IFMR Research
CENTRE FOR DEVELOPMENT FINANCE

Rural Market Insight Brief

Empowering Villages

A Comparative Analysis of DESI Power and Husk Power Systems: Small-scale biomass power generators in India

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1. Introduction

With nearly 70% of India's population living in rural areas, many households still do not have access to affordable and reliable sources of electricity. This lack of access hampers households income generation capacity as well as their ability to use modern agricultural appliances and better lighting solutions.

The Indian Planning Commission (2001) data indicate that approximately 600 million people – roughly half of India's population do not have access to grid-based electricity. Unfortunately, this situation has changed little since 2001. In response, the Indian government set ambitious plans of 100% village electrification by 2007 and total household electrification by 2012. However, the progress has not reached the mark and, going by the current demand and supply scenario (12% shortage during peak hours), a reliable supply of electricity for all electrified villages seems to be a distant dream.[1]

Decentralized renewable energy generation offers one possible solution for rural electrifcation. It provides a cost effective and 'green' way to overcome the high cost of connecting remote villages to the grid and offers the potential to augment traditional grid electricity supply. This comparative analysis of two biomass - based decentralized renewable energy companies operating in Bihar, DESI Power and Husk Power Systems, provides insight into business strategy and technological suitability of biomass based decentralized energy generation plants for rural India and highlights critical elements that may be of high relevance for replicating similar solutions in other geographical locations.

This case study is based on secondary research about these companies and extensive qualitative field research carried out in the companies' areas of operation.The perspectives presented in this case study draw heavily from a scan of the Base of Pyramid clean energy space conducted by Center for Development Finance and the World Resources Institute. Data was gathered from semi-structured interviews with company stakeholders, focus group discussions with users and non-users and field visits to the companies, areas of operation.[2]

1. The Indian government has set a target of adding 78,577 MW of electricity production capacity by 2012, but in last five years only 20,950 MW were added against a target of 41,110 MW. (http://timesofindia.indiatimes.com/Editorial/EDIT-Lights-On-Please/articleshow/4495869.cms)
2. The CDF team visited DESI Power operations at Baharbari, Bebhra, Gaiyari in Araria district and Husk Power Systems operations at Tamkuha, Madhubani and Dhanaha in West Champaran district.

Section 2 provides an overview of the genesis of DESI Power and Husk Power Systems and the companies, respective business models. Section 3 takes a closer look at the main components of each company's business model, including technology, cost of operation and pricing strategy. Finally, Section 4 draws important insights on clean energy provision to the Base of Pyramid (BoP) market that emerge from DESI Power and Husk Power Systems' collective experience.

2. Company Overview

Based on the pilot phase, DESI Power launched the 100 Village EmPower Partnership Program in Araria district in 1996 under Kyoto Protocol of the UNFCCC and registered the villages for carbon trading under Clean Development Mechanism (CDM). Three new plants in two villages have been built under the CDM scheme and are currently operational.

2.1 DESI Power

DESI Power emerged from a partnership between Mr. Hari Sharan, an energy sector professional with more than five decades of experience with traditional energy companies, and DASAG Seuzach, a Swiss energy technology company that acquired the license for biomass gasification technology developed by Indian Institute of Science, Bangalore. Together they field tested and piloted biomass gasification-based power plants. They improved the design and completed financial packaging for commercialization of the technology.

In 1992, Sharan and DASAG founded Netpro Renewable Energy Ltd. to provide total power plant solutions, including gasifiers, engines, onsite services and training, to clients and client communities. In 1996, DASAG, Development Alternatives Group started Decentralised Energy Systems India (DESI) Power. In collaboration with FREND, a Swiss non-profit, they commissioned the first decentralized renewable energy plant in Orchha, Madhya Pradesh.[3] The DESI Power Orchha plant, an 80kWe capacity captive plant, had completed more than 21,500 hours of operation by December 2008.

