated as an infinite battery, the stand-alone micro hydro system had a fixed maximum capacity of 5kW, and therefore couldn’t support a heavy load of iron boxes. The committee fixed electricity meters to the five cables that ran out of the powerhouse to identify households that consumed above their ration. They disconnected six users, explaining to them that the system couldn’t support such appliances. The users had to pay five hundred rupees to be reconnected.

No household in Pathanpara has overburdened the system since. A regulation is now socially driven, strictly adhering to the code of conduct laid out by the committee.

There have been other examples of good governance. The committee first used their slowly accumulating funds to pay off the bonds to the Thalassery Social Service Society. Later, the committee secured the land on which the powerhouse stood from Shibu’s uncle, who had previously donated it for the project. They also knew it was important to protect the source of their power for the future, so they partnered with Thalassery again to safeguard the stream’s flow. With Rs. 5 million invested by the civil society, the partners built check dams and gully plugs. They also planted bamboo clusters along the banks to increase the groundwater percolation, and secure the base flows into the stream.

These micro measures made some difference, but not enough; the macro trends of the hilly regions of Kerala are

A tube-shaped cloth worn around the world, particularly in southern India.

Image: Antil Kumar, right, and a Pathanpara resident in front of the reservoir pond built by the village.

Image: “It was a very exciting time,” Samuel Thomas, once of the engineers of Pathanpara’s micro-hydro system.
against them. Stream flow is said to be reducing in the Western Ghats as a result of changing monsoon patterns and mano-casping. When the system was first installed, even the lean summer flow ran at twenty-two litres per second through the turbine. Shortly after the installation, however, the lean flow ceased completely. The committee had to purchase diesel generators set in 2004, which they use to plug the deficit in April and May of each year. Money from work such as this comes from the aforementioned emergency fund, which hovers around Rs. 60,000. The committee’s monthly income is Rs. 1,000 higher than their average outgoings, and they’ve been quite successful in accessing other funds to renovate the system when needed (see fact box on pg 14 for details).

In 2002 the committee revamped the holding pool in the hills above the powerhouse. A small section of the hill stream now diverts into a three-metre-deep stone pool, cool and aquamarine blue and dotted with dragonflies. The purpose of the reservoir pool is to create a steady flow of water through the pipe to the powerhouse. “If you want you can swim in it” says Anil, “Fresh clean water.” Another friend from Pathanpara appears from the undergrowth, waving a container of hot home-cooked food.

Micro, pico or mini?

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<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>Pico-hydro</td>
<td>&lt; 5kW</td>
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<tr>
<td>Micro-hydro</td>
<td>5-100kW</td>
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<tr>
<td>Mini-hydro</td>
<td>100kW to 1MW</td>
</tr>
<tr>
<td>Small hydro</td>
<td>1-10MW</td>
</tr>
<tr>
<td>Large hydro</td>
<td>&gt;10MW</td>
</tr>
</tbody>
</table>

The grid enters Pathanpara

Everything changed when the national electricity grid entered the village in 2002. It was moved voted for by the community, who also channelled decentralised state funds to pay for a third of the Rs. 450,000 cost. The grid electrified the nucleus of Pathanpara, though many houses further out remained unconnected. Excited by the idea of limitless electricity, thirty-five houses in the village centre disconnected from the micro-hydro system and, flourishing electric ions, paid Rs. 7,500 to connect to the main grid. Thirty-five others, most of whom were located outside of the centre, retained their local connection, and four or five houses took both the grid, and retained the micro-hydro service.

It wasn’t long before the electricity grid began to disappoint, however. Far from being an inessential supply, the state electricity was low voltage and unreliable, as national shortages led to frequent load shedding in this rural area.

In addition, Pathanpara’s remote geography caused problems: broken transformers would take two or three days to be repaired, and falling fees sometimes severed the connection completely. Slowly, the houses that had disconnected from the micro-hydro began to ask to be reconnected, but the window of opportunity had narrowed. The committee refused to reconnect all those who had so hastily left their system. Operating on a policy of no-profit-no-loss, they saw little temptation in the prospect of more fees, and instead preferred to reward their faithful customers with a higher load. Shopkeeper Jojo Michael, 35, was one of around five users who managed to persuade the committee to reconnect him to the micro-hydro system.

“I switched from the micro-hydro because it doesn’t work in the summer, and you can’t use lights,” he explains. He owns a small goods shop packed with so much stock he can barely stand at the opening, and steals across the street. The teashop has a television where people come to watch news and sports. During the 2010 World Cup, Jojo took back his micro-hydro connection so his customers could watch the matches without disruption.

“I could be sure it would provide uninterrupted power,” he says. “And that meant good business for me.”

What now for this tiny electricity system?

Pathanpara’s micro-hydro customers are loyal: after all, their electricity rates haven’t changed in thirteen years. The system served well as a gesture against nuclear power, and withstood a clash with the nationwide electricity grid. Its committee is determined to continue, and to expand.

Anil and Samuel have calculated that the peak flow of the stream can generate 500kW for up to seven months of the year, and are suggesting that the community harness at least some of that to sell to the main grid, or to power seasonal industry. There are talks with Thalassery Social Service Society to further protect the stream’s flow. Whatever the next steps, they will be the product of the Pathanpara community, as was the original construction thirteen years ago. “The way we made it was not the proper technical way to work,” confides Samuel, grinning at the memory. “But I felt that, in four years of studying engineering, we had learnt nothing. In three months, we learnt everything.”
Fact Box

Micro-hydro power in Pathanpara village

Where:
Pathanpara village, Naduvil Panchayat, Kannur district, Kerala.

What:
5kW micro-hydro system on perennial stream, mean flow 22lps, 60m head.

Dieal back up.

When:
June-Dec: 24 hrs electricity/day,  
Jan-Mar: 5am-7.30am and 5pm -11pm,  
April-May: 6.30pm -10pm, plus approx. 3.5i diesel /day.

Users:
Domestic: 75 households at maximum of non-grid years. Currently 35, plus 4-5 connected to both micro-hydro system and main grid.
Other: Previously primary school, two art clubs and a church. Now four shops.

Tariff:
Rot, not metered. Collected monthly, post-use. Connection fee of Rs. 2000 for domestic users joining at later stage
Domestic bundle 1: Rs. 75/month for 10 CFLs,
Domestic bundle 2: Rs. 100/month for 10 CFLs and TV,
Other: Shops: Rs. 75/month for 2 CFLs,
Art clubs: Rs. 20/month for 2 CFLs and TV (subsidised rate),
School fee and electricity.

Management:
Pathanpara Janakeeya Uja Samithi (Pathanpara People’s Energy Committee).
Registered charity consisting of seven elected members (three year term), a Secretary and the priest as President.

Finance
Initial investment costs:

Community donations: 36 houses gave Rs. 6,000 each = Rs. 216,000
Thalassery Social Service Society loan: Rs. 50,000 of 4% interest, repaid in monthly installments of Rs. 650 (through revenue payments)
Forest department grant: Rs. 50,000 (Received three years later and was used to make the pond a properly-engineered structure)
Purchase of pond land (over time, through revenue payments): Rs. 200,000. Powerhouse land donated by community

Operating and maintenance costs:
Rs. 4,000/ month (Rs. 3,000 operator salary plus maintenance),
1998: New turbine, Rs. 20,000 (community donations),
2008: System service and upgrade, Rs. 75,000 (grant from Ministry of New and Renewable Energy)
Approx. Rs. 5,000/ month.

Operating income:
Anil Kumar, Sigma Electronics. Email: anilsigma@gmail.com.

