FINANCE

Off-Grid Business Models

THE CLIMATE GROUP

IN PARTNERSHIP WITH

Goldman Sachs

This is part of THE CLEAN REVOLUTION

THE BUSINESS CASE FOR OFF-GRID ENERGY IN INDIA

TABLE OF CONTENTS

FOREWORD

The Government of India has set an ambitious target of generating over 150 gigawatts of renewable energy by 2022, warranting investments of over US$150 billion. Realization of this target calls for the rapid creation of a positive enabling environment for investors and entrepreneurs alike.

In the next few years, we anticipate considerable opportunities around off-grid as well as grid-ready decentralized renewable energy in India.

There has been strong indication from across the world that investment in renewables is yielding higher returns on investment. There is also a marked improvement in risk perception around renewable energy projects. Coupled with the emerging clean tech market in India, these aspects offer investors compelling motivation for venturing into renewable energy financing.

This report is based on a study of off-grid business models in India by The Climate Group, produced in partnership with Goldman Sachs Center for Environmental Markets, which aims to inform investment and financing decisions on decentralized, distributed renewable energy. It offers first-hand information on some of the most viable, scalable business models that are investment ready. It answers key questions for investors ranging from analysis of sound business models to future prospects and regulatory frameworks in India. The report also consolidates the findings and objectives of The Climate Group's Bijli – Clean Energy for All program, which is funded by the Dutch Postcode Lottery.

I am sure international investors and domestic financing institutions will find this report highly useful and practical to inform their decisions. We are hopeful it will generate sufficient interest that will result in considerable financial investment into renewable projects in India, to support and complement national goals to scale renewable energy generation.

KRISHNAN PALLASSANA

EXECUTIVE DIRECTOR, INDIA
THE CLIMATE GROUP

LIST OF FIGURES

LIST OF TABLES

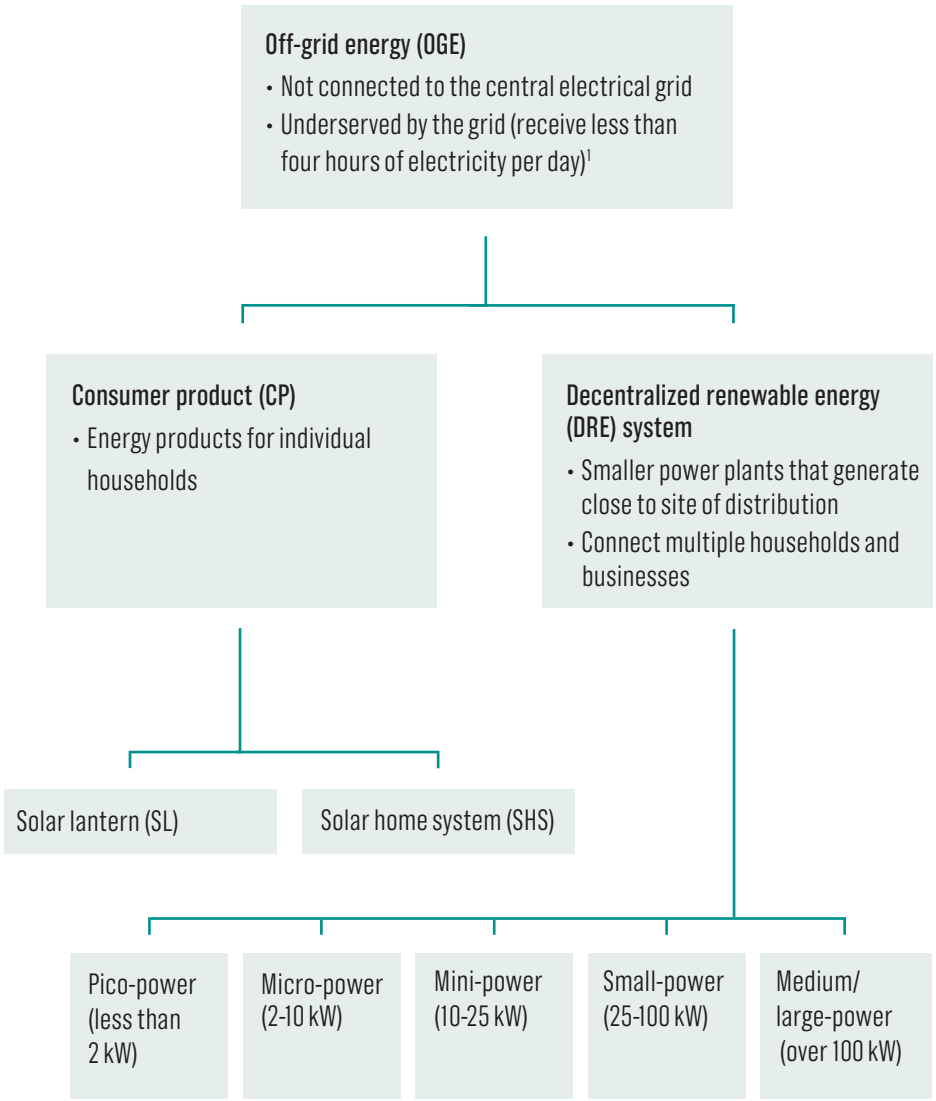
LIST OF ACRONYMS

AC	Alternating current
BOOM	Build, own, operate, maintain
BPCL	Bharat Petroleum Corporation Ltd.
CDM	Clean Development Mechanism
CFL	Com pact fluorescent lamp
CP	Consumer products
DC	Direct current
DDG	Decentralized distributed generation
DRE	Decentralized renewable energy
GSMA	Groupe Speciale Mobile Association
GW	Gigawatt
HPCL	Hindustan Petroleum Corporation Ltd.
IEG	Independent Evaluation Group
IEP	International Expert Panel
IMG	Inter-ministerial group
INR	Indian Rupees
IOCL	Indian Oil Corporation Ltd.
IPO	Initial public offering

IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
JNNSM	Jawaharlal Nehru National Solar Mission
kW	Kilowatt
LED	Light emitting diode
MFI	Microfinance institution
MGP	Mera Gao Power
MNRE	Ministry of New and Renewable Energy
MW	Megawatt
NABARD	National Bank for Agricultural and Rural Development
NGO	Non-governmental organization
NSSO	National Sample Survey Organization
NWEM	National Wind Energy Mission
OGE	Off-grid energy
PV	Photovoltaic
RBI	Reserve Bank of India
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
SHS	Solar home system
SPV	Special purpose vehicle
US$	US dollar
VLE	Village level entrepreneur
W	Watt

DEFINITIONS

For the purposes of this report, the following definitions apply to enterprises that serve the off-grid and under-electrified population in India.



[1] *International Finance Corporation. Assessment of the Off Grid Solar Appliance Lighting Market in India. Market research report, New Delhi, India, 2015*

OBJECTIVES, SCOPE AND APPROACH

This report sets out to boost entrepreneurial activity and private sector investment in renewable off-grid energy (OGE) by assessing the market, identifying business models with the greatest potential to achieve scale, and recommending investments that will be catalytic for the sector.

We focus on solar home systems (SHS) with capacity ranging between 10-200 watts (W), and decentralized renewable energy (DRE) utilities of up to 100 kilowatts (kW) in size which use renewable energy. This range covers the vast majority of systems and plants in the space. While we have looked at solar, wind, hydro and hybrid sources of energy, most off-grid utilities (~80%) run on solar energy.

The report begins with an overview of existing OGE business models in the SHS and DRE space. For both SHS and DRE sectors, the report details current technology and business models, key players, unit-level economics, future growth forecasts, and potential for social and environmental impact. Each section also outlines current challenges in the space, business characteristics – over and above usual operational excellence – that can address these challenges, and a brief hypothesis on the likely evolution of both the SHS and DRE sectors.

As well as the above, the report provides an overview of the policy and regulatory environment and highlights the need for private sector investment while laying out recommendations for financiers and organizations looking to promote private sector involvement in the off-grid space.

METHODOLOGY AND RESEARCH SOURCES

This research, produced in partnership with Goldman Sachs' Center for Environmental Markets, builds on ongoing work by The Climate Group in the renewable off-grid energy (OGE) sector. The Climate Group's flagship project Bijli – Clean Energy for All, supported by the Dutch Postcode Lottery, aims to reduce carbon emissions by deploying renewable energy technologies through innovative, social-impact business models and reaching over 50,000 rural people in India. The project has already invested in four business models as part of its initial efforts.

We conducted a combination of primary and secondary research to inform our findings, including interviews with 13 SHS and DRE players.[1] We also used previous sector analysis, conducted by the research firm Dalberg, that covered off-grid solar lighting, the decentralized energy solutions space, and financing needs for small and medium-sized enterprises in the off-grid space. Input and feedback was provided by our International Expert Panel (IEP) with representation from across the energy sector, including: Mark Kenber, The Climate Group; Gauri Singh, IRENA; Jessica Long, Accenture Development Partnerships; Brinda Ganguly, Rockefeller Foundation; Ankur Trehan, Goldman Sachs (India) Securities Private Limited; Namita Vikas, Yes Bank Ltd.; Pankaj Agarwal, PRM Power Holding AG and Uday Khemka, SUN Group.

[1] See annex.

ONE

1. EXECUTIVE SUMMARY

The case for solar home systems and decentralized renewable energy solutions

Nearly 50% of India's rural population – 80 million households – has little or no access to grid-based electricity and instead, relies on kerosene as its primary source of lighting.[2] While government efforts are expected to increase grid connectivity, progress has been slow and the number of underserved households is expected to decline by only 5% over the next 10 years. As well as providing dim, low-quality lighting, there are many negative impacts of kerosene use, including environmental pollution from carbon emissions and chronic illnesses due to high levels of indoor air pollution. Improving access to proper lighting is critical. It increases income generation potential and also has a positive effect on school performance. Through providing households with better quality lighting, off-grid energy solutions have much broader social, environmental and economic impacts.

Thankfully, growing awareness, falling prices and greater access to finance are making off-grid energy solutions – including solar lanterns, solar home systems (SHS) and decentralized renewable energy (DRE) – increasingly attractive to consumers. And while solar lanterns can meet basic lighting and mobile charging needs, SHS and DRE solutions are better positioned to serve the evolving demand for consumer goods, and desire for more reliable services. In this report, we analyze nearly 80[3] players in India who have been tapping into this opportunity with varying degrees of success.

Overview of solar home system enterprises

There are over 40 established players and new entrants trying to capitalize on the growth opportunity in the SHS market in India, but no single player has achieved any meaningful scale to date. There are some large players linked to conglomerates who have succeeded in winning government tenders, but these enterprises have struggled to claim a sustained pipeline of direct customer sales. The majority of the remaining players are small, selling less than 5,000 units a year, mostly through third party distributors and dealers. There are a few players, however, who have seen success in reaching rural households by building their own rural distribution networks, focusing on branding and building relationships with consumers.

Issues around affordability have put pressure on these enterprises' margins, as they keep prices low to stay competitive. As a result, there has been significant emphasis placed on consumer finance. Gross product margins hover between 10-25%,[4] but after adjusting for marketing, transportation and distribution, margins are closer to 1-5%. A lack of meaningful scale has meant few enterprises have achieved profitability to date. Even leading players claim they need to grow to at least 2-4 times their current size in order to break even. As a result, the SHS market seems viable, but enterprises who sell only solar home systems are unlikely to see high returns.

Despite these challenges, fast growth and cross/up-sell opportunities mean SHS enterprises could represent a high potential, albeit risky, investment opportunity for investors. Due to increasing affordability and reach, we estimate that nearly 5 million solar home systems will be sold between 2014 and 2018. By 2018, the market is likely to reach an annual sales volume of 3 million units and a market opportunity of over US$215 million.[5] The growth in these sales will be driven by enterprises

NEARLY 50% OF INDIA'S RURAL POPULATION – 80 MILLION HOUSEHOLDS – HAS LITTLE OR NO ACCESS TO GRID-BASED ELECTRICITY

[2] International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015.
[3] ~40 mini-grid and ~40 SHS enterprises with an online presence.
[4] Interviews with SHS enterprises.
[5] See section 3.1.

CURRENT REGULATIONS MAKE IT DIFFICULT FOR INDIAN DRE COMPANIES TO GET FOREIGN FINANCING

able to establish deep rural networks and effectively win consumers through product branding – and who place a strong emphasis on maintaining trust through strong after-sales support. Beyond this, we see potential for companies who provide their consumers with products and services which are complementary to their solar home systems, such as televisions and fans. Such enterprises demonstrating their ability to evolve with their consumers represent interesting opportunities for future investment.

Overview of DRE enterprises

DRE enterprises have adopted a wide range of technologies and business models, but most are struggling to achieve commercial viability. Of the ~40 players in the sector, the majority are reliant on subsidies and/or grants, and only three have total installed capacities (capacity of all utilities put together) greater than 300 kW. However, a few enterprises have shown signs of scaling, and these enterprises project strong growth over the next five years.

