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POWER TO THE PEOPLE

Investing in Clean Energy for the Base of the Pyramid in India

FOREWORD

India is facing a severe energy crunch. Roughly four hundred million rural inhabitants – more than the entire U.S. population – still lack electricity, making energy access a development imperative. At the same time, economic growth is sending national energy requirements soaring. India's GDP is on pace to grow by 8% in 2010, and domestic energy demand is predicted to more than double by 2030.

The energy shortage is most acute among India's rural poor, the majority of whom rely on relatively inefficient, polluting and health-threatening fuels such as kerosene and firewood for their lighting and cooking needs. As India's government and energy sector seek to provide more modern and reliable heating and lighting services to these communities, a fledgling market in cleaner, more efficient energy products is emerging. This huge and under-served rural Indian market offers significant opportunities for investors looking to support the sustainable energy solutions of the future.

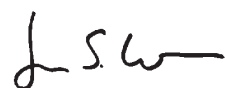
In recent years, a number of domestic companies have developed clean energy products and services specifically targeting India's rural "Base of the Pyramid" population – the 114 million households who spend less than US\$75 a month on goods and services. About 45 percent of these families do not have reliable access to electricity and rely on kerosene for lighting, while over 85 percent largely rely on firewood and dung for cooking. Successful (though small scale) business models such as solar-based home electricity systems and lanterns, energy-efficient cookstoves, and electricity services generated from decentralized sources such as micro hydro and biomass gasifiers are increasingly finding a market among such households.

India's government has also facilitated the emergence of this rural clean energy sector by supporting distributed generation in the form of community-based, self-sufficient biomass and solar power. The recently launched National Solar Mission seeks to achieve 20 gigawatts of solar power by 2022, in part through the installation of rooftop photovoltaic systems. It also sets the specific goal of providing 20 million solar lighting systems in place of kerosene lamps to rural communities within the next dozen years. Such measures serve the government's dual objectives of providing electricity to rural areas and reducing the trajectory of India's greenhouse gas emissions. Several Indian states, including Andhra Pradesh, Gujarat and Haryana, are also encouraging development of the clean energy sector by instituting statewide renewable portfolio standards. These mandate that a certain percentage of electricity is generated by solar, wind or other renewable, non fossil, fuels.

Against this encouraging backdrop, this report by India's Centre for Development Finance at the Institute for Financial Management and Research (CDF-IFMR) and the World Resources Institute's New Ventures Program, seeks to enhance understanding of the investment potential of the clean energy industry serving India's rural poor. Based on extensive field work with clean energy companies and rural BoP consumers as well as rigorous secondary research, the report showcases eleven companies selling innovative products and services to sustainably meet the energy needs of the rural poor. It also analyzes both the market opportunities and the challenges to scale up that the industry faces.

WRI and CDF-IFMR hope that these research findings and recommendations will help investors – both in India and abroad – better understand the enormous potential of this market. We believe the expansion of this sector is highly achievable through the development of more efficient business models, additional favorable national policies, and increased, targeted capital. The potential opportunity for investors is significant. We estimate the aggregated potential market for clean energy consumer products and services to be INR 97.28 billion or USD 2.11 billion per year.

Realizing this potential would be a win-win for investors, for India's people and for the global climate: profit-making clean energy solutions bringing light to millions of India's poorest households.



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PHOTO CREDITS

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DEDICATION

This publication is dedicated to Professor C.K. Prahalad (1941-2010), one of the founders of the Base of the Pyramid concept and a long time and greatly valued member of the World Resources Institute's Board of Directors. His 2004 book, 'The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profit' – named one of the best books of the year by the Economist - laid the foundation for the concepts incorporated in this report.



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ICICI Foundation:

ICICI Foundation for Inclusive Growth (ICICI Foundation) was founded by the ICICI Group in early 2008 to give focus to its efforts to promote inclusive growth amongst low-income Indian households. It is committed to making India's economic growth more inclusive, allowing every individual to participate in and benefit from the growth process. The ICICI foundation does this by supporting strong independent organisations which work towards empowering the poor to participate in and benefit from the Indian growth process.

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Executive Summary

Box 1: What is the Base of the Pyramid?