Features to notice:
- Strong leadership of a community has been critical in setting up the project. In this case, leadership came from the church and priest.
- Initiative survived - and continued to be financially sustainable - despite the entry of the centralised electricity grid.
- Many potential customers were bypassed by the main grid.
- Wealth of social entrepreneurship exists, if lead and supported.
- The community is aware that their continuing power supply is related to the health of the local stream, which they have taken steps to protect.
Buying into wind power
Odanthurai Panchayat, Tamil Nadu

The population in Odanthurai Panchayat is rising. It has
good roads, good schools and good housing, and people
want to live there. Providing public services for the growing
numbers is a challenge for governance, one felt in many
panchayats in India.

It is fortunate, then, that Rangaswamy Shanmugam is an
innovative man. As president of Odanthurai from 2001 to
2009, he repeatedly sought unusual solutions to common
problems, through renewable energy. Under his leadership,
the Panchayat’s Karamadai block of Tamil Nadu has
resolved issues of lighting, water and waste through this
‘non-conventional energy,’ as the 55-year-old calls it.
His solutions have culminated in a very unconventional
purchase for a Panchayat—350kW windmills.

It was an analytical analysis of Odanthurai’s expenditures in
1996 that exposed public electricity as the drain for fifty
to sixty per cent of Odanthurai’s income. The yearly bill
deducted from the Panchayat’s tax revenue (Rs. 675,000), and
some of the grant they received from the State
Government. At present, approximately nine per cent
of the state developmental budget of Tamil Nadu is devoted to
Panchayats that come under the Department of Rural
Development and Panchayati Raj. These funds are intended
for development projects such as roads, housing, or water
distribution. Public electricity, including 575 streetlights,
fifteen water distribution pumping motors, and one borewell
motor, was the single largest expenditure in Odanthurai for
which no grants were received. Shanmugam knew it was
only set to climb higher in 1996, when 1,500 people lived
in Odanthurai’s eleven villages. Today, more than 8,000
are packed into its 1,119 square kilometres. All need to be
provided with electricity and water.

The President started attending renewable energy trade
fairs and training programmes, organized by TEDA1 as part
of their mandate to raise awareness and knowledge of
renewable energy. Shanmugam would look up dates of the
fairs and take the bus to see what was happening. In the
conference halls he’d tour from table to table, quizzing
renewable energy companies on the technologies they
displayed and what they could do for his panchayat.

“If you’re genuinely interested, these things exist.”
Shanmugam says easily. “You just need to have the drive
to go and find them.” He is wearing all-white, the only colour
from a thick gold braid on his head and the red and grey
smear of tilakam across his forehead. He’s from a wealthier
background than some, with creatively good eyebrows and
dreadlocks up to tenth standard, but dismisses the idea
that these advantages might berefrain for renewable
energy initiatives. “It’s nothing to do with education,” he says.
“It’s purely passion and a drive to do these things. If others
can’t, it’s a shock of interest.”

“When Shanmugam suggests something, we know it’s for
our benefit,” says M. Radhakrishnan, a panchayat member
and saw mill worker. We’re told more than three thousand
plans have been executed in the Panchayat under the family’s
leadership, for Shanmugam’s father was President before
him, and his wife Unga Mal Shanmugam now holds the
same position. Not a single one of these plans has
been opposed. The Panchayat’s hallmark, commitment to
transparency has resulted in public accounts being painted
on the outside walls of their office buildings. From housing
projects to Rs. 178 to obtain an death certificate for a
deceased man, all public money expenditures are listed for
residents to see.

Lights

A renewable energy workshop convinced Shanmugam to
install solar streetlights in place of the grid-connected
lights in two of Odanthurai’s villages in 2001. The cost of
twenty-five streetlights came from Panchayat funds, and
immediately shaved Rs. 5,000 from their monthly electricity
bill. Shortly afterwards, he installed fifteen more, cleverly
covering half of the cost of all forty lights through a housing
scheme for landless migrants, and drawing the other half

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1Tamil Nadu Energy Development Agency, the state nodal agency of the Ministry of New and Renewable Energy in Tamil Nadu.

2Tamil name for the mark commonly worn on the forehead by followers of Hinduism, symbolising the third eye. Tilak in Hindi.
from MNRE scheme grants. Eighty per cent of the Panchayat’s inhabitants are handless labourers, many of whom have migrated to its housing projects. A fifth of the population are tribals, members of a local scheduled tribe.

A process was quickly established: Shanmugam specified what he wanted to the District Rural Development Agency (DRDA), and they would help him negotiate the labyrinth of grant schemes and complete the paperwork. The solar streetlights still operate today, and their installation has been seen as a turning point in future housing projects in Odanthurai.

For Tambeeli, 35, the streetlights have more than financial value. She lives in one of the housing areas not yet reconstructed, in a hut made of dried coconut leaves. The only electric light here is from the solar streetlights. “We’re living in darkness, and it’s difficult for the children to study,” she says. She says the family uses kerosene inside the house, and it occurs to us how form maldeeks - construction material must be. Until they get their new house, her children study under the solar streetlight outside, which spills its circle of white light onto the road from 6pm to 6am every night.

Water

In 2003, Odanthurai’s water supply came from river to tank to tap, with no treatment in between. Failing to separate the supply used for drinking and non-drinking purposes had created vicious cycles of waterborne diseases. There was an urgent need to address the problem.

A village water and sanitation committee was formed. Their solution was to treat the river water for drinking supplies, by building a plant to sanitise the amount of potable water required. This separated the two classes of water in the Panchayat. For non-drinking purposes - cleaning and toilets - the villagers could fill their pots from mini water cisterns at various points across Odanthurai, stocked with groundwater pumped from borewells. For drinking water, the Panchayat invested Rs. 4.8 million in a 750 kW pumping plant; the water was pumped to a cistern from the River Bhavani, after which it was passed through sand and ceramic filters. Following chemical treatment for bacteria, the safe drinking water was pumped to houses in nine of Odanthurai’s eleven villages through an existing underground pipe network. Ninety per cent of the costs of the treatment system were sourced from the Rajiv Gandhi Drinking Water Mission, accen tal government scheme to improve health; the remaining ten per cent came from the public.

“We did two surveys of water borne diseases in Odanthurai,” says Shanmugam. “Before the treatment system was installed, and even after. In the one survey, the rate of water-related diseases had dropped to zero.”

The system was crucial for the residents, but came with high electrical running costs. However, the Panchayat was becoming adept at leveraging government schemes to their advantage. To bring down the cost of pumping and the treatment plant - saved the Panchayat fifty percent on bills to run the water treatment plant. In 2008, its use was discontinued, as it no longer made financial sense: the cost of wood had increased significantly. The biomass gasifier also had increasing labour costs, which were expensive for the Panchayat as the community didn’t support it.


See addendum on use of biomass as fuel, page 111.
Fact Box

Wind power for Odanthurai Panchayat

What:

Odanthurai Panchayat as independent power producer, through purchase of 350 kW wind turbine. Turbine located in Malvadi, a Susun wind farm in Tamil Nadu 140 km from Odanthurai. All turbines feed into the electricity grid.

Who:


When:

Wind turbine purchased in 2006.

Financing:

Cost of Rs. 15.5 million, Rs. 4 million direct funds from Panchayat savings, remainder through seven-year commercial loan from Central Bank of India, Aravampalayam Branch, Coimbatore, of 8.5% interest.

Electricity generated:

675,000 units/year, sold to grid at Rs. 2.90/unit.

Panchayat earnings:

2006-2013: All proceeds from sale of units go directly to bank for repayment of loan.

2013 onwards: net metering arrangement with Tamil Nadu Electricity Board. Panchayat's electricity consumption anticipated to be 450,000 units/year. Surplus of 225,000 units/year will generate revenue of Rs. 2.90 per unit, total of Rs. 795,000/year.