In 2001, DESI Power and Netpro Renewable set up their first power plant for non-captive commercial production and distribution in Baharbari, a remote unelectrified village in the Araria district of Bihar. Subsequently, DESI Power has built six pilot powerplants based on biomass gasification in villages, technical universities and industrial areas. They gained financial support from the Government of The Netherlands under the Activities Implemented Jointly (AIJ) pilot phase of the United Nations Framework Convention on Climate Change (UNFCCC) and Shell Foundation to make the technology adaptable for village-based decentralized energy generation plants, establish Operations & Maintenance standards, learn to establish micro-enterprises, and work with village partners and

3. The plant had equity investment from Development Alternatives Group and FREND as well a loan from SIDBI and a subsidy from Ministry of Non-Conventional energy sources

local organizations to examine ways to make decentralized plants commercially viable. Based on the pilot phase, DESI Power launched the 100 Village EmPower Partnership Program in Araria district in 1996 under Kyoto Protocol of the UNFCCC and registered the villages for carbon trading under Clean Development Mechanism (CDM). Three new plants in two villages have been built under the CDM scheme and are currently operational.

DESI Power plants are gasifier-based power plants with capacity ranging from 30-100 kWe that run on a variety of crop residues, such as rice husk briquettes, sugar cane toppings, corn cob, mango kernels, and coconut frond/shells. Additionally, tree species, such as *Casuarinas, Eucalyptus, Silver Oak, Padauk, Pine, Lantana, and Julie Flora*, can be used as raw material. Raw materials must be cut into pieces 20-25 mm in diameter and 60-65 mm in length and should not contain more than 15% moisture before being fed into the gasifier. To date, DESI Power primarily has used woody mass from *Dhaincha* (a local weed), *Ipomea* and firewood.

DESI Power's fundamental approach and business model integrate two core activities: 1) setting up decentralized, biomass based renewable energy power plants and 2) creating rural micro-enterprises and energy services which provide demand for DESI Power and livelihood opportunities for local communities. To accomplish both goals, DESI Power promotes sister organizations DESI Mantra and Baharbari Odhyogik Vikash Sahkari Samiti (BOVSS) that promote and support micro-enterprises. DESI Mantra, a non-profit organization, trains women and youth for various job profiles at DESI Power plants, such as project construction staff, accountants, power plant operators, site surveyors and micro-enterprise owners and operators. BOVSS, a registered cooperative society, provides financial assistance and guidance to individuals interested in setting up micro-enterprises. BOVSS also maintains ownership in micro-enterprises through investments. As of January 2009, BOVSS had stake in the micro-enterprises in Table 1. In Baharbari village in Araria district, where DESI Power's first plant is located, micro-enterprises have been established, including irrigation, a battery charging station, flour mill, chuda mill and a small workshop for repairing agricultural equipment. Table 1 provides a complete list of micro-enterprises in Baharbari. From 2001 to 2006, the Baharbari plant customer base consisted mainly of the micro-enterprises. DESI Power did not target the household lighting market in Baharbari for the following reasons: 1) they focused on meeting the intermittent, and often seasonal, demand of the micro-enterprises; 2) household lighting requires regular plant operation for a relatively small demand load - one to two light bulbs per house, three to four hours per day, six days per week. In June 2008, DESI Power started a household lighting scheme in Baharbari village with financial support from International Copper. They have completed a mini-grid in the village that supplies power to marketplace shops and all the village households on a commercial basis.

The goal of DESI Power's 100 Village EmPower Partnership Program is to set up renewable energy power plants (with a cumulative capacity of 5.15 MW) in 100 villages in Araria district by 2012. The project was successfully validated by Det Norske Veritas (DNV), a leading project validation agency, as per the criteria of UNFCC for advance sale of carbon credits. By March 2009, they established three plants in two villages, Bebhra and Gaiyari in Araria district, and upgraded the existing Baharbari plant.

In a marked shift from the initial strategy of demand creation through establishing and promoting micro-enterprises exemplified by the Baharbari plant, DESI Power

TABLE 1: List of micro-enterprises at Baharbari

Enterprise	No.	Clientele	Energy Needs	Comments
Irrigation Pumps	6	Farmers	21 kW	Seasonal operations, 90-100 days/yr
Chuda Mill	1	Villagers	3.5 kW	Runs for a couple of hours a days, huge seasonal variation
Rice Huller	1	Villagers	7 kW	Runs for a couple of hours a day, huge seasonal variation
Flour Mill	3-5	Villagers	15-18 kW	---
Battery Charging Unit	1	Villagers	3.5 kW	Daily operations for 2-3 hours
Workshop	1	Villagers	2 kW	Highly seasonal

is now looking to set up plants in locations where functioning micro-enterprises and existing demand for electricity already exist. They have grouped power plant locations into three categories: 1) rural remote areas, 2) near highways connected to urban centers, and 3) near urban/semi-urban locations. The three categories will have different demand aggregation and creation, and selection of micro-enterprises depending on local resources and markets for produced goods and services.