As capital intensive businesses, DRE enterprises face a number of challenges. First, they need significantly high levels of up-front capital for plant installation. Second, debt is a primary unmet need of DRE enterprises as the cost of standard domestic financing is high. Furthermore, current regulations make it difficult for Indian DRE companies to get foreign financing or leverage equipment and inventory as collateral for lease financing. Third, like other rural off-grid enterprises, DRE players face challenges surrounding affordability as well as collecting regular payments from consumers. This potential for non-payment is a significant risk for anyone wishing to invest in a DRE project. Lastly, the lack of clarity around the Indian government's plans for grid extension and interactivity has led to concerns about the long-term viability of the DRE business model. These challenges have made it difficult for enterprises to find and scale financing from traditional sources.

However, enterprises in the DRE space have addressed these issues in different ways. In particular, we have seen two DRE models demonstrate strong potential for commercial viability:

- Business-to-consumer (B2C) models that provide households with only basic lighting (2-3 lights) and mobile charging, can build smaller plants with less than 500 W in capacity. In many ways this offering is very similar to buying a high-quality solar lantern, but collections over time are better aligned with consumer cash flows. Given that these companies can offer households a price lower than kerosene, rural consumers can simply substitute their monthly kerosene expenditure for payments to the DRE provider. As a result, this model can reach many consumers fast, with a small amount of capital investment. Overall, enterprises can recover costs quickly: within one to two years if they are able to attract enough customers and ensure strong collections.

- Business-to-business and business-to-consumer (B2B + B2C) models with installed capacities greater than 25 kW can provide power to commercial anchor clients such as a rural mobile tower or an ATM, in addition to rural households. The commercial anchor client can provide a stable stream of revenue that is enough to cover yearly operating expenses on their own, and excess electricity is then sold to nearby households. While this model requires larger plants, the anchor client provides a way to quickly recover costs, and the offering to consumers is a way to make extra profit.

Overall, we estimate the market size of the DRE space will be at least US$150 million by 2018, largely driven by B2B revenues. Not all B2B companies will expand to household DRE offerings, but we have seen some B2B enterprises begin to do so. Off-grid DRE businesses serve close to 100,000 households today, and this number is set to grow rapidly at 60-70% annually to around 900,000 by 2018. While the household market will generate annual revenues of US$45 million by 2018,[6] commercial rural infrastructure is growing and presents a huge B2B opportunity to ensure stable revenues from anchor clients alongside households. Companies looking to serve businesses can tap into a range of enterprises such as rural mobile towers, ATMs and petrol pumps, and secure large scale contracts to drive expansion. Potential revenues from serving rural mobile towers alone could grow to at least US$95 million by 2018.[7] And in light of a Government of India mandate requiring 50% of all rural cell towers to shift to renewable energy, this number could be significantly higher.

Furthering private sector engagement

Given the current challenges in both the SHS and DRE markets, investors have a strong role in supporting innovative and scalable off-grid models. Some emerging high potential organizations have ambitious growth plans, and are confident of tapping into commercial sources of funding. In particular, organizations are looking for affordable debt and long-tenure finance. For SHS enterprises, there is potential for equity style investments to grow companies that are looking to serve the evolving rural consumer base through products and services beyond lighting. Potential acquisitions by large electronics companies, who have not seen success in rural markets, could result in interesting exit options for equity investors. For B2B DRE enterprises, there may also be potential for large scale securitization of stable anchor load revenues.

Increasing the attractiveness of the sector will require broader engagement from all actors to help push policy and make the investment climate easier. Improving access to information for the private sector through industry coverage reports, spurring innovation through competitions with prizes, and supporting initiatives to make the carbon market more attractive, are a few ways to help transform the sector for all players. This transformation could lead to not only sizeable returns, but also expanded access to electricity for many poor, rural households.

[6]See Section 3.2.
[7]ibid.

WE ESTIMATE THE MARKET SIZE OF THE DRE SPACE WILL BE AT LEAST US$150 MILLION BY 2018

TWO

2. THE OPPORTUNITY FOR OFF-GRID RENEWABLE ENERGY

2.1 UNMET ELECTRICITY DEMAND IN INDIA

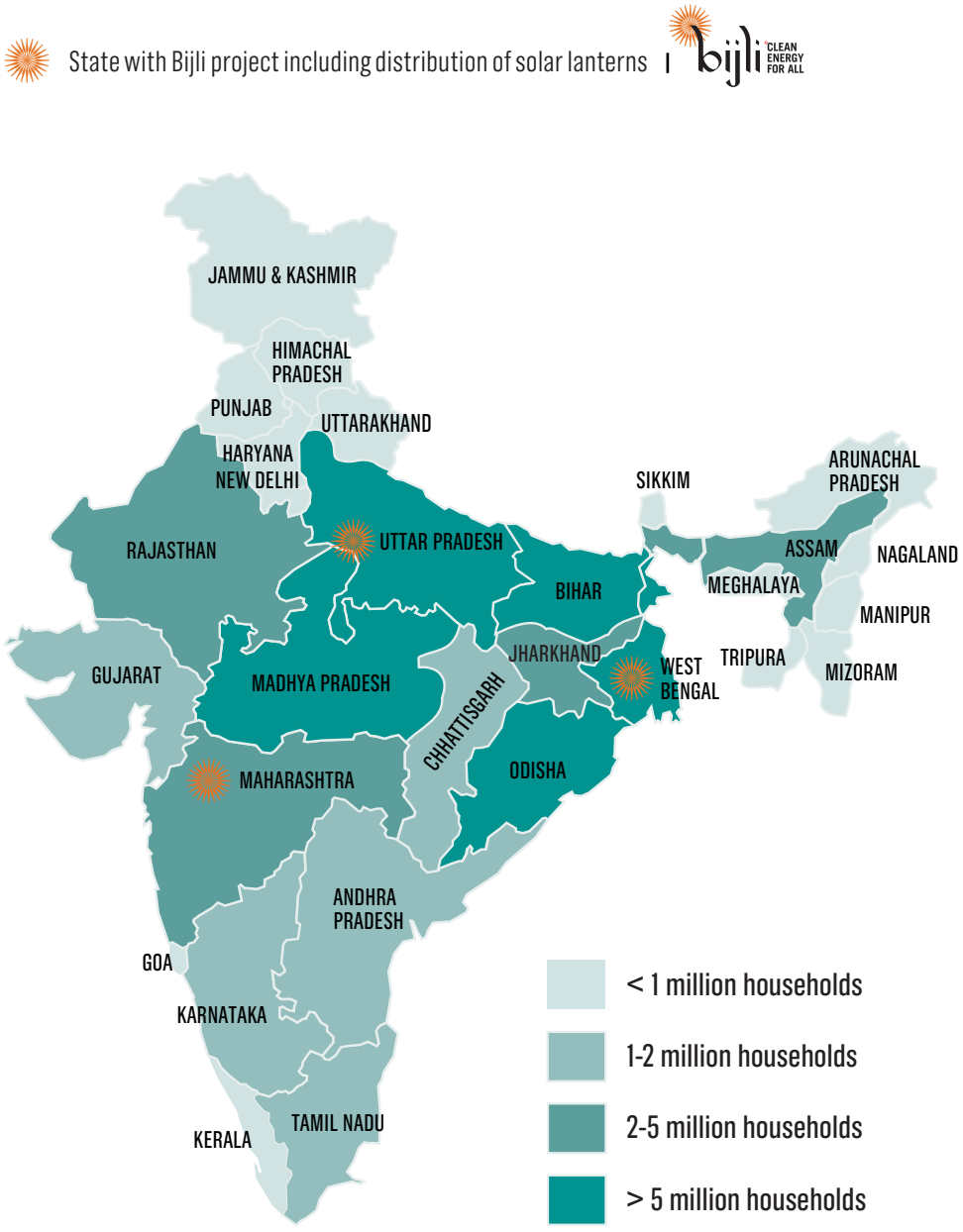
India currently has 77 million[8] households (about 360 million people) who lack adequate access to grid-electricity, and another 20 million underserved households (approximately 95 million people) who receive less than four hours of electricity in a day. While grid connectivity is expected to improve over the next 10 years, at the current rate of grid expansion, urbanization and population growth, 70-75 million households will still lack access to grid electricity by 2024. Since 90% of these households live in rural areas, a significant reduction in the 83 million rural households who are currently not served or underserved by the grid is unlikely.

More than half of the total underserved rural population lives in five states: Uttar Pradesh, Bihar, Odisha, West Bengal and Madhya Pradesh. Rural underserved households are not equally distributed across India (see Figure 1). Large sections of Northern and Eastern India have significant underserved populations. Furthermore, two-thirds of the underserved rural population, or ~55 million households, live in the states of Uttar Pradesh, Bihar, Odisha, West Bengal and Madhya Pradesh. The Climate Group, through its Bijli project, works with local delivery partners in Uttar Pradesh, West Bengal and Maharashtra.

[8]International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015. Calculated by projecting the number of households in the 2011 Indian Census who do not list electricity as their primary source of lighting, taking into account population growth, rates of urbanization, and rate of grid expansion within each state. The number of under-electrified households was calculated using a conservative estimate of the percentage of grid-connected households who receive less than four hours of electricity a day.

Figure 1: Off-grid households in India

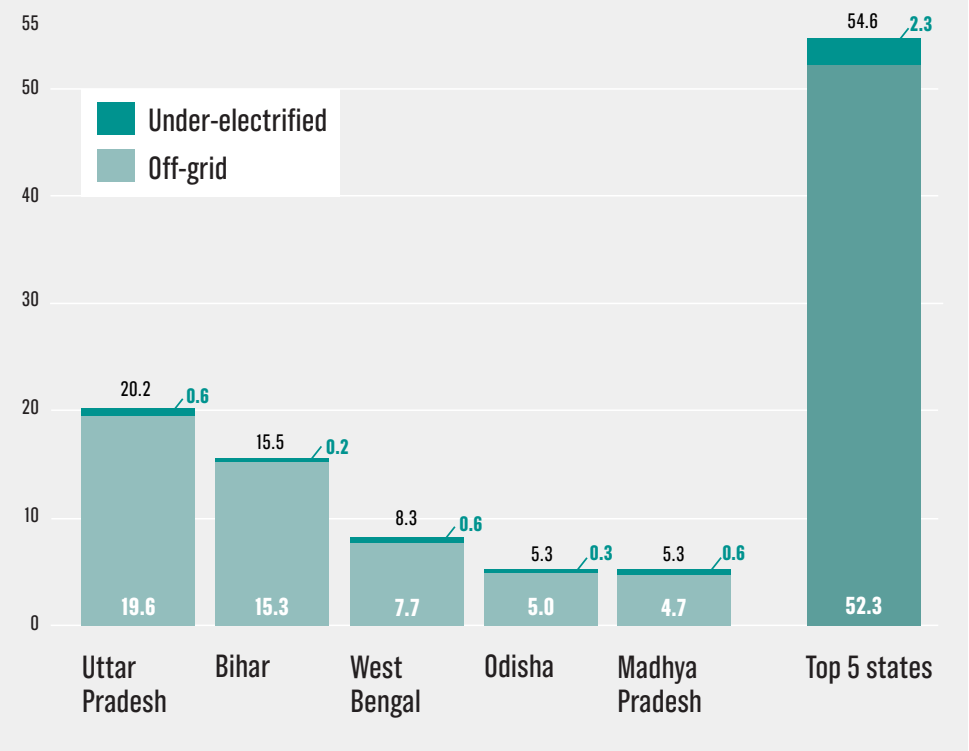
Distribution of underserved households in rural India (millions)



Source: Population totals from India Census 2011; Electrification data (source of lighting) from India Census 2011.