The Base of the Pyramid (also referred to as the Bottom of the Pyramid) refers to the estimated 4 billion people around the world who are poor by any measure and have limited or no access to essential products and services such as energy, clean water, and communications. Globally, people in this socioeconomic group earn US\$1 to US\$8 in purchasing power parity (PPP) per day. Yet these households often pay higher prices than wealthier consumers do for lower-quality goods and services because of uncompetitive markets.^a

Since this report focuses specifically on rural India, we define the rural Indian BoP market as households in the bottom four expenditure quintiles (based on data from the National Sample Survey Organization) that spend less than INR 3,453 Indian rupees (US\$75) on goods and services per month. This definition represents a market of 114 million households, or 76 percent of the rural population.^b

Notes: ^a A. Hammond, B. Kramer, et al., *The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid* (Washington, DC: World Resources Institute, 2007).

^b CDF-IFMR analysis, National Sample Survey Organization (NSSO) 2004/2005, round 61.

India, a rapidly emerging economy with the world's second largest population, is facing a surging energy demand. Its rural Base of the Pyramid (BoP) consists of 114 million households, representing 76 percent of India's rural residents and almost 60 percent of the country's total population (see box 1)¹. Despite their low income, these households constitute a significant consumer market for the energy services and products required to provide daily necessities such as cooking and lighting. Using the most recent available expenditure data (2004/2005), we estimated that India's rural BoP consumers spent INR 224 billion (US\$4.86 billion) per year on their energy needs².

In 2005, approximately 45 percent of India's rural BoP households still did not have reliable access to electricity and relied on kerosene for lighting, and more than 85 percent of rural BoP households mostly used conventional free or inexpensive sources of fuel, such as firewood and dung, for cooking³. These fuel sources, however, are not only harmful to users' health⁴ but also contribute to pollution and environmental degradation.⁵

A growing number of Indian companies see a market opportunity in providing rural BoP households with access to alternative cooking and electricity solutions and consequently are developing clean energy products and services for this market. "Clean energy" refers to products and services that produce energy from renewable resources and emit fewer greenhouse gas emissions than does energy from conventional fuel sources. The lack of a reliable supply of power from the electricity grid and the availability of free and inexpensive fuels, such as wood and kerosene, are key influences on this market. In this report, we focus on two areas in this growing, high-potential market: clean energy electricity systems and clean energy cooking and light products. We examined a representative selection of companies selling solar lanterns, solar home systems, energy-efficient cookstoves, and electricity generated from decentralized sources, including small hydro power plants and biomass gasifier systems (see box 2).

ABOUT THIS REPORT: INFORMING INVESTORS

The goal of this report is to inform investors about the market potential of the clean energy industry serving India's rural BoP market, by looking at its opportunities, challenges, and potential paths to growth. The purpose of our report is to present an overall picture of these growing clean energy sectors, rather than to provide investment advice on individual companies (see box 2).

Box 2: Information and Data Sources

CDF-IFMR and WRI collected secondary data on forty-five companies from India and abroad and selected eleven Indian (from a total of twenty-three Indian clean energy companies identified as targeting rural BoP clean energy markets) and four global companies for in-depth analysis based on technology, product or service, business model, value proposition for the BoP, and potential to scale.

The information and data used for this publication were derived from three sources: (1) field research conducted by CDF-IFMR and WRI in India and globally, to collect quantitative and qualitative data from companies through a survey, interviews with company leadership and field staff, and focus group discussions with more than 240 rural BoP consumers; (2) data from the National Sample Survey Organization's (NSSO) sixty-first round of the Consumer Expenditure Survey, conducted in 2004/2005; and (3) peer-reviewed secondary sources.

The potential opportunity for investors in the Indian clean energy market for the rural BoP is significant. We estimated the aggregated potential market for the four sectors studied in this report to be **INR 97.28 billion (US\$2.11 billion) per year, including INR 94.06 billion (US\$2.04 billion) for decentralized renewable energy services and INR 3.22 billion (US\$70.1 million) for energy products per year** (see box 3 for our method of calculation).

Our analysis shows that clean energy services and products may require an upfront investment three to ten times greater than that for conventional energy sources such as kerosene and firewood, which often are subsidized or free to India's rural consumers. Yet despite these and other drawbacks, the average annual gross revenue of the companies profiled in this report has grown 36 percent since 2004⁶.