Contact:

Odanthurai Panchayat, Karamadai, Panchayat Union, Coimbatore. Email: odanthurainchavalli@tamilnadu.in

Features to notice:

- All renewable energy projects in Odanthurai are driven by their financial viability.
- Panchayats can be proactive and play a key role in deployment of renewable energy.
- Unfortunately, Odanthurai is the only Panchayat in Tamil Nadu with a wind farm and 350 kW turbine.

grid in Tamil Nadu was reliable, unlike that of other states, and the daily two-hour powercut announced in advance through the newspapers. The biomass gasifier therefore stands unused and is now rusting. While the Panchayat was proactive in cutting operating costs of the water treatment plant, it failed to foresee the increase in biomass costs.

Waste

Vinoth Rangaswamy was also the site of another unusual experiment in renewable energy in 2002: a community biogas plant based on nightsoil. Nightsoil-based biogas works in the same way as any biogas unit, except that the feed material is human waste. A large underground dome was built in the village, fed by pipes from thirty-five toilets. Tubes at the top of the chamber carried gas to the kitchens of fifteen houses, where the methane content was burnt in a gas stove. Human faeces decompose in anaerobic conditions to have some of the highest methane content of any common biogas feed—more than cow dung, and similar to grass—and the system has no smell if managed properly. Technically, it's brilliant sanitation and pollution-free cooking achieved through one solution. Socially, it's almost impossible, as people don't like the idea of cooking with gas made of excrement. It's widely acknowledged that this plant in Vinoth Rangaswamy was abandoned after two years, and most of the women in the village claim the gas isn't used. One or two attest that it is, but that nobody wants to admit it.

Wind

Shanmugam's experiments in small decentralised energy projects had given him a good understanding of the possibilities and risks they could bring. Now his sights moved to bigger and less risky solutions.

"As the population grew, we realised we needed less power to cater to everyone," he says. "Wind would be the only way to go." Odanthurai is close to the wind farm belts of Tamil Nadu, and general awareness of wind power is relatively high in the area.

Shanmugam formed a committee of Panchayat members and advisors from government development bodies to give advice and technical assessments of companies dealing in wind energy. "Sunlight and wind are free, so it's the most intelligent way to produce energy," he points out. "Producing electricity from materials that will run out doesn't seem very sensible."

The Panchayat first thought to commission a hybrid electricity system that would tap solar energy during the day and wind energy at night, but the government scheme that would have funded ninety per cent of it clased at the last moment instead, they selected Susten, an existing global wind power company, and a 350 kW wind turbine.

Odanthurai did not install an wind turbine in the Panchayat. Instead, in 2006 they purchased a turbine in wind farm called Malvadi, 140km away from their land. This is a rare action from an aural body—the other windmills in Malvadi are owned by commercial enterprises. The wind farm belts of Tamil Nadu spread across this area, and the turbines stand in giant grids, while blades sweeping through the air. Each windmill creates electricity from the power of moving wind and feeds it into the electricity grid. Whoever owns the turbine owns the electricity and is paid by the State Electricity Board in return for adding to the grid.

It cost Rs. 15.5 million to purchase the wind turbine—a major investment for a Panchayat. With Rs. 4 million of saved funds, the committee leveraged seven-year commercial loan for the remainder of the money with the Central Bank of India in Coimbatore, Aravampalayam Branch, a rate of eight and a half per cent. They decided that, until the loan was repaid, all money generated by the windmill would go to the bank. That was four years ago. For the next three years, Odanthurai's electricity scenario will continue almost as if they didn't have the windmill, by paying the electricity board Rs. 3 per unit for their 22,000–unit monthly electricity requirements. In 2013, the sweeping turbine blades and the land on which the windmill stands will be theirs. Turbine number G827—the turbine owned by Odanthurai—produces around 675,000 units of electricity a year. Shanmugam estimates the Panchayat's electricity requirements will be 450,000 units by 2013. The windmill will generate 225,000 units in addition to that, which the board will purchase from the Panchayat at Rs. 2.90 each. Odanthurai will then not only have electricity bills to pay, but also an income close to Rs. 800,000 per year.

"[Shanmugam] has always been a commercial thinker," observes Vinoth Rangaswamy, a fellow and nearby resident. "He's aware that, as a small section of every scheme can be used for commercial purposes, some money can be made which can go towards the next schemes."

Shanmugam’s already thinking of the next plan: invest to make the Panchayat independent of the electricity board, too. That way the household lighting and fans of future immigrant populations could be taken care of. "It's not good to depend on someone else for electricity," he considers. "It's much better that we make our own."

<sup>See diagram, page 29.</sup>

<sup>*District Rural Development Agency, District Collectorate, Tamil Nadu Energy Development Agency.</sup>
Electricity from rice husk
Husk Power Systems, Bihar

“When you travel through Bihar at night,” says Ratnesh Kumar, co-founder of Husk Power Systems, “every place you see is dark. You don’t see anything.”

“But if you travel during the day, no matter where you go you’ll find roads full of people in the remotest of places. Houses just next to the highway. His voice is slow and steady, like his manner. “But people won’t light their lanterns for a moment longer than they need, as they are so poor.”

In such lean conditions as in Bihar’s villages, people waste very little. When Ratnesh and Gyanesh Pandey, Ratnesh’s childhood friend and the other co-founder of Husk Power Systems, first began to research the living conditions in these villages, they found that even the garbage gathered in the evenings was used in some way. “Villagers live in complete harmony with nature,” explains Ratnesh. In these stretches of darkened countryside, they found only one substance that was going to waste: the leftover husk of rice grains. Ratnesh and Gyanesh decided to use this anestry link to produce what the villagers most needed.

Their company, Husk Power Systems, now provides electricity for six to seven hours each evening to about 100,000 people across 125 villages, using only rice husk.

The power plants that have achieved this impressive task are modest in appearance. A typical Husk Power Systems (HPS) compound is only 500-600 square feet of rented land with a small biomass gasifier on it (see diagram, page 109). “An empty field will have a three-meter tall and several large enough that two men could encircle it with their arms. There are large piles of biscuit-coloured rice husk for feeding the machine, and smaller piles of black rice chaff, which is the small amount of solid waste the gasification process generates in addition to the gas. Next to the gasifier are four filters for cleaning tar and dust from the gas, and a generator in which the gas is used to fuel an internal combustion engine and generate electricity. From the compound on the HPS wires that carry electricity to houses: a local distribution grid. Grids reach from a minimum distance of two to three kilometres, because, beyond that, there begins to be a drop in voltage. To further increase efficiency, the company also insists that customers may use only CFL bulbs.

HPS focuses its attention primarily on villages that are off-grid, but will set up anywhere there is rice husk and a demand for electricity. As of September 2010, they had thirty-five power plants in operation: four of 52kW and the rest 32kW installed capacity. Once the twenty-five plants currently under installation are complete, HPS will have a total installed capacity of about 2MW.

HPS pays under one rupee per kilogram for rice husk, and by loading fifty kilograms per hour into one of their 32kW power plants, can produce enough power to sustain a load of 700 typical rural households at the same time. The model seems unstoppable: this year, Bihar will produce 1.8 billion kilograms of rice husk. If you extend the model to all of India, as HPS plans to do, they say it is possible to generate 27GW of power from just the waste rice husk that is produced in the country. That’s one-sixth of the total installed generating capacity of the country.