MORE THAN HALF OF THE TOTAL UNDERSERVED RURAL POPULATION LIVES IN FIVE STATES: UTTAR PRADESH, BIHAR, ODISHA, WEST BENGAL AND MADHYA PRADESH

Underserved rural households in least electrified states[1] (millions)



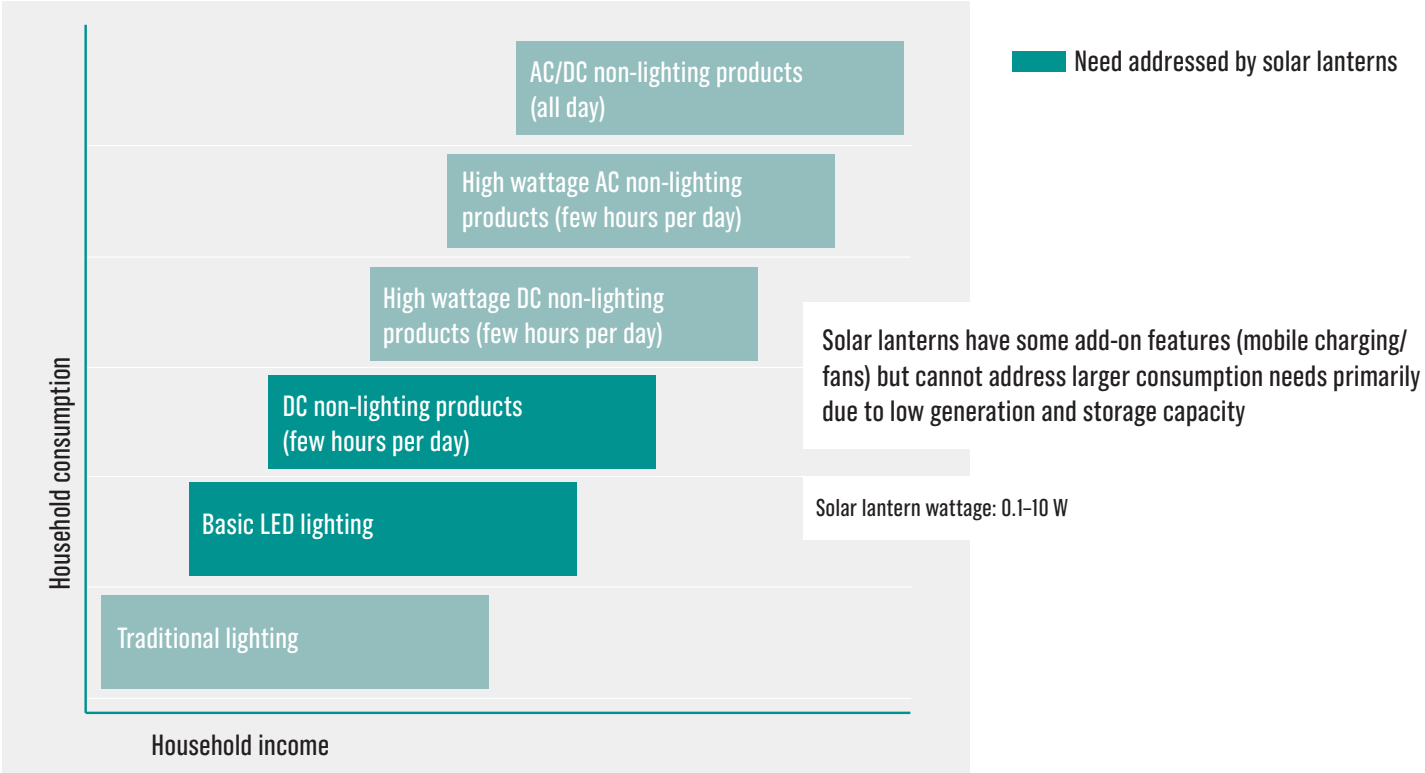
[1] Split between off-grid and under-electrified households for all states is based on the national average.

Source: Population totals from India Census 2011; Electrification data (source of lighting) from India Census 2011.

2.2 THE CASE FOR SHS AND DRE BUSINESSES

Market penetration for solar lanterns is expected to grow from around 5-6% today to nearly 35% of the total underserved market by 2018.[9] However, while solar lanterns are affordable and can address the customer needs of today, they cannot meet the evolving needs of rural consumers beyond basic lighting. Today, a customer with no prior access to electricity is willing to pay for just basic lighting and mobile charging, but tomorrow that same customer is likely to want to move up the energy ladder and use higher wattage appliances like fans and TVs (see Figure 2). The unmet demand for electricity presents a huge opportunity for solutions like solar lanterns, solar home systems (SHS), and distributed renewable energy (DRE) systems.

Figure 2: Moving up the energy ladder



Source: Interviews, company websites and online resources

[9]International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015; the penetration rate is the projected number of units sold divided by the projected underserved population. The units sold is calculated by projecting the number of households willing to buy a solar lantern as a percentage of those that are aware of lanterns and can afford the product.

MARKET PENETRATION FOR SOLAR LANTERNS IS EXPECTED TO GROW FROM ~5-6% TODAY TO NEARLY 35% OF THE TOTAL UNDERSERVED MARKET BY 2018

SHS and DRE systems allow for a wider range of consumption at different price points. Solar home systems consist of solar panels fixed on a building or open land that powers a nearby home or business. Systems range in size from 10 W to more than 200 W and can cost anywhere from US$20 to over US$500. Depending on the size of the system, consumers can power CFL and LED lights as well as higher wattage products like fans and TVs.

DRE models use a renewable energy source like solar, wind, hybrid, or biomass to provide electricity to multiple homes as a mini-utility. Plant sizes span a large range, from 200 W to more than 100 kW. While DRE models can include large-capacity renewable energy power plants that feed electricity into the grid, off-grid models tend to be smaller. Most of these DRE models only provide enough electricity for basic lighting and mobile charging, though some have begun offering enough for higher wattage appliances and AC connections. Consumers typically pay US$2-8 per month depending on their consumption.[10]

We estimate that there are over 80 businesses operating in the SHS and DRE sector, with an even split between SHS and DRE players. This includes large, medium and small enterprises functioning via off-grid as well as grid-connected models, or operating in under-electrified regions. Figure 3 shows companies operating in regions across the country. There is a large concentration of enterprises in Uttar Pradesh and Bihar where the largest underserved populations live. Additionally, a number of SHS players are operating in South India, particularly in Karnataka, where greater microfinance institution (MFI) and rural bank penetration makes consumer financing easier in the southern states. Most early stage enterprises are currently focusing on one region, while some relatively older companies we spoke to have plans to expand to other regions as well.

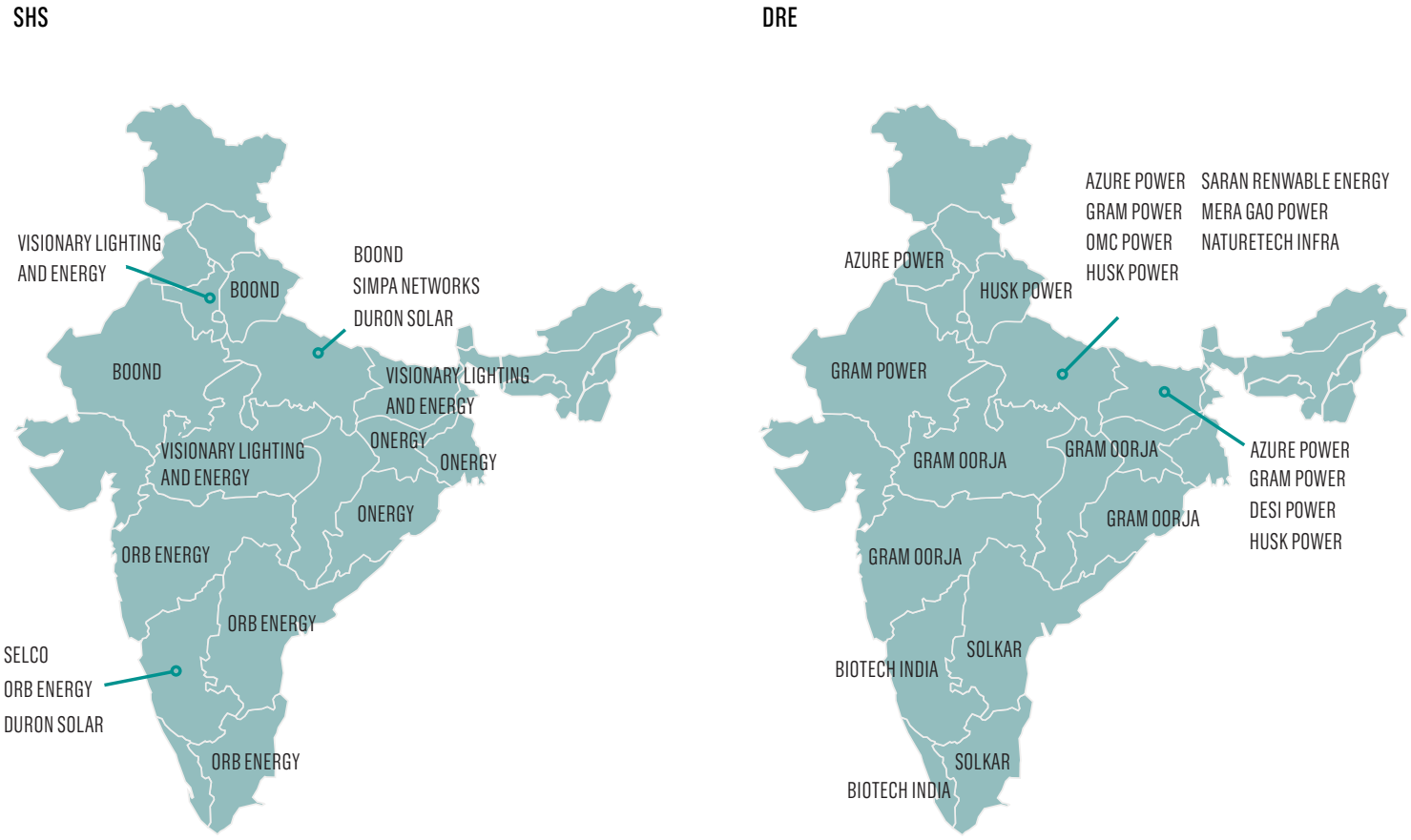
Of these businesses, The Climate Group partners with ONergy and Selco alongside non-profit and micro-finance providers to reach rural and remote off-grid communities. In addition, The Climate Group provided project funding (US$30,000-100,000 each) to Simpa Networks, ONergy, Naturetech Infra and Mera Gao Power in 2013 through its "Off-Grid Energy Challenge" Competition.

[10]Interviews with OGE enterprises.

DEBT IS A PRIMARY UNMET NEED OF DRE ENTERPRISES AS THE COST OF STANDARD DOMESTIC FINANCING IS HIGH

Figure 3: Examples of key SHS and DRE players and the states in which they operate

Based on primary and secondary research, we estimate there are nearly 80 businesses (~40 mini-grid enterprises and ~40 SHS manufacturers and distributors with an online presence) in the sector. Examples of a few players in the two off-grid energy categories are shown below.



Source: Interviews, company websites and online resources

The majority of SHS and DRE players are only 5-10 years old. Within this time, these businesses have undergone multiple iterations of their business models to arrive at their current scale. At present, the average SHS enterprise sells about 1,000 units per year, and the average DRE enterprise serves 1,000–2,000 households through total installed capacity.

However, SHS and DRE enterprises understand that the off-grid market is still largely untapped and are optimistic about their future growth. SHS and DRE enterprises have projected annual growth as high as 400% and 250% respectively, and even conservative estimates show annual growth rates ranging from 40-70%.[11]

[11] Interviews with OGE enterprises.

THREE

3. ASSESSMENT OF OFF-GRID ENERGY BUSINESS MODELS

3.1 OVERVIEW OF SHS ENTERPRISES

3.1.1 SHS TECHNOLOGY AND PRICING

SHS products can be broadly divided into three categories: basic, standard, and advanced. Solar home systems consist of solar panels and an energy storage device (battery) that power a nearby home or business. Systems can also include a charge controller and/or an inverter for AC connections.

Broadly speaking, a basic SHS will be less than 10 W and be able to power one to three lights, and can look similar to larger lanterns, which typically range from 2-10 W. A standard SHS can be up to 150 W and can power multiple lights, as well as appliances such as DC fans and TVs. An advanced SHS is greater than 150 W, will often have multiple panels, and can power the lights and large appliances of an entire house. Prices can range anywhere from US$20 to over US$500, depending on the size and specifications of the product. Figure 4 below summarizes the characteristics and prices of each segment.

An SHS as mentioned above can allow for use of DC appliances or even AC appliances. AC appliances need an SHS to have an inverter in addition to the solar panels and battery, and are likely to be priced higher. Electronic appliances used in homes with grid-electricity are typically AC compatible, and new products such as low wattage DC TVs are a fairly new range of products targeted at rural consumers.