TARGET SECTORS

CLEAN ENERGY ELECTRICITY SYSTEMS

We found that the need for a dependable supply of electricity for multiple uses was the primary driver of the demand for clean energy products and services. Installed in either the household or the community, clean energy products and services can supply enough electricity for several different uses, such as providing lighting, running fans, charging mobile phones, and operating radios and small appliances.

- » **Decentralized renewable energy enterprises (DRE)** are energy companies that supply clean power for a community in a specific geographic region. These systems supply rural BoP consumers with electricity services generated from renewable sources of energy (primarily small hydro and waste biomass) through existing grids or company-owned distribution systems. Based on the most recent available data (2004/2005), we estimated the potential market value of the DRE sector for India's rural BoP segment at **INR 94.06 billion (US\$2.04 billion) per year**. DRE constitutes more than 95 percent of our total market forecast.
- » **Solar home systems (SHS)** are solar-based electricity-generating and storage systems designed to provide power to individual households. These systems use photovoltaic panels to generate electricity, combined with a battery and a controller to regulate charging and discharging. These systems are typically purchased on credit by individual households and are customized to meet their specific electricity requirements. Based on the most recent available data (2004/2005), we estimated that the SHS sector's potential market value for India's rural BoP segment is **INR 1.26 billion (US\$27.39 million) per year**.

Box 3: Methodology for Estimating the Potential Annual Market Value of India's BoP Clean Energy Sector

The following formulas were used to estimate the potential market for clean energy sectors:^a

Decentralized Renewable Energy (Clean Energy Services)

Average annual household expenditure on electricity^b * (Number of households not connected to the grid^c – Average number of households connected to the grid each year)^d

Solar Home Systems, Solar Lanterns, and Energy-Efficient Cookstoves (Clean Energy Products)

(Price of least expensive clean energy product currently available in the market^e * Number of households * Observed adoption rate for the clean energy product^f) / Average Product Life Span^g

Using these formulas, we calculated the potential annual market for each product/service as illustrated in the following table. For further explanation, please see the rest of the text.

	Decentralized Renewable Energy Services	Solar Home Systems	Solar Lanterns	Energy-Efficient Cookstoves
Number of Households	75 million	18 million	51.3 million	29.6 million
Lowest Product Price/ Annual Expenditure	INR 1272 (annual expenditure)	INR 7,000	INR 500	INR 150
Life Span	N/A	10 years	3 years	3 years
Adoption Rate	98.6% (discounting for rate of rural electrification)	10%	10%	75%
Potential Annual Market Value	INR 94.06 billion (US\$2.04 billion)	INR 1.26 billion (US\$27.39 million)	INR 855 million (US\$18.58 million)	INR 1.11 billion (US\$24.13 million)
Potential Annual Clean Energy Market Value for the Rural BoP = INR 97.28 billion (US\$2.11 billion)				

Notes: ^aThroughout this report, we distinguish between clean energy electricity systems that can supply power for a variety of uses, and single-use cooking and lighting solutions. However, clean energy electricity systems, such as solar home systems, are sold as products and are installed in individual households, whereas DRE providers sell electricity as a service. Therefore we use different formulas to calculate the potential market estimates.

^b CDF-IFMR, WRI analysis, NSSO 2004/2005, round 61.

^c Ibid.

^d Ibid.

^e CDF-IFMR-WRI field research, 2009.

^f Ibid.

^g Ibid.

COOKING AND LIGHTING SOLUTIONS

Alternative cooking and lighting products such as solar lanterns and energy-efficient cookstoves provide cleaner substitutes for conventional, highly polluting products like traditional cookstoves and kerosene lanterns. But there is not a strong demand for clean energy lighting and cooking products at their current prices, which put them out of reach of the majority of rural BoP households. Many BoP consumers also are not aware of the health benefits of these cleaner alternatives.

We also analyzed the two main types of clean energy cooking and lighting products in India.

- » **Solar lanterns** are portable LED lanterns that are powered by solar panels and can provide light for four to eight hours, replacing polluting and inefficient kerosene lanterns and supplying basic lighting for BoP households. Based on the most recent available data (2004/2005), we estimated the solar lantern market is worth **INR 855 million (US\$18.58 million) per year**
- » **Energy-efficient cookstoves** are fixed or portable cookstoves that burn solid-biomass cooking fuels 20 to 65 percent more efficiently than traditional stoves do. Energy-efficient cookstoves can replace traditional polluting stoves that cause indoor air pollution and severe respiratory problems in women and children. Based on the most recent available data (2004/2005), we estimated the energy-efficient cookstove market is worth **INR 1.11 billion (US\$24.13 million) per year**.