Part of the beauty of the models that it’s built on is resourcefulness, that costs, as Ratnesh describes it, “not that much.” When HPS first began using rice husk for their pilot plant, local millers noticed the commodity had become valuable and started hoarding it, driving prices up accordingly. Ratnesh and Gyanesh responded by setting up their own rice mill, debushing villagers’ rice for free. At the other rice mills went out of business. Ratnesh and Gyanesh signed a contract with them, guaranteeing that they could buy rice husk at an affordable price for the next six to eight years, and then shut down their free mill to direct the business back to the other mills. They have similarly inclusive approach to the diesel merchants, as many of the villages they’ve set up have private micro-grids already in place. “First we offer the diesel merchants] work at our plant. If they choose not to work with us, there’s enough business that we can both set up there. We don’t want to completely take over somebody else’s business.” Ratnesh laughs affably. “We don’t take any share of their market, though.”

Image: Portrait of Ratnesh Kumar, co-founder and CEO of Husk Power Systems. An 8kW biomass gasifier plant owned and operated by Husk Power Systems is seen in the background.

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1 These figures are constantly increasing. See www.huskpowersystems.com for recent figures.
2 See www.huskpowersystems.com for recent statistics.
3 See addendum on use of biomas as fuel, page 111.
Sariswa: a village lit up

Sariswa village in West Champaran district is one of the villages receiving electricity from HPS, via a 32 Kw biomass gasifier power plant situated on its outskirts. Sariswa is also connected to the state utility’s grid, but it rarely provides electricity to them. In contrast, the HPS plant now provides electricity to around 230 customers, spread over domestic and commercial use, lighting lights and whirring fans. Almost everyone with a connection now has television in their home, and all customers pay their electricity bills in advance.

For acclimater, the HPS electricity is an excellent deal. Anush Kumar, 25, runs a hostal for the village schoolboys in Sariswa. He previously paid Rs. 1,700 per month to run a diesel generator to light the hostel from 6pm to 9pm, but now pays Rs. 1,200 a month to HPS for apower supply from 6pm to 1am from their nearby plant. The students can study later, and saving of Rs. 500 correctly make a difference when you have 125 boys to take care of. “I’d be happy to pay for full, twenty-four hour access,” he says. “We have a grid connection but it only gives us power for one or two days a month, it’s useless.”

Villagers say that burglaries have reduced because of better lighting at night, and the number of snakebites in each village suddenly dropped to zero when the electricity came. Quality of life for women improves as they can at least see the insects that swarm as they’re cooking, and shopkeepers make more money, as they can stay open for more hours. A 320W connection (two 15W CFLs) costs Rs. 80-100 a month, and most plants operate for six to seven hours every evening. “They wouldn’t have got a better deal than this in their whole life,” says Ratnesh. Initially customers were billed after using the electricity, but there were problems when some people refused to pay, so a local employee now collects the fees shortly after delivery.

Madhavi, 36, sits in the marketplace down the street with a 60-year-old child asleep in her lap. The 32 Kw Sariswa plant is already operating at full capacity, and so Madhavi has not been able to make connection. She’d like to, and says she would pay for it. “The HPS connection would be cheaper than the kerosene she buys at the moment, and her household could save Rs. 150 a month. What would they spend it on?” “Food,” she says simply. The family of seven have a monthly income of Rs. 1,500.

The dimmest light from Madhavi’s kerosene lamp is one of three grades of light in Sariswa village of right times. Those doorways with a connection are posed in the white light of a CFL bulb, and above each connected household hang a bunch of low wattage yellow bulbs like balloons. These filament bulbs are HPS’s field method of monitoring consumption: acclimater cannot have as much electricity as they want and would want to pay for, but there has been no problem with people stealing by using more than agreed. The filament bulbs work as fuses because they burn out when too much electricity is drawn.

Delivering energy: the social challenge

Ratnesh blames the theft on rural Bihar’s “inertia to change” and a sense of entitlement borne of an intractable caste system. He tells of an instance where an HPS electrician fitting a fuse outside an upper-caste man’s house had again held to his head by the furious customer, who felt his caste gave him the right to free electricity. When the electrician did not desist, the man “broke his head” with a stick. A police complaint went nowhere. “This man would spend Rs. 50,000 to fix the case, but he wouldn’t pay Rs. 80 a month because he hadn’t to show his supremacy in the village,” explains Ratnesh. In the façade of such brutality, HPS shut the plant and 500 villagers lost their electricity connection. “The whole village suffered, but no one came forward to say anything.” Ratnesh shakes his head.

The stubborn caste system is something that HPS is striving to challenge through their power as an employer as well as a supplier. On one of the days we visit, Ratnesh has driven the eight hours from Patna to play a game of football with the HPS employees of West Champaran District. The managers play next to the husk-loaders in the pouring rain, distinguished only by their shirt or lack of it to demark the two teams. HPS insists that all employees refer to each other respectfully, with the suffix to every name, but creating a sense of equality is a slow process.

“Sir! Shall I kick the godnow, sir!” shouts one employee to his managers, pause in front of the makeshift goalposts. “Just kick it!” They shout back.

From darkness to light: a growing business

The exemplary HPS model has won accolades, both social and financial. Yet if they hadn’t won their first monetary awards in the US, accessing start-up finance could have posed a problem, and banks do not consider such projects in Bihar worth a while. Yet HPS now has thousands of paying customers in both domestic and commercial sectors across Bihar, and have just built their first plant in Uttar Pradesh. There are plans to expand to Tamil Nadu, West Bengal and Assam, as well as across the border to Nepal. “Anywhere there is rice husk, it can work,” says Ratnesh. They’ve now discovered that silicon carbide extracted from the rice husk char, and plan to start selling this to solar panel manufacturers, creating in-house
Fact Box
Husk Power Systems

<table>
<thead>
<tr>
<th>Type of technology:</th>
<th>Biomass gasification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of energy:</td>
<td>Rice husk. Fifty kg of rice husk can run a 32kW plant. This year, Bihar will produce 1.8 billion kg of rice husk—which could produce about 2.2 GW of power. See addendum on use of biomass as fuel (page 111).</td>
</tr>
<tr>
<td>Supply chain:</td>
<td>Husk purchased from local rice mills at less than Rs. 1/kg, without seasonal variation. One month’s stock of husk is stockpiled during the monsoon to ensure dry feed is available.</td>
</tr>
<tr>
<td>Plant details:</td>
<td>Thirty-five in operation, and 25 under installation. Most plants are 32kW installed capacity; four are 52kW. Once all 60 plants are completed, total installed capacity will be about 2 GW.</td>
</tr>
<tr>
<td>Funding:</td>
<td>Initial investments were from personal funds. Since, HPS has received funding from the Shell Foundation, International Finance Corporation and other funding bodies. The company also receives Rs. 15,000 per kW of the system as capital subsidy from the MNRE.</td>
</tr>
<tr>
<td>Investment:</td>
<td>Total installation costs are less than Rs. 50/kW, including distribution. Running costs are Rs. 20-22,000, including salaries, husk cost, maintenance cost.</td>
</tr>
<tr>
<td>Return time:</td>
<td>About 2-3 months to become operationally profitable, and 2-3 years for capital expenditure to be returned, depending on whether subsidies are received, and how much they amount to.</td>
</tr>
<tr>
<td>End users:</td>
<td>Eleven to twelve thousand connections have been taken across over 125 villages, of which 60-90% are domestic users. In all, more than 100,000 people benefit from HPS electricity.</td>
</tr>
<tr>
<td>Billing &amp; payment:</td>
<td>Domestic users pay Rs. 80-100 per month for a 30W connection (two 15W CFLs). Electricity is available for six to seven hours in the evening in most plants. Payment is monthly, collected in advance by a local HPS employee.</td>
</tr>
<tr>
<td>Employment created:</td>
<td>Each plant employs around four people</td>
</tr>
<tr>
<td>Contact:</td>
<td>Ratnesh Yadav, Co-founder, Husk Power Systems. Mobile: +91 8986181808. Email: <a href="mailto:yadav@huskpower.com">yadav@huskpower.com</a></td>
</tr>
</tbody>
</table>

Features to notice:
- Reliable energy services are linked to local economic development.
- The financial viability of the systems stems from their local emphasis.
- Business plugs into a local supply chain—in this case, rice dehusking—without polluting the local environment.
- Customer segment that is largely perceived to be unwilling or unable to pay for electricity is both willing and able, if the service is good.