DESI Power is working to take advantage of the Ministry of New and Renewable Energy, Government of India (GOI)schemes and is offering to supply clean cooking energy with biogas plants and energy efficient stoves using pellets (which also create a micro-enterprise) and provide 'green' energy to telecom towers from linked EmPower Partnership Projects in the 100 CDM villages.

2.2 Husk Power Systems

In 2007, Mr. Gyanesh Pandey, an engineer from Bihar, collaborated with Mr. Ratnesh Kumar, a schoolmate, to experiment with de-centralized way of providing power to people. At the same time, Mr. Pandey teamed up with Mr. Manoj Sinha, his college-mate, also an engineer from Bihar who was currently studying at the University of Virginia's Darden School of Business, and Mr. Charles Ransler, another student at Darden School of Business, to enter a business plan competition at University of Virginia. Their business plan focused on providing low cost renewable energy from rice husk to the rural population. Their business plan won the competition and the concept laid the foundation for Husk Power Systems.

Husk Power Systems provides decentralized renewable energy to villages with 1000 - 1200 households. Their business model targets household lighting needs, though it does not rule out the possibility of providing electricity for micro-enterprises or other establishments. Prior to setting up a plant in a village, Husk Power Systems conducts pre-installation energy audits of households to assess the demand for lighting solutions and determine the community's paying capacity on the basis of households stated expenditure on kerosene.

Seed capital for Husk Power, Systems came from their founders' savings and competition prize money. A total of USD 95,000, won at various business plan and clean energy competitions, included USD 50,000 for winning the University of Texas Social Innovation Competition, USD 35,000 for second place at MIT's Ignite Clean Energy Competition[4] and a USD 10,000 top prize from the University of Virginia Darden School of Business Business Plan Competition[5]. As a young company, Husk Power Systems is working on the possibility of claiming carbon credits under CDM.

Husk Power Systems started operations on August 15, 2007 and by March 2009, had six operational plants in Bihar and were planning expansion into the rice producing belts of Orissa and West Bengal.

4. http://www.virginia.edu/uvatoday/newsRelease.php?id=5123
5. http://www.financialexpress.com/news/Power-from-rice-husk-A-US-venture-for-Bihar-villages/309446

Husk Power Systems planned to operate 20 plants by the end of 2009, scaling up to 50 plants by 2010.
Table 2 provides an overview of the business models of DESI Power and Husk Power Systems.

TABLE 2: DESI Power vs. Husk Power Systems - A Summary

	DESI POWER	HUSK POWER SYSTEMS
Launch	2001	15 August, 2007
Funding Source(s)	Subsidy from MNES, Loan from ICICI Bank, Promoters Equity, Revenue from sale of Carbon Credits	Self-funded/Business Plan Competition prize money
Legal Incorporation	Private Limited	Private Limited
Operation Area	Bihar (Araria district)	Bihar (Champaran district)
Number of Plants	4	6
Average Time to set up a Plant	3-6 months	1 month
Collection Frequency and Timing	In the beginning of month for last month's consumption	In the first few weeks of every month
Technology Type	Biomass Gasification	Biomass Gasification
Supplier	Netpro Renewable	Not Available
Estimated Capital Cost	Rs. 3.4 million/plant for 75kWe plant	Not Available
Cost per unit	Rs 7-8/unit (kWh)	Not Available
Plant Size	35kWe - 150kWe	30kWe -100kWe
CDM Revenues	CERs sold in advance for 5.15 MW	Yet to apply for CERs
Target Market	Primary: Micro-enterprises Secondary: Households	Primary: Households Secondary: Local businesses
Revenue Collection	DESI power agents	Village collection agents