Figure 4: Segmentation of SHS products

Basic solar home systems are low wattage systems which have one or more detachable lights. Basic SHS do not have other value-add features.
SIZE: <10 W
PRICE: US$20–100

Examples
- Powapack junior matrix
- In-diya basic
- Solo electric basic plug and play

Image credit: barefootpower.com

Standard solar home systems are higher wattage, have multiple detachable lights and also come bundled with features such as mobile charging and fans.
SIZE: 10–150 W
PRICE: US$100-600

Examples
- Solo electric advanced
- Venus solar home lighting systems

Image credit: barefootpower.com

Advanced solar home systems are significantly high wattage systems which can power the lights and appliances for an entire house. These can also offer AC connections and grid connectivity, so they tend to be more modular in nature.
SIZE: 150 W+
PRICE: >US$500

Examples
- Gautam SS–3012
- Solelectric AC

Image credit: boond.net

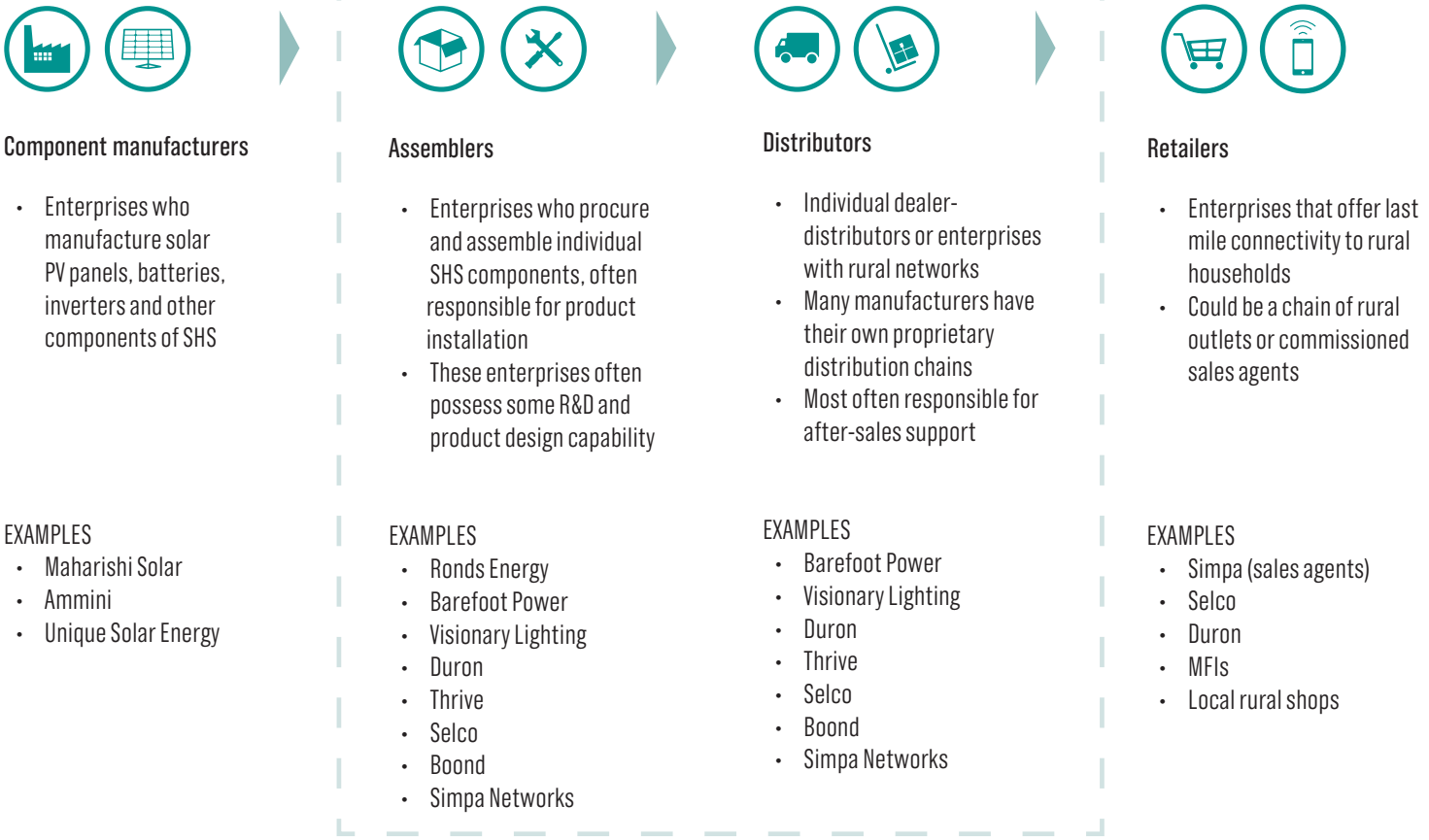
Source: Interviews, company websites and online resources, Noun Project.

Most SHS enterprises offer a broad range of products between 10 W and over 200 W. Very few SHS enterprises offer only one SHS category. Furthermore, most SHS products offered fall into the 40-60 W (standard SHS) range which is usually enough to power two or three lights as well as one or two appliances like a DC fan or a low wattage DC TV. Relatively few enterprises sell advanced SHS. Advanced systems are generally sold to high income households who often use them as a back-up during outages related to grid-electricity.

3.1.2 SHS VALUE CHAIN AND KEY PLAYERS

Most SHS players in India do a combination of assembly and distribution. The four major parts of the SHS value chain as well as examples of key players in each are summarized in Figure 5 below. Component manufacturing requires production facility and specialist knowledge, while retail requires deep rural networks and logistics capabilities. As a result, over 80% of SHS enterprises buy components from manufacturers, assemble them based on in-house designs, and then distribute systems to channel partners who can sell them to the final customer.

Figure 5: SHS value chain



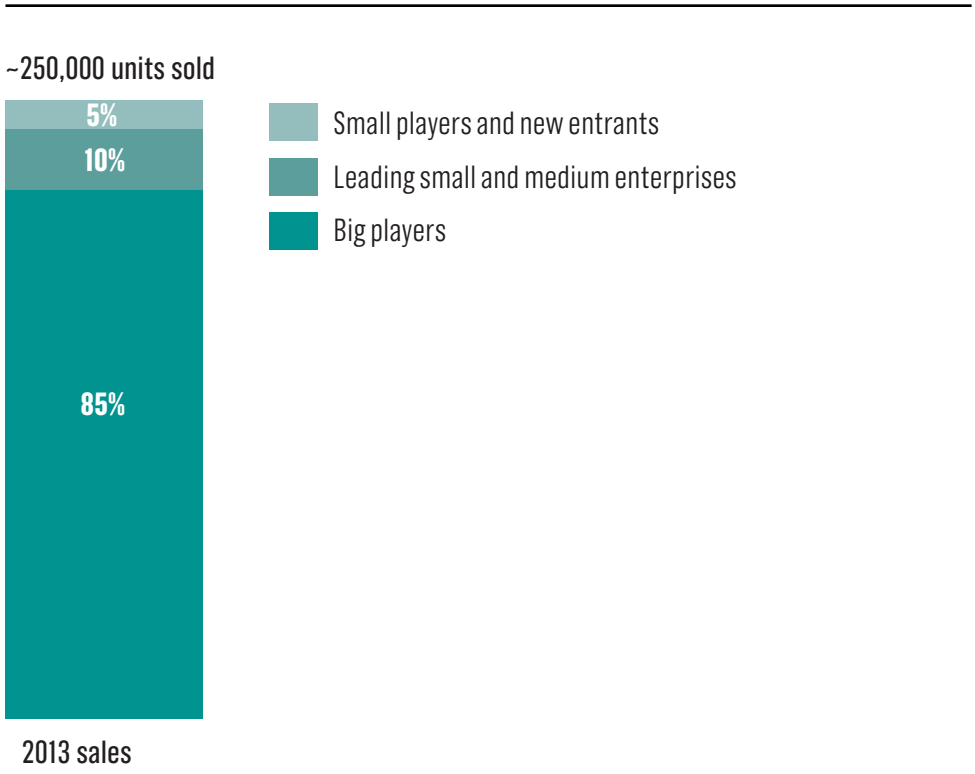
Source: Interviews with enterprises; company websites and online resources; Noun Project.

These assemblers and distributors adopt different business models:

- **Dealer-distributor:** In this model, a company sells its products through the traditional channels of local general and specialty shops and individual dealers.
- **Proprietary (direct to consumer):** Companies with a proprietary distribution strategy have in-house storage facilities and reach the consumer often through a dedicated sales force or commissioned agents.
- **Partnership:** Manufacturers often partner with non-traditional distributors such as NGOs of MFIs or governments, to tap into existing rural networks and a large number of potential customers. Close to 80% of enterprises rely on traditional dealership networks like local specialty shops to sell their products. Assemblers and distributors also provide after-sales support and maintenance services.

Though the market is currently dominated by big players, there is room for leading small and medium enterprises to gain market share.[12] There are three kinds of SHS enterprises currently operating in the market: small players and new entrants, leading small and medium enterprises, and big players. Small players and new entrants made up only 5% of SHS sales in 2013. These enterprises are mostly manufacturers and assemblers who sell through other distributors and third party dealers. Often solar home systems will be a smaller part of their overall business.

Figure 6: SHS market share of different size enterprises



[12]Estimated number of units sold in 2013 using an average of a bottom up and top down approach (see section 3.16): The market is segmented into 5-6 big players, 4-5 leading small and medium enterprises, and ~30 small players and new entrants. The market share for each segment is found based on actual sales data extrapolated to the number of enterprises in the segment.

On the other hand, big players accounted for around 85% of SHS sales in 2013 (see Figure 6). Big players like Tata Solar or Panasonic are generally large electronic companies or subsidiaries of large companies. These companies are able to sell high volumes through channels like government tenders put out by the MNRE, and focus on both rural and urban underserved markets. Smaller players have difficulty in becoming empaneled, and navigating the large amounts of paperwork and bureaucracy necessary for winning these tenders. However, though big players currently make up the majority of SHS sales, they have had trouble making deeper inroads in rural, off-grid markets and therefore sell through third-party channels.

Leading small and medium enterprises, who have deeper rural distribution networks and customer trust than the bigger players, are beginning to scale and expect to have sustained growth over the next several years. This positions them to have greater market share compared to larger companies and smaller players.

SMALL AND MEDIUM ENTERPRISES, WHO HAVE DEEPER RURAL DISTRIBUTION NETWORKS AND CUSTOMER TRUST THAN THE BIGGER PLAYERS, ARE BEGINNING TO SCALE AND EXPECT TO HAVE SUSTAINED GROWTH OVER THE NEXT SEVERAL YEARS

3.1.3 UNIT LEVEL ECONOMICS

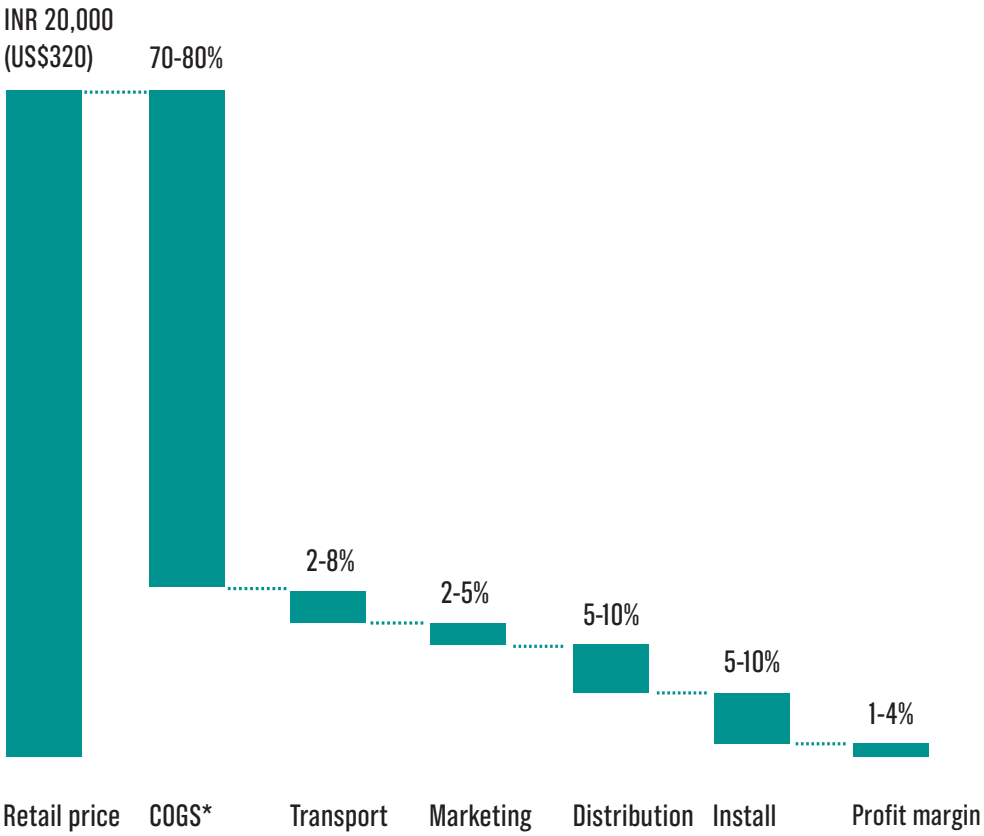
While margins on individual SHS are thin, early stage enterprises are confident of making substantial profits as they scale and reduce overheads. Early stage SHS assemblers have kept profit margins low to keep their products competitive and affordable. They typically pay 70-80% of total retail price on procuring necessary SHS components from manufacturers (see Figure 7), resulting in gross margins of 10-25%. Though the price of solar PV panels has fallen dramatically in the last decade, they account for half of total component costs. The cost of the battery is about 15% of the total retail cost, and the remaining material costs are for wiring, lights and other product add-ons. Technology advancements in energy storage are likely to bring down battery costs in the future.