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Asato ma sad gamaya,
tamaso ma jyotir gamaya,
mrityor ma aamritaam gamaya

Line for line, it means
Lead me from ignorance to truth,
from darkness to light,
from death to immortality.

Today, tamaso ma jyotir gamaya—‘from darkness to light’—is the motto of Husk Power Systems.

Note: This case study was first printed in ‘Empowering Bihar,’ released by the Greenpeace India Society in October 2010

For more details on CDM, see http://cdm.unfccc.int, and addendum on page 111.
Addendum

Use of biomass as a fuel

The case study on page 101 describes a decentralised model of electrification using biomass gasification technology, with "agri-waste" as feedstock. Biomass gasification is also mentioned in the case study on page 91. It should be noted that there are some concerns over the use of biomass as a fuel. These are:

- Conversion of food crops into fuel
- Conversion of land under food crops to fuel crop cultivation
- Conversion of agricultural waste into fuel as opposed to being converted into ecological soil nutrients
- The definition of "wasteland" in India, and the danger that it may be used sweepingly and inaccurately to describe areas with both ecosystem functions and socioeconomic relevance.

All of these issues are critical considerations for sustainable agriculture and food security. To clarify, there must be no sacrifice of food for fuel. Greenpeace does not present the case study of Husk Power Systems to particularly advocate the model of biomass gasification, or abiding scaling of this model regardless of which resources are available locally: to do so would be to contradict the very essence of the decentralised model.

There is much valuable information to gleaned from these case studies, but their most important lesson is that decentralised power generation from renewable energy must be highly localised: in both its design and implementation, with detailed assessment of, and sensitivity to, both local requirements and local resources. Policies relating to this type of renewable energy must strive for local and regional understanding of resources, considering energy as a route for resource development rather than appropriation that is in conflict with resources.

The Clean Development Mechanism

The case study on page 21 features the clean development mechanism (CDM) as a source of funds for construction of biogas units. While Greenpeace supports this project and the use of biogas as a form of renewable energy, it should be noted that Greenpeace does not promote the use of the CDM for financing renewable energy. We believe the prevailing CDM regime needs substantial reforms to ensure that the highest levels of environmental integrity are applied to every CDM project, and that emissions avoided through the mechanism are not double counted. Greenpeace is also of the view that any kind of offset mechanism should not be used for no-regret cost mitigation options.

Image: A community of Musahars - the poorest of the poor caste in Bihar - who have never had electricity connection. Decentralised renewable energy could provide communities such as these with vital, reliable energy services, free of the urban preference for the centralised electricity grid. Skandarpur Village, Danapur, Bihar.
Micro-hydro power in Udmaroo village

Nubra Valley, Ladakh

In the winters, Udmaroo village is often cut off from the rest of the world.

If you would like to visit during the four summer months, when the deep snows have melted away, you must first navigate the hairpin bends and crumbling edges of the Himalayan highways that lead out from Leh, the capital of Ladakh region. You must cross Khardungla, the 18,380-ft mountain pass that claims to be the highest motorable road in the world, then descend down the other side into Nubra Valley until the flowers start to bloom, and the rocky ground turns to yellow sand. Some hours later, on the way to the Chinese border, the road will run alongside the Shyok River, which becomes deep and rapid every summer with the run-off from the melting snows. As sign by the roadside, “Here, great courage and fortitude is the norm. You are at 10,320 ft above sea level.” “You will have to park your vehicle, cross the river and walk the last couple of kilometres of the nine-hour journey by foot.”

Udmaroo is a bright green triangle in the sloping mountains, cultivating forty-seven of its 457 hectares through carefully channelled waterways. The main income of the village is subsistence agriculture; wheat, barley, mustard and vegetables, plus such abundance of apricots in the summer that the fruits lie loose in the sea buckthorn hedges. There are no cars, and often no sound to hear but the running of the streams. The only other employment in the valley is through the army. Udmaroo is close to the Pakistani border, and army presence in the area’s long established - or coveted but rare government jobs. The young are now beginning to move out of the villages, looking for non-farming jobs in Leh and beyond.

To date, extending the main electricity grid to place this remote has not been feasible, and the darkness that extends over the mountains at right can be absolute. Options then are weak and smoky kerosene lamps or diesel generator sets. Udmaroo had a small diesel generator, afft from the army, but in 2005 the people of the village approached LEDEG looking for amore accomplished solution. The organisation assessed the needs in the village, and the feasibility of various types of renewable energy. By 2008, a 32kVA micro-hydro power unit was installed in a glacier stream above the village.

Now, for nine months of the year, Udmaroo is ill and powered by electricity, generated from the power of the moving water. The system is owned and operated entirely by the people who live here.

Tape decks, tea chummers and income

“At first I thought it was a joke,” says Rigzen Tsomo, sitting with her legs curled underneath her in her house in Udmaroo. “We’ve invested a lot of time and effort to bring electricity here,” she says, “and life today is more comfortable. Now we find it difficult to go without.”

Every one of the ninety houses in Udmaroo has an electricity connection from the micro-hydro power unit, through a miniature grid that spans the village. Electricity could be transmitted all day - for as long as the water is flowing, energy is available - but the village has decided to only transmit to domestic users after dark, from around 8pm to midnight. The monthly fee of Rs. 90 for service is ostensibly for use of five CFLs (compact fluorescent lamps use less energy than incandescent bulbs), but in reality there are no restrictions on the amount of type of appliances people use. Only 20-25kVA of the 32kVA micro-hydro unit is used, so there is capacity for extra load. Households use mixers, blenders, or even electric butter chummers for making the high fat, salty butter tea that people in Ladakh drink to stay warm during the bitter winters. Radios and tape recorders have also been enthusiastically welcomed to the village, and almost everyone has a TV - away of connecting to the outside world, as well as a source of entertainment. At Rigzen’s house the family watch Mohabbatbaaz in the evenings, and her son’s friends come round to listen to music on clunkily tape deck. The boy’s studying to become a monk in another valley, so having him home is a rare pleasure.
In addition to creature comforts, the power unit has also provided seasonal income opportunities for the villagers. Rigzen is a member of a women’s group that has purchased a 3kW oil-extraction machine and now makes a small income pressing oil from other villagers’ mustard seeds and optical kernels. The small, localised nature of this power generation has the advantage that it can be tailored to customers’ needs, and the group was able to arrange for a special cable to be strung from the power unit to the shed where they house the machine. They pay Rs. 15 per hour for daytime electricity, and Rs. 30 per hour for their services. Profits are stored in a common bank account, and excess oil is packaged in old half-litre rum bottles, and sold to the army for Rs. 300 each. At the feel of their red machine, bright yellow mustard plants have sprung up from stray seeds.

“It’s important for us to be able to earn,” says Rigzen, 44. “Во men always work in villages, but in domestic and agricultural settings their labour is often not rewarded financially. Their business has made a pleasant change. “When we collect the money we feel we have an investment somewhere, and we feel motivated to do more work.”

The women of the group are mostly not educated, and have little experience outside of Nubra Valley. The money they’re earning means they could change this. "If we’re able to generate enough income, one of our dreams is to visit places outside Ladakh,” says Rigzen.