3. Comparison of Business Model Components

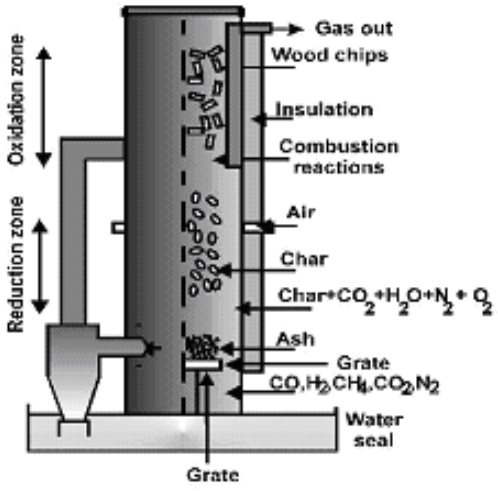
DESI Power plants, including gasifiers, are provided and set up by its sister company Netpro Renewable. Netpro provides a complete package for setting up the plants and training manpower for operations and maintenance. The gas engines used for generating electricity in DESI Power plants are manufactured by Cummins India Limited in Pune.

3.1. Technology

Both DESI Power and Husk Power Systems use biomass gasification technology, which subjects the biomass (containing cellulose, hemi-cellulose and lignin) to partial pyrolysis under sub-stoichiometric conditions with the air quantity being limited to 1.5-1.8 kg of air per kg of biomass. The process produces a combustible mixture of gases called producer gas, which is employed in thermal application or for mechanical/electrical power generation[6].

The gasification plant consists of a reactor that receives air and solid fuel, converts them into gas and removes impurities by cooling and washing. Figure 1 shows a schematic diagram of the gasification technology. The clean combustible gas is sent to diesel generator sets in suitable for running on producer gas. Power is generated using a gas engine or duel-fuel compatible engine. A duel-fuel engine can run on producer gas along with 20-30% diesel.

Figure 1: Biomass Gasification Process



6. http://www.DESIpower.com/technology/biomass.htm

DESI Power plants, including gasifiers, are provided and set up by its sister company Netpro Renewable. Netpro provides a complete package for setting up the plants and training manpower for operations and maintenance. The gas engines used for generating electricity in DESI Power plants are manufactured by Cummins India Limited in Pune. Spare parts for the gas engines are available only through the manufacturing company and not local dealers; this sometimes results in long delays in servicing and repair.

In contrast to DESI Power, Husk Power Systems has collaborated with local manufacturers to produce the gasifiers for their plants. The gasifiers were designed with direct input and training from the Husk Power Systems team to meet the company's specifications. As the name suggests, Husk Power Systems gasifiers are primarily designed to use rice husk as raw material without any processing or conversion into briquettes. The gasifiers can be modified to use any other woody biomass for producing gases. Thus far, Husk Power Systems has been sourcing gasifiers and gas engines from various local suppliers.

While DESI Power and Husk Power Systems use similar technology, important distinctions exist. DESI Power uses standardized gasifiers, which are easy to maintain (routine maintenance can be done by anyone by following the maintenance manual) and have been tested in a number of plants (Netpro Renewable has provided more than 20 plants in different parts of country and abroad). Husk Power Systems, on the other hand, uses gasifers that require more detailed routine maintenance and specialized training. Unlike DESI Power, Husk Power Systems has the advantage of changing the gasifier specification/design as per their requirement. Since Husk Power Systems sources gasifiers from local manufacturers, they see significant cost reductions compared to gasifiers provided to DESI Power by Netpro[7]. Although the maintenance of DESI Power plants is easy, the lack of readily available spare parts could result in prolonged periods of down time[8].

3.2. Area of Operation and End-User Profile

DESI Power started its operation in Baharbari[9] village, which was selected based on the perceived need of the villagers and ease of setting up operations. Also, there was no study done to assess the suitability of Baharbari or nearby villages before concluding Baharbari as the plant location. Table 3 profiles Baharbari village.

When DESI Power established its plant in 2000, Baharbari farmers were dependent on rain for their irrigation needs. Only a few farmers had access to diesel powered irrigation pumps. Like many villages in rural India, the community relied on kerosene-based lanterns or diya (homemade wick-based lamps) for their lighting needs. Focus group discussions (FGDs) and interviews with Baharbari villagers revealed that most of the farmers (75-80%) did not have the needed financial resources to cover educational and health expenditures. Better lighting was low on their priority lists, although need for irrigation was high and considered a necessary investment for better crops. Among many villagers, the perceived value of lighting solutions was seen as luxury and not a necessity.