However, after factoring in transportation, marketing, distribution and installation costs, the remaining profit margin on an SHS product is only 1-4%.[13] SHS enterprises are thus focused on growing sales volume in order to make larger profits.

[13]Based on interviews with SHS enterprises.

Figure 7: Profit margins across SHS value chain

Average unit level cost breakdown of a 40 W SHS (% of retail price, n = 5)



**Cost of generation*

Source: Interviews, company websites and online resources.

A GOOD PRODUCT IS IMPORTANT BUT INSUFFICIENT; ENTERPRISES NEED TO DEVELOP LONG-TERM CUSTOMER RELATIONSHIPS

3.1.4 CONSUMER FINANCING AND AFFORDABILITY

Given the large ticket size of SHS, most companies offer some sort of financing option for their customers. Even with low margins, SHS products are more expensive than small solar lanterns. An average simple solar lantern is priced at US$13 (INR 800), a multiple functional lantern with added features on average is priced at US$23 (INR 1,400) and a smaller SHS is priced at US$65 (INR 4,000). While rural consumers are willing to buy such products, their limited and irregular incomes make it difficult to make large purchases. Consumer financing options are therefore an integral part of the SHS product offering, and companies have developed various ways of supporting consumer purchases. Most companies are looking to develop strong relationships with banks and micro-finance institutions in order to ensure access to finance for the consumer, while a few others have launched installment based or pay-as-you-go models for payment. Figure 8 summarizes the financing options SHS enterprises in India have offered their consumers.

Figure 8: Consumer financing options offered by SHS enterprises

		Mechanism	Examples	Challenges
INDIVIDUAL LOAN		• Consumer makes 10-25% down payment • MFI/Bank provides loan 5-20% interest	ONergy Selco Boond	• Low penetration of banks and MFIs in relevant areas • Banks and MFIs unwilling to lend
GROUP LOAN		• Loans provided to entire village or SHG • Loan sizes range from US$22-25 for SHG and > US$500 for villages	Orb Energy Thrive Solar Energy	• Low penetration of banks and MFIs in relevant areas • Requires organized distribution network
SUBSIDIES/ GRANTS		• Consumer applies for government subsidy through bank • Donor provides funds for buying and distributing SHS	Gautam Solar	• Subsidies can be delayed or difficult to get • May reduce consumer willingness to pay
INSTALLMENT		• Consumer pays fixed monthly installments until the SHS is paid off	Visionary Lighting and Energy	• Requires more working capital since capex is not immediately paid back • Collection costs can be high
PAY AS YOU GO		• Consumer pays per own usage until SHS is paid off • Mobile technology is used for monitoring	Simpa Networks	• Requires monitoring capabilities • There is low awareness about method

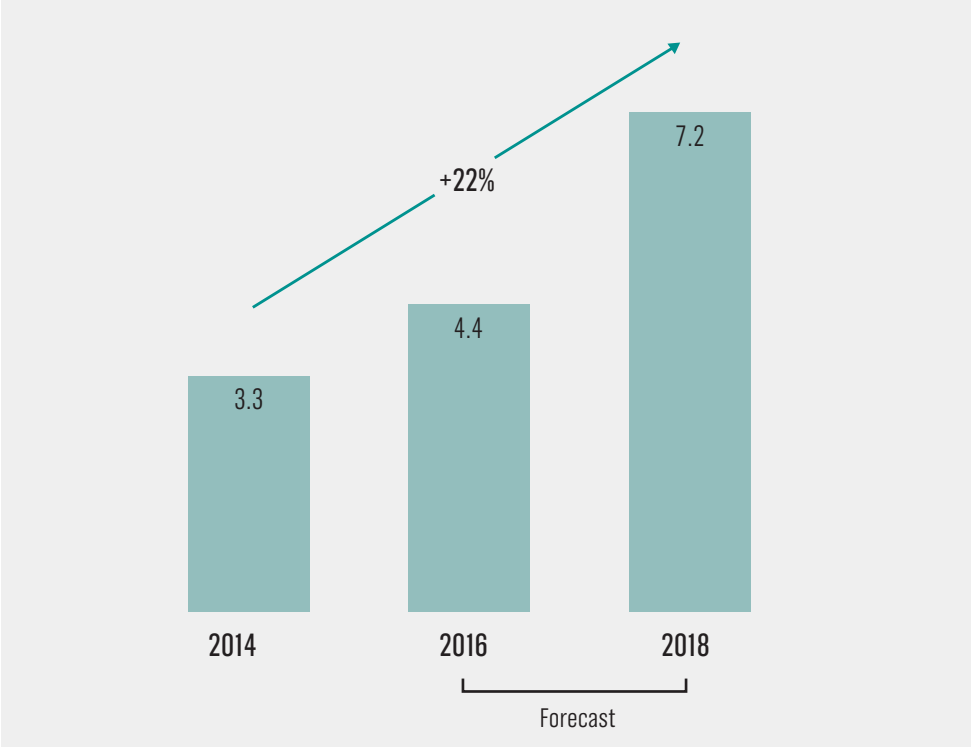
Traditionally enterprises have used individual loans and subsidies for consumer finance; however they are now exploring newer forms of financing, such as group loans and pay-as-you-go.

Source: Dalberg interviews; company websites and online resources.

With financing support, we estimate 7.2 million under-electrified households will be able to afford a solar home system by 2018. Consumer finance in the SHS market allows low-income consumers to buy basic and standard SHS and allows middle-income consumers to buy higher price advanced systems. Better models for consumer finance alongside large demand and rising incomes, will drive the current potential SHS market of 3.3 million households to more than 7.2 million households by 2018.[14]

WITH FINANCING SUPPORT, WE ESTIMATE 7.2 MILLION UNDER-ELECTRIFIED HOUSEHOLDS WILL BE ABLE TO AFFORD A SOLAR HOME SYSTEM BY 2018

Figure 9: Potential SHS market[1] size (millions of households)



[1] Calculated using 2011 Indian Census data on the number of under-electrified, and finding the percentage of households who could afford a US$67 /INR 4000 SHS system, given household disposable income for energy and consumer durables (NSSO)

[14] International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015; calculated using 2011 Indian Census data on the number of under-electrified, and finding the percentage of households who could afford a low end SHS. The percentage who could afford is found based on consumption data from the 68th round of NSSO's survey on household expenditure. A household was considered able to afford if their monthly disposable expenditure for energy and consumer durables was at least one third the price of an average low end SHS (US$67 or INR 4000).

3.1.5 EVOLUTION OF THE SHS MARKET

Given increasing affordability and consumer demand for SHS, there is likely to be greater competition from new and existing solar players. Rising rural incomes mean that households will demand and be able to afford products beyond basic lighting. We expect the number of households that can afford an SHS to increase by more than 20% per year over the next five years.[15]

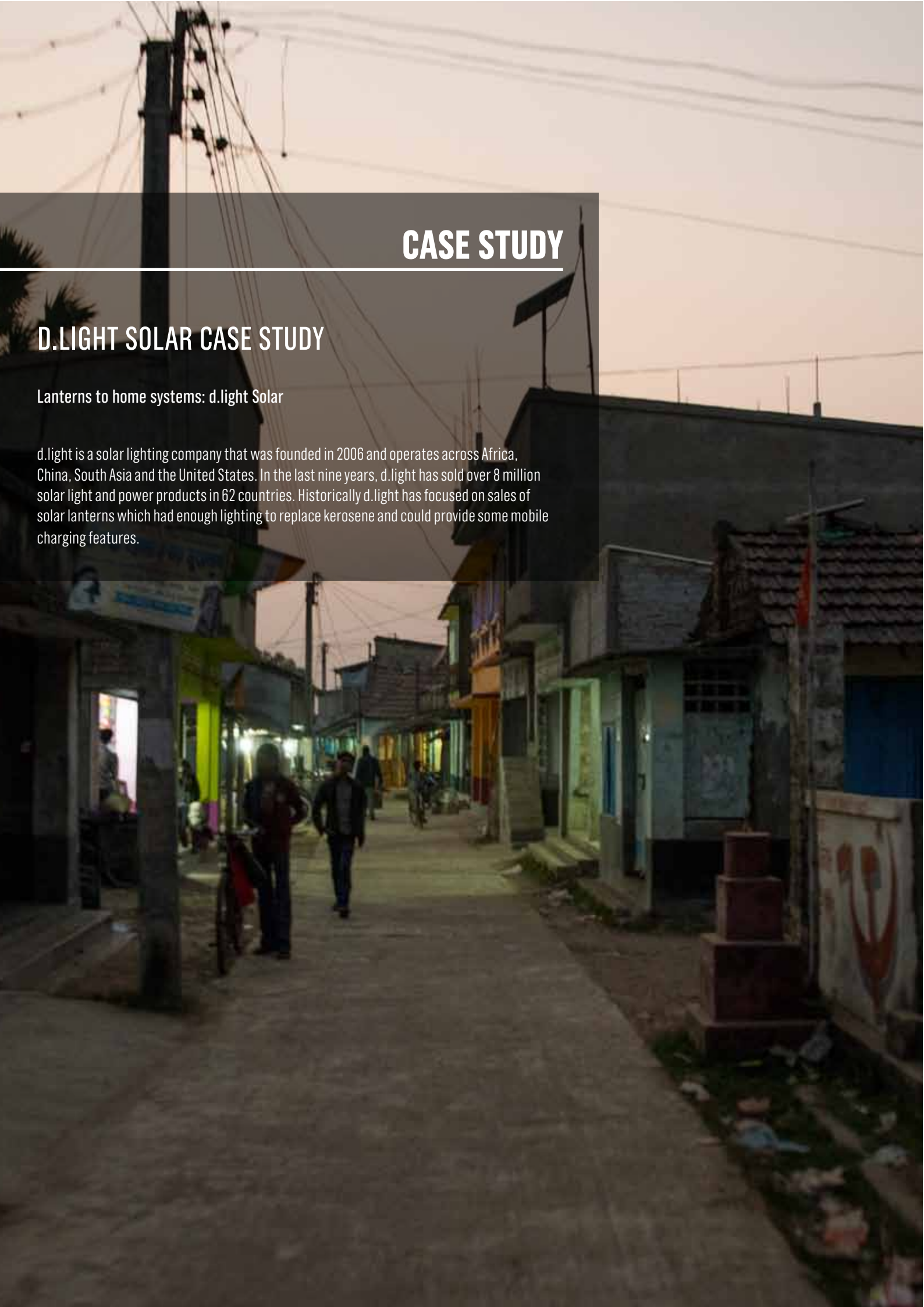
Solar lantern enterprises have noticed this trend and are now also entering the solar home system space (see d.light case study). Established lantern enterprises already have the networks in rural areas to reach customers, and can easily gain a part of the growing SHS market, because the technology is easy to replicate.

While the consumers of today are primarily concerned with lighting and mobile charging, the consumers of tomorrow will want more fans, TVs and other appliances. Enterprises focused on the evolving consumer will be well-positioned for success. Rural consumers have heterogeneous and evolving needs. A number of SHS enterprises like ONergy have already begun offering low wattage DC TVs and fans. SHS enterprises will need to develop a wide variety of consumer offerings and build greater trust, for people to buy their products. And we have already seen some players begin to do this.

Enterprises will also need to invest in continuous innovation to stay relevant. In order to develop products designed for their evolving consumers, enterprises will need to incorporate real-time consumer feedback into their product design. Some have already been building product innovation and learning into their business models (see Selco case study).

A good product is important but insufficient; enterprises need to develop long-term customer relationships. A SHS is a large purchase for a poor, rural household — even with financing. It is risky for them to spend so much money on a product they are not sure will work and with an enterprise they know very little about. Consumers are more likely to do future business with brands they know and trust. To this end, enterprises have used various forms of after-sales support, including providing warranties on their products, free servicing and financing that reduces the risk to the consumer (see Simpa Networks case study).

[15] *See Figure 8.*



CASE STUDY

D.LIGHT SOLAR CASE STUDY

Lanterns to home systems: d.light Solar

d.light is a solar lighting company that was founded in 2006 and operates across Africa, China, South Asia and the United States. In the last nine years, d.light has sold over 8 million solar light and power products in 62 countries. Historically d.light has focused on sales of solar lanterns which had enough lighting to replace kerosene and could provide some mobile charging features.

Figure 10: Solar D20

Source: Company wesite: dlightdesign.com. Image used with permission of dlight.com

In the last year, d.light has entered the solar home system market with its D20 system. This basic system can power 3-4 lights and mobile charging for 15 hours on a single charge. d.light has even paired the product with various financing options ranging from micro-loans to mobile payments to pay-as-you-go.