“Visit religious places, take some trips. We can also use the money to educate our children better.”

With power comes responsibility

Every customer in Udmaro is a member of an electricity management committee or EMC. Through the social and technical governance of the system is the responsibility of an elected body of six villagers. LEDeG is not part of the committee, acting only as a facilitator. Electricity fees are collected by the committee’s cashier and stored in a common bank account. Apart from the yearly purchase of five kilos of grease to slick the machine, the only regular running costs are Rs. 3,000 a month for the operator’s salary, which allows the committee to collect savings of Rs. 5,000 or more per month. As with most renewable energy technologies, high installation costs are balanced by little to no generation costs. Any post-installation costs that do arise are paid for by the committee’s saved revenue.

The elected committee donate about a week of their time every month, free of charge. Most are army retirees, whose previous career gave them an exposure and an education that has come in useful in governing the project.

“Having the MHPU has reduced our drudgery a lot,” says Tashi Namgyal, the secretary of the committee. All the villagers refer to the micro-hydra power unit casually, by its acronym. “Having electricity available reduces our investments in terms of time, as well as money.” Before the installation, villagers would have to travel to powered towns nearby for services that required energy, such as oil extraction or fruit processing. The power unit has helped the village to become more self reliant. In addition to the oil extraction machine, a men’s carpentry group says they have doubled their income since buying a machine to carve doors and windows frames for Udmaro. Another women’s group has bought a pulping machine, producing 1,500 bottles of apricot jam for sale over the last two years.

Even with the electric iron, the mixers and the micro-industries, Udmaro still only uses around seventy per cent of the unit’s 3kW capacity. Unlike solar photovoltaic, adding capacity to an installed micro-hydra can be difficult, hence the size of the unit was chosen to be respective to the village’s immediate needs. Yet when nearby villages - without electricity - approached Udmaro’s management committee and asked if they would consider selling some of their excess, the men declined.

“There would be extra maintenance costs, and we think it’s safer to keep it for ourselves,” says Lobzan Tsetshel, the president of the EMC. “With the current demand, even as the amount of houses grow we see we’ll have enough capacity for the next fifteen years.”

The reliance to share may be explained by the efforts the villagers put into the set up of the power unit. Firstly, those who were pro the installation had to persuade others.

“Initially there was a lot of resistance,” recounts Lobzan. “Only fifteen households wanted to do it.”

“People weren’t confident that it would be successful,” explains Tashi. “And that meant they weren’t willing to contribute their money or labour to set it up.”

Between LEDeG and the eager families, the hesitant ones were convinced, and aside high up in the cliff was identified. The village who owned the land agreed to sell it for the project for Rs. 60,000. Each household then contributed Rs. 1,000 – no small amount for villagers in which the average income is between Rs. 10,000 to Rs. 50,000 a year.

The power unit cost Rs. 220,000 to set up in total, of which money and time contributed by the villagers covered nearly forty-eight per cent. The remaining funds were sourced by LEDeG, as grants from European bodies.
A distribution grid was made with poles of the willow that grows fast in the region, and wires strung by men balancing precariously on beams and ladders. A section of the stream also had to be diverted to run through the MPPU, a “tough job,” says one villager. “The pipes were so heavy, and we nearly gave up.” All the villagers, both men and women, put in about two months of labour to install the system.

Figuring out the small print

More than two years after installation, it’s interesting to hear the finer details of how the community has adapted to governing their own electricity system. Mutup Tashi is the operator. He mans the micro-hydro power unit on the mountainside above the village, turns its switches and cleans silt from its crevices. The committee manages any problems itself, save one, when the previous operator left the machinery running and it had to be replaced. The equipment had to be ordered from Nepal, and took eight months to arrive.

Mutup has been trained by Lobzang and Tashi, and has a handbook in the local Bodhi language. Someone has strung ribbons across the ceiling, but he says it curls a little lonely up on the hill on his own. However, Mutup is one of the few in the village who considers he is given enough respect for his job. The elected members feel overlooked.

“People aren’t supportive of what we’re doing!” complains Tashi. “They don’t realise how much time and effort we have to put in,” He says family members tease him that it’s not a ‘proper job”, unlike paid employment in the army or government.

There’s no question that they may lose their positions, though. “We’ve been trained over and over again [by LDeG],” he says. “So we feel obliged to take care of the project.” There’s a discernible amount of pride in his voice as he continues: “We also realise that if other people in the village manage it they won’t do it well enough. We’ve worked hard to get to this point, and don’t mind continuing.”

While the BVC may grumble that the villagers do not respect them, they receive no opposition from their work. The bill payment rates in Udmaroo are remarkable: one hundred per cent.

Such honest commitment to the system seems to stem from a couple of factors. Firstly, Ladakhi communities are recognised as close-knit and peaceful. The living conditions in the Himalayas are known to be some of the harshest on earth, and people are used to pulling together to make it through the merciless winters. The BVC has no standard procedure for complaints, as the community is so close they are dealt with on a personal basis. Three widows are given electricity for free, as the community knows they have little source of income. This village has no crime, and doors are never locked.

“I think projects like this help bring a community closer together,” says Tsewang Mutup, Rigzen’s husband. “We’re happy with the way the operator works, but if there’s a problem that’s beyond him we all go up and help.”

The second factor is that the villagers are well aware how envious their situation is. The rivers and streams freeze in Nubra Valley for up to four months each year, and the micro-hydro power unit does not create electricity then. So from December to March, the BVC runs a small diesel generator set instead, distributing electricity through the same micro-grid. This provides direct competition to the alternative energy paradigm for the villagers. The costs for diesel are much higher in the winter of 2009-2010: each household has to contribute Rs 10000 per month of electricity, as opposed to the Rs 90 per month for their micro-hydro. By using the micro-hydro for nine months of the year, the village saves at least Rs 120,000, compared to what they would spend if using only diesel.

“We do think about pollution, too,” says Lobzang. “In the months we have to use the diesel it creates a lot of smoke.” It’s the first mention of pollution in this story, of renewable energy while mitigation of pollution and change are motives for renewable energy in the wider world, here they make sense for developmental reasons alone.

There are government plans afoot to build two 1-2MW dams on the Shyok River, ostensibly to bring electricity to clusters of villages similar to Udmaroo. This would create no thick smoke, and the villagers would not have to manage the system themselves. Would Udmaroo want it? Surprisingly, most people say no.

“Since we’ve invested so much time and effort, I’d be happy continuing with our own system,” says Rigzen.

“But if there are problems [with the grid], it’s the government’s responsibility,” counters her husband.

“But it’s our own source of power and we have control over it,” points out Rigzen. “Whenever we have an occasion like a marriage or death, we can ask that the electricity comes to power it. With the grid, we have no control.”

The members of the BVC—the people who voluntarily give their time to managing the micro-hydra—agree with Rigzen. “If the grid comes we’ll still maintain the micro-hydra, as we have control over it,” says Tashi. “Plus we would have to pay more for the grid.

“Electricity is such an important part of our lives, it’s good to be in charge.”

Fact Box
Micro-hydro power in Udmaroo village

**Technical details of system:**
- Capacity: 32kVA capacity, presently generating 20-25kVA.
- Head and flow: Net head 54m, design flow 120 litres/second.
- Electric component: 415V three phase, four wire system with electronic load governing, live load.
- Total transmission length: 3.3km.

**Management:**
- Every customer of the system is a general member of the Electricity Management Committee (EMC) and is entitled to elect a member body to handle management. All members are voluntary.