Husk Power Systems started their first plant in Tamkuha village in East Champaran district in Bihar on August 15, 2007. Husk Power Systems focused on villages with around 1000 households in rice producing areas. Husk Power Systems considers villages with 800-1000 households ideal for the plants. Their initial studies showed that household lighting demand from these villages averages 20-30 kWh, which is ideal for their business model. After the initial visits in East Champaran district villages, Husk Power Systems performed an initial assessment of demand by household survey and listed prospective customers[10] before setting up the plant. Table 4 profiles Tamkuha village.

FGDs and interviews with Tamkuha villagers suggested that more than half the households have frequent inflow of cash as remittances from family members in cities. Electricity figured very high on the villagers' priority lists. Almost all FGD participants (users and non-users) considered electricity to be very important for their daily lives.

With only 45% of the population in Bihar having access to electricity, both Husk Power Systems and DESI Power target villages off the grid. Both companies select villages based on a number of factors such as market size (no. of households/no. of enterprises in the village), paying capacity of the villagers, availability of the raw material, etc. Husk Power Systems has taken the selection of village very strategically focusing primarily on existing demand for home lighting. On the other hand, DESI Power's business model relies on the creation of demand via micro-enterprise development.

7. Based on our interaction with Husk Power Systems, founder Mr. Gyanesh Pandey did not reveal the exact price of the gasifiers but indicated it is more than 30-40 % cheaper than Netpro provided gasifiers
8. DESI power plant at Bebhra waited for 3 months for spare part delivery and restoration of services
9. It should be noted that the DESI Power promoters are natives of this village
10. This survey is done by HPS field staff who collected data on monthly kerosene consumption and amount spent. They also list the households willing to pay the amount spent on kerosene for electricity if a plant is set up in the village

TABLE 3: Baharbari Village Profile	
No. of Households	662
Population	3140
Occupation	Agriculture and ancillary activities
Distance from District Headquarter	25 km
Accessibility	Not navigable by any type of vehicle in rainy season
NGO Footprints	None
Nearest Market	25 km
Main crops	Maize, Paddy, Corn, Gram, Mustard
Baharbari Household Profile	
Average Monthly Income	Less than Rs. 3000 (80% of the population)
Average Household size	5-6 members

TABLE 4: Tamkuha Village Profile	
No. of Households	1100
Population	5400
Occupation	Agriculture and ancillary activities
Accessibility	Easily accessible by road
NGO Footprints	None
Nearest Market	22kms
Main crops	Paddy, Wheat, Gram, Vegetables
Tamkuha Household Profile	
Average Monthly population)	
Average Household size	6 members

3.3. Cost of Establishment and Operations

The average capital cost of a 75kWe DESI Power plant is approximately Rs. 4.2 million, with an average cost of production per unit of electricity (1kWh) of Rs. 7-8kWh[11]. The cost of setting of a DESI Power plant, including cost of equipment and installation, is approximately 80-85% of the total capital cost. The cost of distribution infrastructure for a power plant is about 8-9% of the total cost and it varies according to the number households being served by the plant. The total cost of establishment for a typical 40kWe for Husk Power System is approximately Rs. 1.5 million[12]. Also, Husk capacity at Rs. 2,500,000[13] at almost 60% of the cost incurred by DESI Power.

Husk Power has focused on reducing costs by establishing operational standards and have reduced the total cost of plant construction by reducing expenditure on land, building erection and supervision cost, and by optimal utilization of manpower (assigning multiple responsibilities and maximizing idle resources). Husk Power Systems has minimized the plant construction costs by constructing houses of bamboo and asbestos instead of concrete. The lower production and establishment costs seem to have enabled Husk Power Systems to achieve a competitive pricing strategy, which aims to provide better lighting solutions without placing extra financial burden on households.