As of May 2014, d.light has sold over 125,000 solar home systems around the world. d.light's existing sales network and experience with consumers has allowed it to rapidly gain market share in the solar home system market. Solar lantern enterprises who have seen success in building deep sales networks and who have implemented a variety of consumer financing options are likely to see success in the nascent but growing SHS market.

CASE STUDY

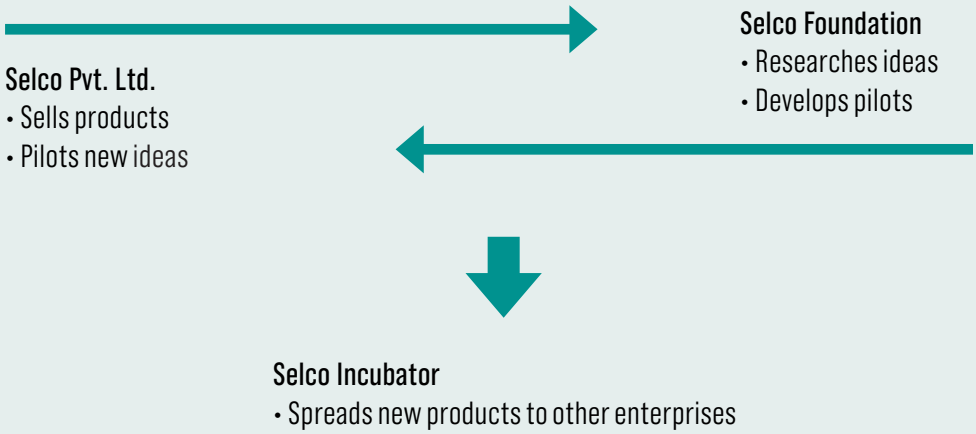
SELCO CASE STUDY

Developing a platform for innovation: Selco

Selco began as a private social enterprise selling solar home systems in 1995. The solar home systems range from small 12 W systems to larger systems for institutions like NGOs and schools. To date, they have sold over 125,000 home systems, mostly in the state of Karnataka.

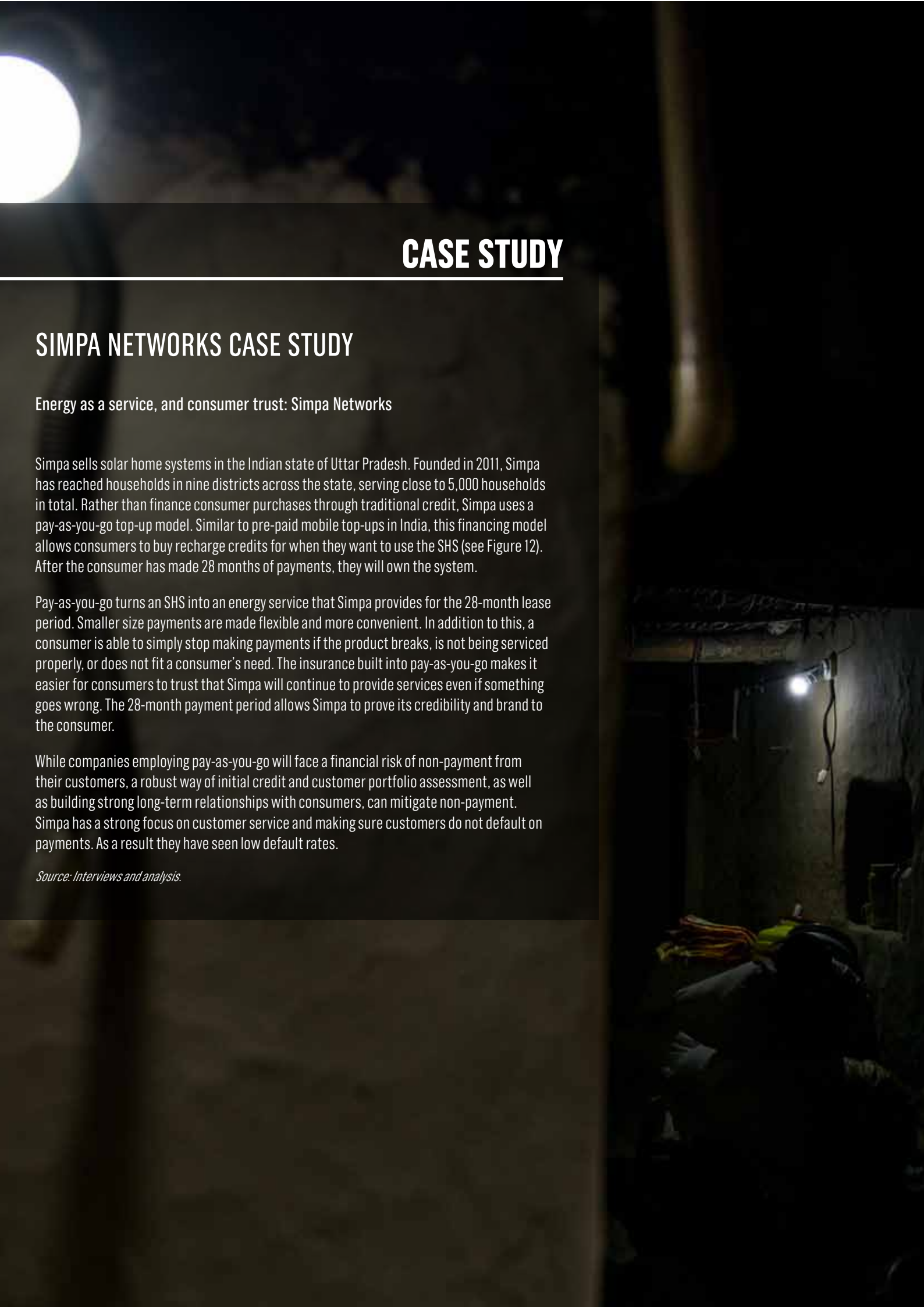
As one of the early players in the solar home system space, Selco realized that innovation was key to keeping products relevant, competitive and attractive to consumers. For this reason, Selco has created a platform of three separate entities: Selco Private Limited, Selco Foundation, and Selco Incubator. Selco Private Limited handles sales of solar home systems. When it discovers a problem or issue that it cannot solve with current design or technology, Selco Foundation will research the problem. Selco Foundation then develops a solution and pilots it through Selco Private Limited. If the pilot is successful, the new solution is developed into a new product and sold through the private limited company. Successful products, designs and processes are then replicated, by disseminating information to other enterprises through the Selco Incubator.

Figure 11: Three different Selco entities



For example, while selling solar home systems among fisherman communities, Selco Private Limited saw that fishermen did not have an effective way of drying fish, which led to spoilage and loss of income. The Selco Foundation developed a solar-powered dryer which was then piloted and sold by Selco.

Source: Interviews with enterprises and analysis; Organization website: Selcofoundation.org



CASE STUDY

SIMPA NETWORKS CASE STUDY

Energy as a service, and consumer trust: Simpa Networks

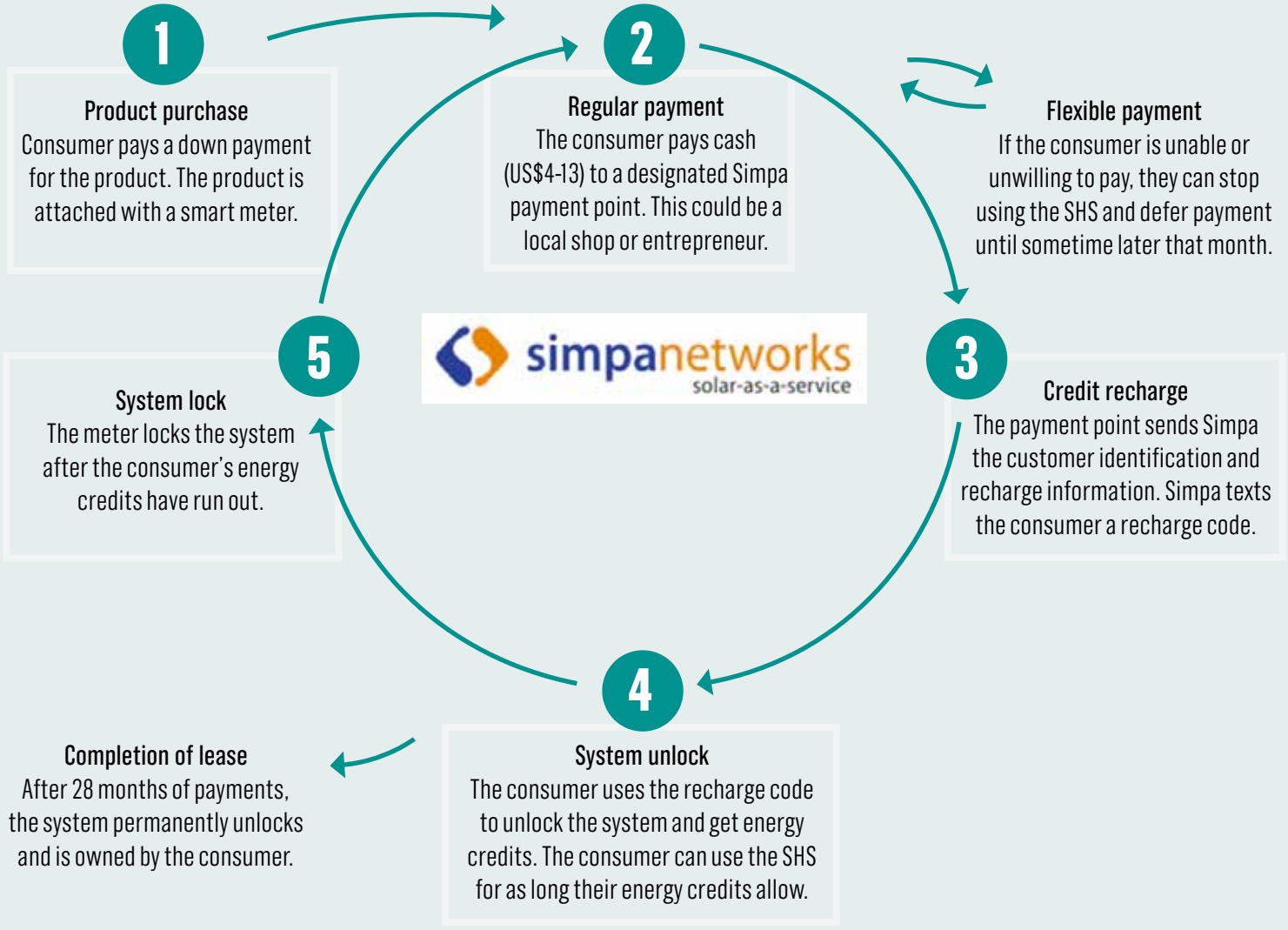
Simpa sells solar home systems in the Indian state of Uttar Pradesh. Founded in 2011, Simpa has reached households in nine districts across the state, serving close to 5,000 households in total. Rather than finance consumer purchases through traditional credit, Simpa uses a pay-as-you-go top-up model. Similar to pre-paid mobile top-ups in India, this financing model allows consumers to buy recharge credits for when they want to use the SHS (see Figure 12). After the consumer has made 28 months of payments, they will own the system.

Pay-as-you-go turns an SHS into an energy service that Simpa provides for the 28-month lease period. Smaller size payments are made flexible and more convenient. In addition to this, a consumer is able to simply stop making payments if the product breaks, is not being serviced properly, or does not fit a consumer's need. The insurance built into pay-as-you-go makes it easier for consumers to trust that Simpa will continue to provide services even if something goes wrong. The 28-month payment period allows Simpa to prove its credibility and brand to the consumer.

While companies employing pay-as-you-go will face a financial risk of non-payment from their customers, a robust way of initial credit and customer portfolio assessment, as well as building strong long-term relationships with consumers, can mitigate non-payment. Simpa has a strong focus on customer service and making sure customers do not default on payments. As a result they have seen low default rates.

Source: Interviews and analysis.

Figure 12: The Simpa product purchase and payment model



Margins in the space will remain low until there are more opportunities for cross/up selling. Enterprises that provide a wide variety of products which meet the needs of consumers and have developed brands their consumers trust, will be able to evolve into more general "white goods" companies. A solar home system or lantern is often the first white good purchased by a rural consumer. As consumers demand other energy and non-energy products like fans, TVs and appliances, they will look to enterprises they have established relationships with. Margins on SHS sales are currently low, partly because of high distribution and logistics costs. However, as existing channels are used to up-sell higher ticket size products, margins are likely to increase. Enterprises, eventually, are likely to mimic white goods companies and move distribution to traditional retail channels.