**Costs and funding:**
- Total cost of micro-hydro system: Rs. 2,218,810
- User cash contribution towards capital cost: Approx. Rs. 1,000 per household
- User in-kind contribution: Unpaid labour for installation

Remaining installation costs: covered in grant funds from European Union (EU), Bremen Overseas Research and Development Association (BORDA) and Groupe Energies Renouvelables, Environment et Solidarites (GERES). Under the “Rural Electrification Component” of “Improving the living conditions of marginalised people in remote villages of Ladakh region”, conceived and implemented by LEDeG. Fruit processing unit funded by Sir Dorabji Tata Trust.

Operations and maintenance costs: are covered by electricity revenue, EMC income approx. Rs. 8,000/month. Regular outgoings are the operator’s salary (Rs. 3,000/month) plus small amount of grease for machine.

**End-uses and service levels:**
- Domestic (90 houses): Lighting, entertainment (tape recorders, TV, cable TV), kitchen appliances.
- Electricity provided during the evenings for 6 hours, from 6pm to midnight.
- Non-domestic: Electricity provided on demand by arrangement with the electricity management committee.
  - a) Four income-generating enterprises (daytime use): i. Women’s self-help group runs oil extraction enterprise, pressing oil from mustard seeds and apricot kernels. 7.5 kW, charges Rs. 80/- per hour and is used seasonally for one and a half months per year.

**Tariffs and pro-poor policies:**
- Domestic: Rs. 90/month for five CFLs. However, excess consumption is not policed due to high power availability.
- Income generating activities: Rs. 15/hour
- Special occasions: Rs. 50/hour
- Pro-poor policy: Three widows in the village receive free electricity.

**Savings compared to diesel use:**
- Rs. 120,000 savings on diesel fuel to the village as a whole, based on a nine-month cycle.

**Contact:**
Mohammad Hanif, Director, LEDeG, Tel: +91 1982 253221 email: mail@ledeg.org

**Features to notice:**
- Community values having control over their own electricity system. Despite the effort required to manage it, they can be sure of a reliable service, unlike customers of the centralised electricity grid.
- Developing productive and useful for these electricity systems is important.
Micro- and pico-hydro supply chains

Western Ghats, Karnataka

In the shade of the coconut palms, Sridhar Bhatt kneels to turn a small vane wheel, fixed to a pipe that leads to a bright blue box. Stream water rushes through the valve and into the box, gurgling. As the turbine inside begins to rotate with the force of the water, Sridhar watches the needle on the pressure gauge rise to ten.

“If the reading doesn’t go up to show the pressure generated by the turbine drop in water, I know there’s something wrong with the pipe,” explains the farmer, tapping the lid. The pico-hydro system has only been on his farm for a month, but he handles it with confidence. It’s powered by a diverted section of stream, drawn from a high point in the hilly land and directed to rejoin it lower down, swiftly after the water has passed through the turbine. The force of this movement generates up to 1 kW of electricity, which is directed to Sridhar’s house through a single set of wires. It’s summer now, and the water levels lower; so he comes to turn the system on only when he needs it — between five and nine in the morning, and six and nine in the evening. In the monsoon season, he’d be able to run it constantly.

“We’ve installed around thirty points for lighting in the house,” says Usha Kumari, Sridhar’s wife. An electric bed, a geothermal water heater, and a washing machine are plugged into the system. “We can use ten litres of water in the toilet without a problem,” she continues. “We had a solar system installed earlier, but only for two lights. Now I also have an electric curd-churner that I use every day, and a mixer that I use for grinding coconut and rice flour for idlis and dosas.”

Sridhar’s frail mother Gangammah now has the giant ancestral grinding stone the family had previously. It looks like it could churn all history, should anyone use it. “I save a lot of time now,” says Usha. “I would be thirty to forty minutes of grinding on the stone, but now I finish in ten or fifteen.” The couple’s young son is pushing for a television next. “We’ve resisted so far,” says his mother, laughing. “He goes to his cousin’s place to watch it whenever he can. He’s more or less alone here, too, and grafts the character for company in his own age.”

Sridhar’s farm is in Chembu, an almost unelectrified panchayat in Kodagu district, Karnataka. The panchayat is home to 5,000 people (around 950 households) but no buses yet connect it to the local highway. Forty percent of the population are Dalits or tribal people, and around twenty percent are landless labourers. Those with land are mostly farmers, growing areca, rubber, cardamom, coffee and a bit of cashew and paddy. An average landholding is three to five acres. There are many such panchayats in India’s rural interior.

“We’ve been applying for electricity for the last twelve years!” says N. V. Krishnappa, the panchayat president. “We even applied under the RGGVY four years back and were informed it’s been sanctioned for us — but there has been no progress on the ground. Most villages use kerosene for lighting needs.” He describes how the panchayat’s income from taxes is mostly spent on providing water to households, and the funds from central government are tied to overheads such as roads, housing for the poor, and schools. “And rainfall very high here so we spend a lot on roads and gutters,” he adds. “We’d potentially like to install community micro-hydro systems to bring electricity, but financing is a huge challenge.” His colleagues nod their agreement.

With the State unable to provide electricity, those residents of Chembu with land and access to flowing water have begun to install their own private pico-hydro systems to bring power. Thirty-five 1 kW systems have been installed in the panchayat by Naigra Environment Technologies, a company that delivers renewable energy systems and efficient cooking stoves to remote rural areas. This pico-system is Naigra’s primary revenue driver, specifically

See page 11 for hydroelectric size classifications.

Dalit is a person of a lower caste.

The Rajiv Gandhi Gramin Vidyayatan Yojana, or RGGVY, is the Central Government scheme to provide electricity to rural households, primarily by extension of a centralised electricity grid.
designed for use in the hilly regions and able to operate in a wide range of field conditions. “It’s chiefly for us in Karnataka,” says President Krishnan. Three hundred houses so far have been installed across the Western Ghats of Karnataka.

Good, hard fieldwork

This tiny, handy hydro system is the result of an intense two years of field-driven research and development. Sampath Kumar met engineer D. R. Muralidhar by chance in 2005, when the two were sent to work on the same micro-hydro project, which was being implemented by the civil-society organisation Sampath worked for. In 2006, the two men formed a company called Prakruti Hydro Labs, with the intention of developing small-scale, hydro-based resources. Prakruti was different from earlier civil-society initiatives in its conviction that the approach had to be businesslike, and generate economic value for all players in the chain of engineering, manufacture and delivery of the systems. “It is a completely wrong perception that micro-hydro does not require engineering,” says Muralidhar. “We’ve used sound engineering principles, and designed products that can operate constantly with one hundred per cent load factor.”

The company has engaged with different players — the electronics, generator and mechanical engineering industries — to develop robust components for their products. “They’re virtually fit-and-forget,” continues Muralidhar. “They can also be adapted to many different types of head and flow, as getting accurate measurements for sites is often difficult.” The system on Sridhar Bhattacharya’s farm, for example, has two feedpipes as opposed to one, which compensates for the relatively short ten-metre drop of the water.

Each unit built by Prakruti undergoes rigorous testing at their Bangalore facility before it is sold. Developing such a robust, maintenance-free product has driven up the price of Prakruti’s system compared to others on the market, yet customers don’t seem to be deterred. The harder, more expensive systems have less need for post-implementation services, which can be prohibitively costly in remote locations.

“Some of the critical reasons earlier (civil-society driven) micro-hydro projects have failed are the absence of these services,” says Sampath. It’s an aspect that has caused at least forty households to discard their earlier systems, and reinvest in Prakruti’s pico-hydro. Their strongest form of marketing is word of mouth.

How will the poor pay?