3.4 Feedstock Supply Chain

DESI Power gasifiers can run on many types of biomass, although the woody biomass must be 60x20x20mm or less in dimension with no more than a 15% of moisture content. To date, DESI Power has mainly used *Dhaincha*[14], *Ipomea* and *firewood* for operations However, with the ambitious 100 village growth plan and the increased demand for *Dhaincha* and *Ipomea due* to regular operations and more plants being operational, they are procuring firewood from the open market. Dhaincha and Ipomea can provide only 2-3 month supply for the existing plants. The price of firewood in the local market is also influenced by demand from brick-kiln owners who are major consumers. DESI Power has recently proposed plantation of fast-growing firewood species to ensure a future supply of raw material. The plan is in an early stage and would take at least three years to provide enough firewood for the power plants.

11. As per data provided by DESI Power
12. As per presentation given by Husk Power Systems founder Gyanesh Pandey at Sankalp Investor Forum, 2010, Mumbai
13. As per data from semi-structured interview (conducted by author) of Mr. Gyanesh Pandey, co-founder
14. Dhaincha (Sesbania aculeata) is a green manure crop useful in paddy cultivation

Husk Power Systems uses *rice husk*, which is a waste product for farmers and rice mill owners who have limited to no alternative use for it. Rice husk is abundantly available in the rice producing areas along the Uttar Pradesh-Bihar border. Husk Power Systems has signed a contract with a local villager to supply rice husk. Villagers are paid Rs. 0.6-0.75 per kg and are responsible for collecting and transporting the rice husk to the plant premises. Table 5 details the raw materials used by DESI Power and Husk Power Systems.

Both DESI Power and Husk Power Systems procure raw material from local farmers/vendors, who normally deliver it to the plant premises, or raw material storage locations. Husk Power Systems appears to face low supply-chain risk for raw material as it is easily available from farmers cultivating paddy. Almost ever farmer cultivates rice and a village with 1500-2000 acres of farmland produces more rice husk than required by the Husk Power Systems plant. DESI Power has the advantage of using a variety of biomass without any modification to the gasifier. They can use local weeds and operate in any crop cultivating area.

3.5 Distribution and Revenue Collection

DESI Power employs entrepreneurs to distribute DESI Power electricity and does not deal directly with household consumers. However, DESI Power does deal directly with micro-enterprise consumers. DESI Power entrepreneurs supplying electricity to household are allowed to fix a collection and price schedule for household electricity charges. Most DESI Power entrepreneurs collect charges on a monthly basis.

DESI Power distributes electricity via 25mm underground trunk wires and then 16 mm branch wires, from the point of distribution to enterprises and clusters of households. Households bear the expenditure for their own electrical wiring from the branch wire, which ranges from Rs. 50-100 depending on the distance of household from the branch wire. DESI Power installs a small bulb-based fuse that disconnects a household's electricity supply if the household consumes more than is entitled.

For evening household lighting, electricity distribution and revenue collection are done by a village entrepreneur who procures distribution rights from DESI Power for a given area in the village. The village entrepreneur invests in electric wires and installation to provide electricity in his area, and decides on the pricing for households in informal consultation with DESI Power. DESI Power entrepreneurs benchmark the price of evening household electricity against the price charged by diesel genset-based electricity providers in nearby markets.

Alternatively, Husk Power Systems distributes electricity by installing poles to carry overhead wires and does not employ mediators for distribution. Husk Power Systems directly reaches the end-user and provides sales and support services such as installing new electricity points for newly purchased household electronic items. Electricity consumption is monitored by frequent visits from Husk Power Systems employees from the same village who collect money and provide maintenance services. In the event of over consumption, the electric supply is disconnected and a fine of Rs.10 is charged for restoration.

Overall, DESI Power's underground wiring-based distribution is costlier than the pole wiring used by Husk Power Systems. Although underground wiring requires more labour cost for installation and repair, it is more secure from theft and bad weather. The collection frequency is monthly for the both the organizations. Husk Power Systems collects each month's payment in advance in the first week of every month, while DESI Power

TABLE 5: Raw Material Type and Consumption Details

Raw Material	Cost (including transportation)	Supplier	Source
Ipomea	Rs. 0.40 - 0.75/kg	Villagers	Local Weed
Dhaincha	Rs. 1.4 - 1.6/kg	Villagers	Cultivated on waste lands
Fuel Wood	Rs. 2.5 - 3.0/kg	Local Fuel wood dealer	Procured from open market
Rice Husk	Rs. 0.75 - 1.5/kg	Villagers/Rice Mill owners	By product of rice processing
Avg. Husk Power Systems Raw Material Consumption/Hour - 30kg (40kWe plant)			
Avg. DESI Power Raw Material Consumption/Hour - 50-70 kg (75kWe plant)[15]			

15. The raw material consumption varies depending on the kind of fuel used; it is less for quality biomass such as fuel wood

entrepreneur collects for last month's consumption in the first week. The advance collection limits the possibility of default by Husk Power Systems consumers.