Table 1 summarizes our analysis of each of the four sectors. Next we offer more detailed analyses of each sector.

Table 1. Clean Energy for the rural BoP in India: Sectoral Analysis

	Decentralized Renewable Energy: Biomass and Small Hydro	Solar Home Systems	Solar Lanterns	Energy-Efficient Cookstoves
Potential Market Value (per year)	INR 94.06 billion (US\$2.04 billion)	INR 1.26 billion (US\$27.39 million)	INR 855 million (US\$18.58 million)	INR 1.11 billion (US\$24.13 million)
Average Pricing	INR 8 to 13 /kWh (biomass) INR 2 to 2.5 /kWh (small hydro)	INR 7,000 (US\$150) to INR 20,000 (US\$450)	INR 500 (US\$ 11) to INR 1,600 (US\$ 35)	INR 150 (US\$3) to INR 1,100 (US\$24)
Competitive Advantage	Biomass and small hydro have higher levels of operational reliability compared with other DRE technologies; low upfront cost for consumers; and sized to meet demand.	Customized electricity solution based on individual requirements.	Long-term cost savings for rural households currently using kerosene.	Reduced cooking fuel costs; health benefits from lower emissions of pollutants.
Business Model	Biomass: Provided through company-owned minigrids; electricity priced to existing fuel expenditure levels. Small hydro: Supplied to villages using existing underutilized grid infrastructure; paid at government-determined tariffs.	Sold on credit, in partnership with local banks. Users typically pay 10 to 25 percent upfront and the rest in installments.	Bulk sales to corporate, NGO, and microfinance institution (MFI) partners; sold directly to consumers through local retailers.	Sold through multiproduct rural distributors and retailers; partnerships with microfinance institutions (MFIs), and NGOs.
Challenges	Biomass: Correctly estimating demand to optimize plant size and load. Small hydro: Highly dependent on regulation tariffs set by government; requires negotiation of power purchase agreement (PPA).	Pricing is currently too expensive for the larger market of low-income groups; adequate maintenance is difficult in remote rural areas.	Government subsidies for kerosene use dissuade consumers; charitable distribution schemes distort the local market.	Pricing is currently too expensive; product design does not always meet users' needs and habits; little awareness of health benefits among consumers.
Opportunities	Government subsidies can reduce expenditures; carbon credits can generate new revenue sources; PPAs in grid-connected regions can minimize demand risk by allowing companies to sell power to the state electricity board (SEB).	Leasing options for solar home systems may be tried out, as in Brazil and the United States.	Industry group can be formed to represent companies' interests to policymakers, provide service resources to reduce product misuse, and implement pay-per-use business models that mirror purchasing patterns and income streams.	Partnerships with MFIs and NGOs can reduce financing and marketing costs; market exists for products that meet users' needs.

Source: CDF-IFMR and WRI analysis.

INVESTMENT THEMES

In our analysis of the primary and secondary data, we observed several key themes for each sector relevant to investors interested in this market, which are outlined in the following box.