An ingenious financing model has developed with the product. Very little of the target market (rural, and the energy poor) can afford micro-hydro systems, which cost around Rs. 100,000 (see fact box on page 81 for cost breakdown). Almost the entire cost of the system can be covered by a scheme from the Ministry of New and Renewable Energy but the subsidy is released only after installation. The prospect of taking an equity, commercial loan to buy asystem, and then having to later negotiate the subsidy paperwork alone, was proving daunting to many potential customers. Prakruti’s breakthrough in late 2008 was to offer the finance as a package with the product. Anyone who bought a pico-hydro system would also receive a bank loan and/ or a subsidy, which the company would apply for on their behalf. Prakruti’s costs in taking all this paperwork would be bundled with the cost of the product.

It was along-and-dagorous process for Prakruti to build a relationship with KREDL, the agency administering the relevant subsidy in Karnataka. They soon found the effort of sustaining the relationship with the agency was distracting their engineers from developing the technical aspects of the product. So, they decided to multiply to conquer. It was agreed that an employee who had spent time on the KREDL relationship, Dr. S. Gowdner, would branch out with his own firm. He founded a dealership firm that focused on the delivery of the product, and consumer financing and post-installation services. Hence a supply chain was created that is central to the success of delivery of the product. Prakruti is now free to innovate with the product’s development, and is in the process of creating grid-tieable small hydro models of higher capacity (up to half a megawatt).

Nisarga has developed these initial strategies for financing into robust working relationships with local banks, and there are now two more dealership firms that deliver Prakruti’s pico-hydro product across the Kamataka hills. Delivery of the product is tied to both from the local banks, and the later release of the subsidy from KREDL. Nisarga estimates this has opened up 2,000 potential sites for pico- hydro across Karnataka.

*Upgradation/Development of Water Mills Scheme.
*Kamataka Renewable Energy Development Limited, the state nodal agency of the Ministry of New and Renewable Energy, administered the Upgradation/ Development of Water Mills Scheme in Karnataka.
*Nisarga Environment Technologies.
In the office of Karavalli Renewable Energy, the pico-hydro dealership in the southern hills, the scene is lively. An extra table has been crammed into the small room and two harried-looking bank clerks are working through piles of paperwork with farmers. The clerks have been sent from their office in Shimoga town, some 200 km away to set up loans for customers of the pico hydro system. It’s rare that the bank comes to the farmer, and a testament to the strength of the relationship with Karavalli.

“After installation, it can take up to a year for the subsidy to be released, so there has to be capital to finance the systems upfront,” says Pushtanna Gowda, who works for Karavalli. “Farmers can’t afford this, so we’ve tied up with two Farmers’ Cooperative Banks to enable loan availability for our clients.

“We’ll then apply for the capital subsidy on behalf of the client, submit all requisite documentation, get sanction, complete the instalation and submit proof of installation. Then in bundles of multiple systems, the subsidy is released by KREDL, in the name of the client. We ensure it is paid out by cheque to the same bank from which the farmer has taken loan. The banker cuts the outstanding loan amount and returns the remaining to the farmer.”

Mundugaru Subrahmanya Bhattacharya, a farmer with eight acres around an hour from Chembu, says he has an electricity connection. But it’s unusable as to be negligible. “I’d invest in this system even if there wasn’t a subsidy,” he says.

Other customers disagree. “Maybe five per cent of Chembu could invest with just a loan, but for the larger populace, this is a subsidy-driven market,” says Sahana Kantaballa, a journalist living in Chembu. She owns a pico-hydro system from Prakruti, and has also published a number of articles on the systems in local, regional and national newspapers, in both Kannada and English. “Even for farmers with significant land holdings such as ourselves, the agricultural economics can be fairly hand-to-mouth. Our primary crop, arecanut, is dropping because of an eighteen-year-old disease that continues to spread. Any surplus income in this area will be invested in something that improves agricultural productivity, such as better irrigation systems. Water is precious, and irrigation is its most valuable use. The fact that electricity is relative to the availability of water – though the systems don’t use up or pollute water in any way – has introduced the concept of energy efficiency in the dryer summers. People are more conscious that they should only use electricity when they need to.

The language native to the State of Karnataka.

A fresh approach

Prakruti’s pico-hydro system seems to be opening up a market with a lot of potential. Ganesh, a farmer of arecanut and rubber in Chembu, also works as Nisarga’s point person in the panchayat, both for business development and after-sales service. He was introduced to the company when he became its first customer there. “I was always tinkering with micro-hydro systems, anyway, as many farmers around here do,” he recalls. “I’d make turbines out of cycle wheels bolted with tumblers, and use belt drives from that to run jeep alternators that would charge batteries for lights in the house. Of course, this product is far superior.”

Ganesh was impressed by the efficiency and low maintenance of Prakruti’s systems, and when they came to Chembu he was excited enough to “start engaging with them not only as their customer, but as their colleague”.

“We look for the right attitude in employees, rather than just the right paper qualifications,” confirms Murudekar of Prakruti Hydro Labs, from whom Nisarga and the other two dealership firms have harnessed many values. “They don’t even necessarily have to be graduates. At the moment we’re building our teams around young people who have the basic skills but perhaps a lower level of education, such as a diploma.” The employee who installed the system at Pratik’s house, for example, is just twenty-one. He has been working for Nisarga since he completed his diploma at age nineteen at a local industrial training institute. It’s through the dedicated enthusiasm of people such as this, and the innovation of companies such as Prakruti, that formerly forgotten houses deep in the hills are now being lit up.
Financing details

- Loan disbursed by banks: 91,817 @ 16% interest for a period of up to 1 year, no early repayment fees
- Membership share in cooperative bank: 525 Customer pays this at the time of loan process
- Loan documentation fee: 2,900 Customer pays this at the time of loan process
- Subsidy amount: 110,000 Paid by KREDL under the “Upgradation/Development of Water Mills” scheme after completion of installation.

Fact Box

Micro- and pico-hydro supply chains

**Parent company:** Prakruti Hydro Labs, Bangalore.

- Founded by Sampath Kumar and D. R. Muralidhar
- Daughter dealerships:
  1. Nisarga Environment Technologies, Shimoga (central hills of Karnataka)
  2. Karavalli Renewable Energy, Benthangady (southern hills of Karnataka)
  3. Canara Renewable Energy, Sirsi (northern hills of Karnataka)

A 1kW pico-hydro system, developed by Prakruti Hydro Labs, can operate on 10m-60m head and 4-60 l/s flow rate.

Prakruti Hydro Labs and its dealerships estimate approx. 2000 sites for the 1kW pico-hydro system in Karnataka.

250 as of Jan 2011

Approx. 220, two thirds of which have been repaid as of Jan 2011

**Product costs and financing:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost/Rs.</th>
<th>Source of money</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil works and piping</td>
<td>20,000 – 60,000</td>
<td>Customer</td>
</tr>
<tr>
<td>Electromechanical equipment</td>
<td>91,750</td>
<td>Subsidy from KREDL, Bridge loan from bank until subsidy release</td>
</tr>
<tr>
<td>Wiring and basic end use devices</td>
<td>15,000</td>
<td>Customer</td>
</tr>
</tbody>
</table>

**Turnover of Prakruti Hydro Labs:**

Rs. 3.7 million in 2009,
Rs. 6.8 million in 2010 (close to 100% growth).

In 2011 PHL plans to become a Private Limited Company, and is seeking equity from friends and relative networks.

**Contact:**

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**Features to notice:**

- Bundling finance and financial services for end users (here, a bridge loan and access to subsidy) is critical to drive uptake of decentralised renewable energy.
- Post-sale maintenance services must be available to sustain decentralised renewable energy.
- Sustainable supply and delivery chains effectively place RE products where they are needed – and creates local employment.