3.6. Pricing Strategy

Since its inception, DESI Power has been experimenting with different pricing models. Their core pricing strategy is based loosely on the existing prices for similar services charged by diesel generator-based electricity suppliers or by irrigation water providers. The entrepreneurs who receive electricity from DESI Power and sell to household for evening lighting charge Rs. 5 per day for a 60-watt electricity bulb, while they pay Rs. 3 per day[16] to DESI Power. Unlike household consumers, micro-enterprises normally pay per kWh consumption. End users/consumers of the micro-enterprises typically pay for the services at a fixed price. For example, enterprises supply water for irrigation to farmers at a fixed price (i.e. Rs. 60 for one hour of irrigation from a 5 HP pump),which is based on the prices charged by diesel genset-based pumps providing irrigation.

In contrast to DESI Power, Husk Power Systems' pricing strategy accounts for the paying capacity of households. Husk Power Systems' end-users are offered a price for their energy needs based on the amount they spent on kerosene purchased for lighting. For bigger households and enterprises, Husk Power Systems employees conduct energy need audits and offer customized packages as per the customers' needs and paying capacity.

While DESI Power has a standard price for supplying electricity to micro-enterprises and village entrepreneurs, entrepreneurs are free to set prices for end users. Prices, benchmarked against diesel generator set-based electricity providers whoprimarily target small shops and economically well-off households, remain out of reach for most low-income households. The minimum monthly payment required for electricity from DESI Power plant is approximately Rs. 100 In contrast, a household in a village where Husk Power Systems operates can get the same amount of electricity for half that price.

3.7. Management Team and Manpower

Most strategic decisions for DESI Power are made by Dr. Saran, who is based in Switzerland but visits India frequently. Plans of expansion and micro-enterprise development are usually led by top management. The biggest constraint that DESI Power faces is availability of trained manpower to lead operations at the village level, especially for micro-enterprise selection, creation and management. Recent senior managerial recruitments have moved from the company within a short time,there by slowing the concentrated growth of existing enterprises. DESI Power has expertise in power generation technology and power plant operations; however there is a lack of expertise and experience on micro-enterprise creation and guiding this crucial aspect of their business model.

Husk Power Systems has four individuals leading the company's strategic decisions. Ratnesh Yadav and Gyanesh Pandey work with the end users in order to get to know more about their preferences and Charles Ransler and Manoj Sinha work in the United States to identify investors. Middle management is handpicked by the team and trained in village activities. Middle management is promised incentives, promotions and pay hikes as the company scales up, thereby increasing motivation of the users and encouraging efficient service. Husk Power Systems benefits from the fact that two company founders work closely with end-users to understand and address their needs through service and pricing.

DESI Power, having a holistic approach and operation model from power generation and micro-enterprise creation to demand generation for the micro-enterprises, could benefit from more trained and experienced middle-level management. Husk Power Systems on other hand has one founder onsite to oversee plant operation, and facilitate timely decision making.

16. Stated by entrepreneur in an interview conducted by the Author

4. Conclusion

Small renewable energy plants with capacity of 25 - 40kW can be viable if they select an ideal area of operation, as demonstrated by the business models of Husk Power Systems and DESI Power. Husk Power Systems' business model focuses solely on household lighting, whereas DESI Power's profitability requires propagation of micro-enterprise.

A comparison between DESI Power and Husk Power Systems highlights three crucial aspects of decentralized renewable energy service companies operating in rural India.

4.1 Plant Size and Scale of Operation

Since decentralized renewable energy companies have a limited distribution area, and hence, limited clientele, size becomes a crucial factor for viability and sustainability of the plant. For villages with 1000-1200 households, the demand is approximately for 20-30kW, considering only the evening household lighting for 3.5 - 4 hours. Small renewable energy plants with capacity of 25-40kW can be viable if they select an ideal area of operation, as demonstrated by the business models of Husk Power Systems and DESI Power. Husk Power Systems' business model focuses solely on household lighting, whereas DESI Power's profitability requires propagation of micro-enterprise.