Decentralized Renewable Energy Enterprises	<p>Increasing consumer demand: Consumers want solutions comparable to grid electricity in cost, convenience, and capability.</p> <p>Forecasting is key to successful supply/demand management: DRE companies that set up their own mini community-focused grids and charge rural consumers directly for their services need strong forecasting abilities to accurately assess local consumers' demand for power and to build appropriate, cost-effective facilities.</p> <p>Available options to offset demand risk: DRE companies that operate in regions with existing grid infrastructure but poor local power availability can sell electricity directly to the state electricity board (SEB), which can then be routed to underserved local communities through the existing underutilized grid. SEBs are required to purchase power from independent renewable energy providers, making this an attractive option for DRE companies to offset demand risk.</p>
Solar Home Systems	<p>Demand for multiuse electricity solutions: Consumers want multiuse electricity solutions that mimic grid-based electricity, which has largely driven the demand for solar home systems among the BoP's higher-income groups.</p> <p>Reductions in upfront costs and improvements in after-sales service likely to drive consumer demand: Consumers are currently deterred by high prices and companies' poor after-sales maintenance. SHS companies can reduce the upfront product cost by developing leasing options, providing various financing options for users, and developing other sources of revenue, such as after-sale service contracts.</p>
Solar Lanterns	<p>Limited demand that could grow as prices fall: High prices and subsidies for traditional energy sources have limited the demand for solar lanterns. While bulk purchases from charitable programs currently drive the market, solar lantern companies are starting to produce cheaper lanterns that are more affordable for individual BoP consumers.</p> <p>Financing and partnerships critical to lowering upfront prices: Solar lantern companies can lower the upfront purchase price through tight controls on value chains' distributor and retailer margins and partnerships with microfinance institutions to provide consumer-financing options. They also can reduce their marketing and distribution costs through partnerships with nonprofit organizations.</p>
Energy-Efficient Cookstoves	<p>Demand restricted to higher income levels: The relatively high price of most energy-efficient cookstoves in the market and the unclear value proposition (since most consumers collect firewood for free and do not receive a direct monetary gain from the improved fuel efficiency) have made it difficult for companies to sell these products to lower-income groups.</p> <p>Creating markets through partnerships and design: In the near to mid term, companies in this sector should work with nonprofit market development organizations (see section VII) to raise awareness of the significant health benefits of their products and to build a market for energy-efficient cookstoves. Companies should also lower the upfront price by designing simpler products using low-cost materials, which mimic the ease of use of traditional stoves; or by providing product financing to penetrate the considerably larger, but as yet untapped, lower-income BoP market.</p>

Source: CDF-IFMR and WRI analysis.

ROLE OF GOVERNMENT POLICIES

The potential growth of this market is significant, but the government's role is critical to the development of clean energy services and technologies for India's rural BoP population. The government provides many incentives for renewable energy projects, including capital subsidies of up to 90 percent, tax holidays, accelerated depreciation, and low-interest loans. In addition, state electricity boards (SEBs) are required to buy power from independent power producers, and states are required to set targets for renewable energy generation⁷. But some of India's current policies undermine the demand for clean alternatives. For example, government programs that distribute solar products for free often make users less inclined to purchase these products at cost, and the availability of highly subsidized kerosene distorts the market for competing alternatives like solar lanterns.⁸

Our report concludes that the investors and clean energy firms serving this market should work together to advocate policies that achieve the dual objectives of increasing access to clean energy and stimulating the industry's growth. The improved implementation of existing regulations by the states, combined with new favorable policies such as considering clean energy products and service providers a priority lending sector for Indian banks would help achieve both objectives. We make three policy recommendations:

- » Shift the existing subsidy for kerosene to a subsidy based on lighting, to enable BoP consumers to choose their own lighting source while stimulating innovations related to solar lanterns and other clean technologies and business models.
- » By streamlining the application process, make the current subsidies and incentives more easily accessible to existing and potential DRE providers.
- » In accordance with the lending guidelines of the Reserve Bank of India, promote clean energy and energy efficiency companies as priority sectors for Indian banks.

THE INVESTMENT POTENTIAL OF THE INDUSTRY

Despite the great opportunities for growth in India's nascent clean energy market for the rural BoP, our detailed analysis of the industry, described in the rest of this report, shows that significant obstacles remain. The DRE sector is the most mature and appears ready to absorb mainstream investment. Although consumer demand in the other sectors is currently limited, it could grow considerably if the upfront prices were reduced through a combination of tighter control over distributor and retailer margins, cheaper manufacturing, lower marketing and distribution costs through strategic partnerships, and the availability of consumer-financing options.

Investors seeking to supply capital to this industry require patience and pragmatic expectations regarding their initial returns. Two of the eleven Indian companies we profiled have received investment; four others have received grants and donor capital; and three have received both investment and grants. In addition, four companies complained about the general lack of availability of short-term debt financing for small companies.

Impact investors, who seek to use their investments to generate positive social and environmental impacts, can have a significant effect on the industry at this stage by supplying firms with patient capital and non-financial resources such as management expertise and access to their business networks. Patient capital and guidance from impact investors will help companies in this industry overcome market challenges and provide rural Indian consumers at the base of the pyramid with clean sources of energy.