MARGINS IN THE SPACE WILL REMAIN LOW UNTIL THERE ARE MORE OPPORTUNITIES FOR CROSS/UP SELLING

3.1.6 MARKET SIZE AND IMPACT

Overall, we conservatively estimate the market size for solar home systems will grow at 60% per year to reach a market size of US$200-250 million by 2018. In 2014 there were approximately 518,000 SHS units sold and a total of ~900,000 households using solar home systems.[16] Given an average SHS price of US$65, the total SHS market was worth US$35 million. We estimate that annual SHS sales will reach over 3 million units by 2018 resulting in a market worth over US$215 million.

SHS enterprises provided reliable electricity to around 900,000 households and offset about 39,000 tons of carbon emissions in 2014.[17] Rural off-grid households use kerosene for much of their lighting, spending roughly US$2-3 a month on lighting. Kerosene lighting produces carbon emissions as well as "black carbon" which has a much stronger greenhouse effect than regular CO_2, but the use of solar home systems can offset these carbon emissions. In 2014, the Indian SHS market offset 39,000 tons of CO_2 equivalent, and by 2018 this number will be more than 235,000 tons (see Figure 13 below). To put this in perspective, this amount is the equivalent of the annual emissions from 50,000 passenger vehicles.[18]

There are also significant social benefits to expanding electricity access to 900,000 households, including increased study time for children. Beyond this, an increase in productivity of rural businesses from longer hours of electricity and the income benefits of increased economic activity (especially distribution and retail in local communities) added more than US$21 million to rural economies in 2014.[19] For example, an SHS enterprise, E-Hands, based in Chennai, South India, sold solar home systems to flower vendors helping them increase incomes by US$5 a day, while organizations such as Selco pay commissions to sales agents for last mile sales, adding to local employment and income.

[16]International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015; units sold (3 million) is an average of a bottom up and a top down approach. Bottom up approach takes sales figures given by enterprises and then is extrapolated for the whole market. Projections are based on company growth rates. Top down approach takes total off-grid and underserved population. This is multiplied by percentage number who can afford US$100 SHS. This is then multiplied by the percentage who are aware of SHS, have access to retail shops, and are willing to pay.

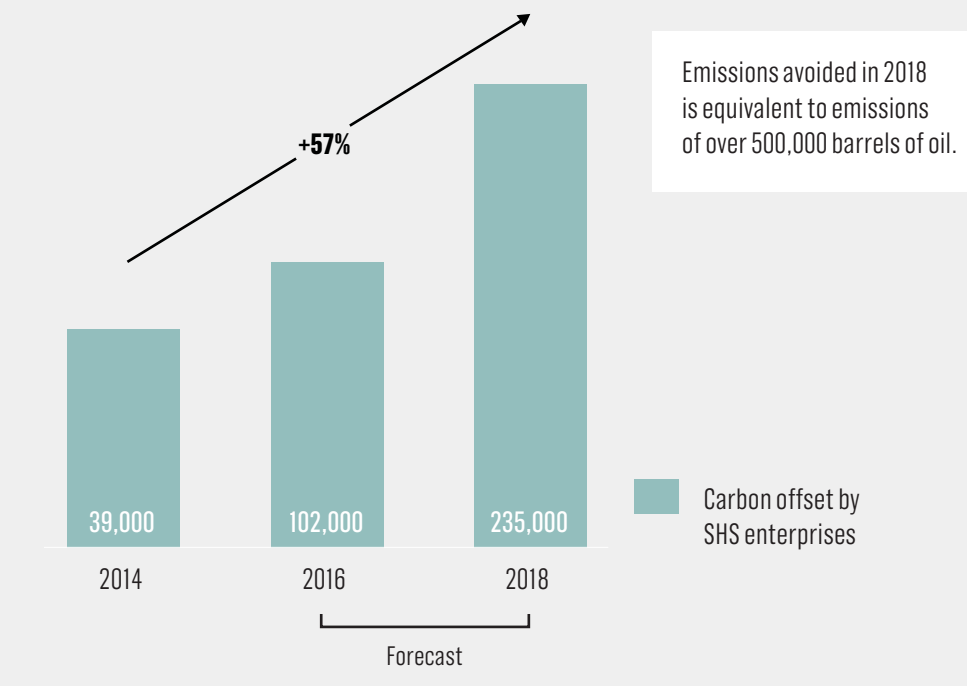
[17]Compared to electricity/light generated from diesel or kerosene.

[18]EPA Emissions Calculator.

[19]Uses a conservative estimate of average monthly increase in income (US$3/month) that results from electricity access (IEG), multiplied by the 51% of households who are self-employed (US$17 million). Then adds the 5-10% of total revenues that are distributions costs used to hire local staff and distributors (US$4 million).

Figure 13: Environmental and social impact of SHS enterprises

Environmental impact of Indian SHS markets (tons of CO2 equivalent[1] avoided annually)



MARKET SIZE FOR SOLAR HOME SYSTEMS WILL GROW AT 60% PER YEAR TO REACH A MARKET SIZE OF US$200-250 MILLION BY 2018

Current social impact (2014)

900,000 households[2] have access to at least seven hours of electricity per day

1 billion additional hours of studying every year for more than 2.5 million children[3]

US$21 million in additional income for local economies[4]

"Our MFI partners tell us that SHS help their customers continue business into the evening resulting in lower default rates. One group of flower vendors made US$5 per hour extra in income.
-SHS assembler/distributor

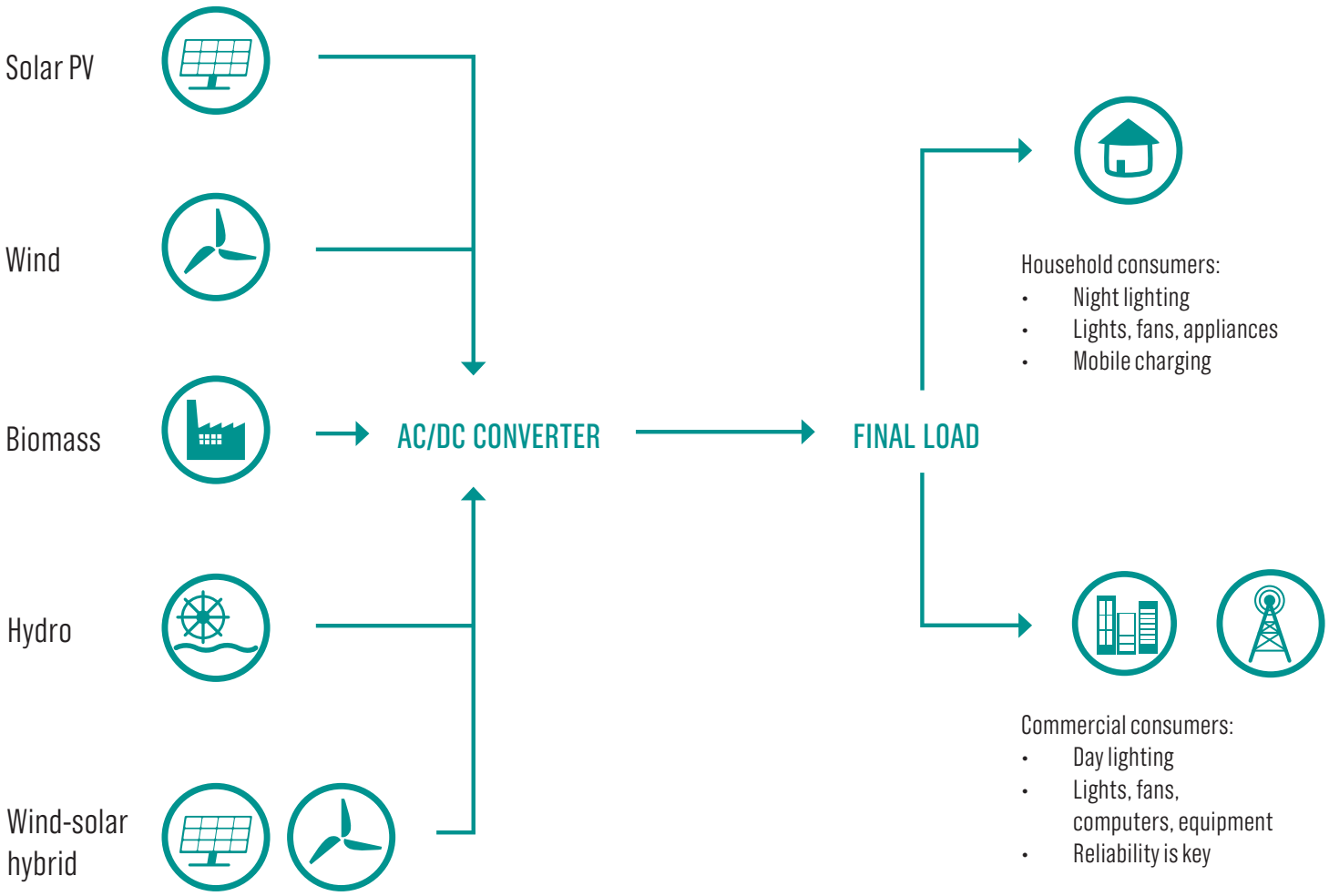
Source: Analysis and interviews, NIRS, Impact Evaluation Group.
[1] As compared to electricity/light generation through diesel or kerosene.
[2] Number is all the households that own a SHS in 2014 (cumulative sales figure).
[3] Calculated using the average number of children per household multiplied by the average number of extra hours of studying that results from electricity access.
[4] Uses a conservative estimate of average monthly increase in income (US$3 per month) that results from electricity access (IEG), multiplied by the 51% of households who are self employed (US$17 million). Then adds the 5-10% of total revenues that are distribution costs used to hire local staff and distributors (US$4 million).

3.2 OVERVIEW OF DECENTRALIZED RENEWABLE ENERGY (DRE) ENTERPRISES

3.2.1 DRE TECHNOLOGY AND SERVICE OFFERING

DRE enterprises can use several types of energy resources to serve domestic and commercial consumers. DRE models use renewable energy sources like solar, wind, hybrid, or biomass to provide electricity to multiple homes as a mini-utility. DRE infrastructure includes batteries, charge controllers and inverters, as well as distribution infrastructure to service individual houses or businesses. Some enterprises have begun deploying systems with meters and smart-grid capabilities, which can monitor electricity consumption and optimize generation and distribution based on that data.

Figure 14: Overview of DRE systems

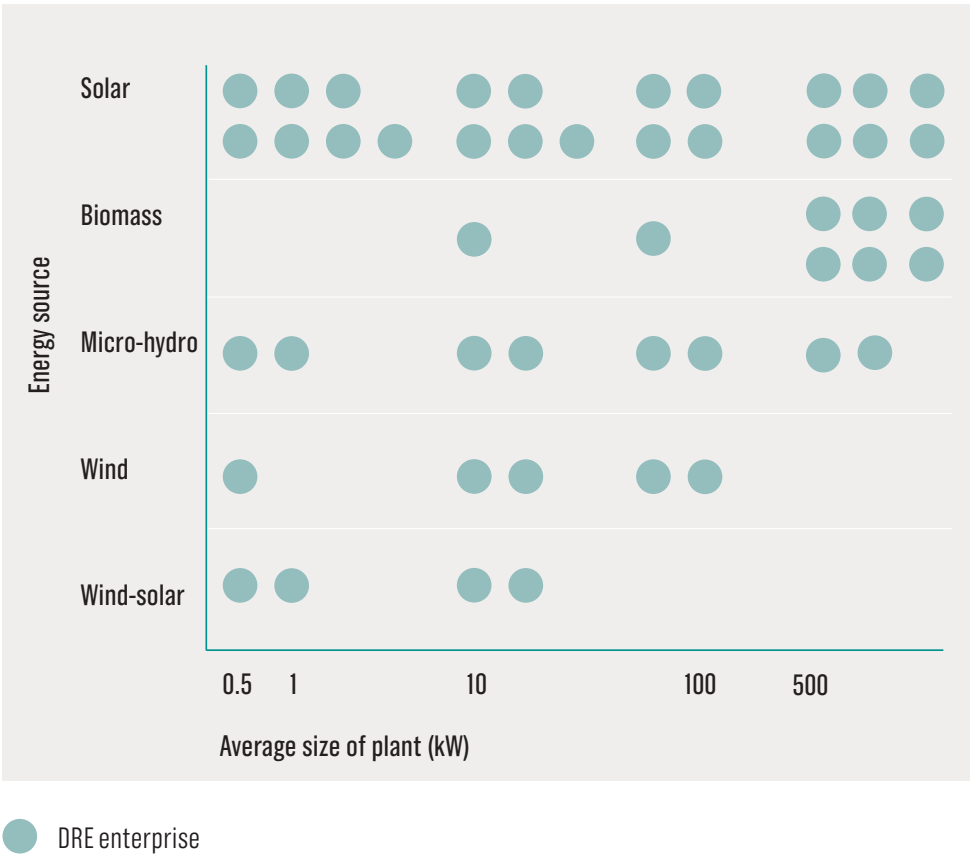


Source: Interviews; company websites and online resources.