4.2. Demand Estimation

Like many low income communities, the villages that constitute DESI Power and Husk Power Systems' target market have a visible need for electricity, but often have low levels of dispensable income and irregular income streams. Unfortunately, while the investor, donor, and entrepreneur community may see an exciting market opportunity in this need, need for electricity solutions does not necessarily translate into ability to pay, willingness to pay, or demand in the open market place. This, combined with the need for plants to maintain a certain Plant Load Factor to not operate in a loss, underscores the needs for careful demand estimation while selecting target villages.

DESI Power has selected its target villages based on ease of access to the community and potential for small and micro-enterprise creation. The long ramp up in, and uncertainty of, demand from newly created enterprises necessitates careful estimation of existing house hold, commercial, and agricultural demand, and projection of potential demand from new enterprises to determine the correct plant size to ensure profitability over an acceptable timeframe. This has been a core challenge for DESI Power to date.

Unlike DESI Power, Husk Power Systems primarily targets the home lighting segment. As a result, Husk Power Systems conducts a village audit to estimate the likely demand for home lighting and sizes their plant accordingly. The different approaches to site selection adopted by DESI Power and Husk Power Systems underscores the differences in their respective enterprise mandates, strategic foci, and funding sources. Both models highlight the need for careful attention to demand estimation.

4.3. Pricing Strategy

DESI Power and Husk Power Systems adopt different pricing strategies for their electricity services. Husk Power Systems sells directly to consumers and sets the price of electricity to the users projected use and estimated ability to pay. In the household lighting segment, DESI Power sells electricity to local entrepreneurs who set electricity prices and sell directly to the end user. In this model, users typically pay a price that is equivlent to electricity service from a diesel-based electricity supplier. On the other hand, in the agricultural and commercial market segments, DESI Power sells directly to the farmer or business owner. In this model, DESI Power sets the electricity price at or slightly below the price a farmer or business owner would pay for diesel-based electricity. The experience of DESI Power and Husk Power Systems suggests that renewable energy lighting solutions have been successful when they provided better solutions at the cost of traditional lighting solutions or with a small, affordable premium.

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Santosh Singh leads the Rural Market Insight group at the Centre for Development Finance. His research interests include BoP Market Strategy, Demand Dynamics of BoP Markets and demand estimation methodologies. Working in close collaboration with several base of Pyramid enterprises operating in energy and water sector, he has been providing research insights and business strategy for these enterprises. He also, conceptualized and developed the district level Economic Environment Index for Tamil Nadu.

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ABOUT CDF

CDF: Helping Market and States Work for Development.

The Centre for Development Finance is an action research think tank focused on improving governments' and markets' capacity to channel finance into sustainable, holistic development. Our research and consulting in two core areas - Infrastructure and Governance as well as Environmentally Sustainable Finance - seek to influence public policies, improve program implementation and impact, and inform private and nonprofit interventions. Analysts in our Development Metrics group enable more effective prioritization and oversight of development interventions by developing platforms for aggregating and disseminating local socio-economic data. The Strategy Advisory Group concentrates on providing strategic insights and project guidance while designing customized solutions for development entrepreneurs, corporates, investors and non-profits seeking to contribute to India's development. Our approach across all program areas combines deep contextual knowledge and operational experience with academically grounded development insight to contribute to more effective delivery of the infrastructure and services that are essential underpinnings for inclusive, sustainable economic and social opportunity.

The Centre for Development Finance is one of seven research centres affiliated with the Institute for Financial and Management Research (IFMR) in Chennai, India.

ABOUT RURAL MARKET INSIGHT

Rural Market Insight (RMI) team seeks to improve the impact of social venture investing and social enterprise by delivering deep insight into rural market behavior. RMI employs rigorous qualitative and quantitative research techniques to both identify and characterize demand dynamics as well as efficiently uncover consumer preferences in BoP market segments. Additionally, RMI's rich thematic research probes critical challenges facing entrepreneurs and investors in the clean energy and water spaces.

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