DREs can serve both household consumers – which require general lighting, the ability to plug in appliances like fans and TVs, and typically need more power at night – and commercial clients, who need constant, reliable electricity to power lights and equipment during business hours.

The majority of DRE players, roughly 51%, use solar technology. We estimate that the number of DRE enterprises in India has quadrupled from about 10 in 2006 to over 40 in 2014. More than half of these DREs use solar, while another third use biomass or hydro as their energy source. Only a few DRE enterprises employ wind or solar-wind hybrid technologies. Most DREs have plant capacities that are less than 10 kW, and of these the most commonly used technology is solar. Biomass is more commonly used for larger plants of 30 kW or more. Figure 15 shows some of the major players in the DRE space as well as the sizes of their plants.

Figure 15: Plant size and technology of DRE companies (operating utilities of all possible sizes)[20]



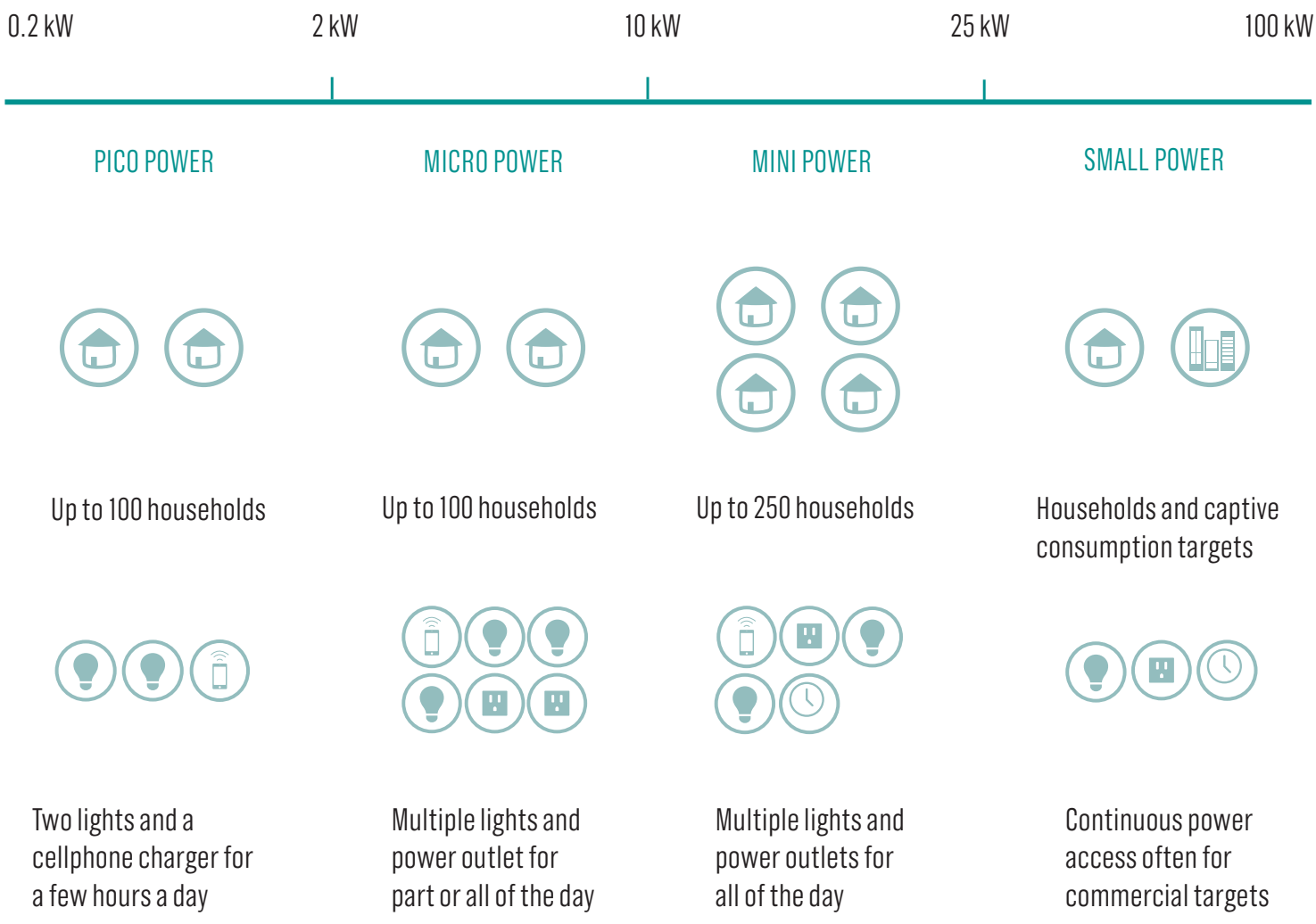
Source: Interviews; company websites and online resources .

[20]The DRE universe consists of companies that operate renewable energy plants of all possible sizes that are not connected to the central grid. The study focuses only on plants upto 100 kW in size.

Solar is more prevalent because current regulations favor solar energy over alternative forms of renewable energy. There are large programs like JNNSM, which provide subsidies for solar DRE projects. In contrast, government incentives for wind have only recently been re-instated, and programs like the National Wind Energy Mission are yet to be implemented. Enterprises have expressed the need for greater support for biomass models and are concerned that government entities often do not understand solar-wind hybrid models, resulting in little policy support for organizations employing this technology.

DRE companies can provide a range of services, from basic lighting and mobile charging for small villages to continuous power for commercial clients, such as telecom towers. DRE plant capacities can be segmented into four categories: Pico power, micro power, mini power and small power (see Figure 16 below).

Figure 16: Consumer offering and DRE plant capacity



Source: Interviews with enterprises.

Most DREs operate plants with capacities in the 200 W–10 kW range.[21] This capacity allows for 5-8 hours of basic lighting, mobile charging, and sometimes one or two low watt appliances for up to 100 households per plant. DRE enterprises can typically serve 30-60 households per plant and have village penetration rates of 50-60%.

Larger DREs that have capacities greater than 25 kW are much less common. Often these plants are built for commercial clients who need continuous, uninterrupted electricity. These plants might be used to power, among other businesses, rural telecom towers, ATMs and petrol pumps.

Of different ownership models in the DRE space, most enterprises adopt the "build only" model. Three different ownership categories for DRE classification are as follows:

- **Build only** – The company installs a plant and transfers ownership to a third party (village community, government, local entrepreneur, NGO etc.) and might provide some maintenance and after-sales support.
- **Build-operate-transfer** – The company installs a plant and operates it for a period of time before transferring ownership to a third party.
- **Build-own-operate-maintain** – The company installs the plant and employs its own staff to operate it and collect payment from end-consumers.

Build-only models are most common because enterprises can immediately recover capex costs. The second most common model is build-own-operate-maintain, and the least common is build-operate-transfer. Ownership transfers are considered most difficult, because of the need for a third party that can both pay for the plant as well as operate and maintain it.

[21] Interviews and analysis.

3.2.3 PRICING AND PAYMENT MECHANISMS

Depending on consumption and the pricing mechanism, consumers pay between US$1.7–10 (INR 100-600) per month for a DRE connection.[22] DRE enterprises that take up payment collection responsibilities use one of two models: a fixed tariff or a pay-as-you-go model (see Figure 17 below). In a fixed tariff model, households receive a standard offering and are charged a fixed amount at regular intervals (every month or week). This model is typically used by DRE enterprises with smaller consumer offerings (such as a few lights and mobile charging). In a prepaid pay-as-you-go model, households buy credits for the amount they want to consume – though there may be a cap on the amount any one household is allowed to consume. This model is more common among DRE enterprises that offer consumers the option to use more electricity. Enterprises mention the need for flexible consumption options given the non-homogeneity of the Indian rural landscape. Outside of these options, post-paid metering is not a common model because of the increased metering cost and the higher risk of payment default.

[22]Interviews with DRE enterprises.

Figure 17: Consumer pricing for DRE enterprises

	Company	Offering	Pricing mechanism	Average cost to consumer (US$ per month)
Fixed tariff	Mera Gaon Power	2 lights and a phone charger (8 hours per day)	US$0.50 per week	1.5
	Husk Power Systems	2 lights and a phone charger	US$2–3 per month	2-3
	OMC Power	2–9 lights or other products based on consumer need	US$2.50-11 per month	2.50-11
Pay as you go	Gram Power	Basic lighting and mobile charging (based on need)	US$1.50 per month + per unit consumption fee	3
	Naturetech Infra	Basic lighting and non-lighting products (24 hours)	US$0.50–0.67 per unit	1.50-5
	Gram Oorja	Basic lighting and non-lighting products (up to 1 unit per day)	US$0.25–0.33 per unit[1]	8-10

Post paid metering is not common among Indian off-grid utilities because of concerns around expenses for metering systems and risk of payment defaults.

Source: Dalberg interviews; company websites and online resources.
[1] Plant installation is subsidized by way of grants.

DRE enterprises are exploring new payment collection models; however most still collect payments through field collection agents. Some enterprises such as Mera Gao Power use field agents, but rather than collect from individuals, they have implemented a group collection model inspired by microfinance collection meetings. In this model, a collector goes to a village where groups of individuals, organized by the enterprise, pay during regular public meetings. Besides field collections, some DRE enterprises like NatureTech Infra and OMC have started using mobile payment systems. In this model, consumers can use SIM cards or their cellphones to buy credit for electricity and pay bills.

Though Indian DRE enterprises are aware of different payment collection models, skepticism and capacity constraints such as lack of working capital and access to mobile commerce technology prevent most from trying them. The Reserve Bank of India (RBI) requires all mobile transactions to be linked to a formal bank account. In rural areas, most poor households do not have bank accounts, making mobile payments challenging. Such regulations have historically made it difficult for mobile payment systems to gain traction in India.

There are some countries, especially in Africa, where mobile money is more mature and DRE companies have experimented with other payment models like scratch cards. In one model a DRE company sells prepaid scratch cards that have a pin on them. The consumer can call a number and enter the pin to access electricity. In Kenya, the Kenyan Power Authority sells power credits to MFIs, and the MFI then collects payments from the community like they would a loan. As mobile payments evolve in India, the successful models of DREs in Africa and elsewhere could be a source of innovation.

3.2.4 ADDRESSING CHALLENGES IN THE DRE SPACE

DRE companies face a number of risks that could prevent them from achieving meaningful scale. Some of these are outlined below:[23]

- **High capital expenditure.** Off-grid renewable energy DRE enterprises, more than 50% of which are solar, need significantly high initial investment in plant installation. Large DRE systems above 10 kW in size cost upwards of US$30,000. This has strong implications on recovery timelines at a utility level which tend to be longer, and is therefore a key barrier to scale for an enterprise. Government subsidies, although substantial, are difficult to obtain, and timelines for disbursement of funds are uncertain. So enterprises want little dependence on subsidies and express a strong need for long-tenure project finance.

- **High-interest costs.** Most firms and projects look for long-term financing products (typically 7-10 year tenures) due to difficulties involved in setting up and operating in the off-grid sector. However, banking institutions rarely provide these loans, and the perceived risk in the renewables sector and lack of adequate financial history for early stage enterprises makes access to financing even more difficult. Enterprises perceive the cost of standard financing products on the market (13-18% annually) to be too high and are looking for financing that is in the 7-14% range, based on the type of lender (foreign lenders, impact investors, commercial banks, etc.).

- **Potential for non-repayment.** Rural off-grid enterprises face traditional challenges of ensuring affordability as well as collecting regular payments from consumers. While

[23] Interviews with DRE enterprises.

enterprises benchmark prices to current traditional sources of lighting and offer a variety of payment schedules to ensure villagers are able to afford their service, collection of payments is time consuming and labor intensive. Payment collections can make up to around 50% of total operational costs. High default rates could have a significant impact on cash flow and profit margins, which is crucial to recover upfront investment faster.

- **Uncertainty around grid future connectivity.** The lack of clarity around the Indian government's grid extension plans has led to some skepticism about long-term viability of the DRE business model. DRE enterprises simply cannot compete with the lower, often subsidized cost of grid-electricity. Some enterprises, therefore, look only to operate in remote off-grid regions with low probability of grid extension. While grid compatible technology is available, none of the six DRE enterprises we interviewed for this report currently use it.

We have seen two business models that are able to successfully overcome these issues. The first is a B2C model providing households with a basic offering (lighting and mobile charging). Here, certain players have been able to reduce upfront capital costs to as little as US$1,000 by reducing plant size, and have ensured strong collection rates due to the affordability of the basic service.

The second model is a B2B + B2C model, where the DRE enterprise sells electricity to a commercial consumer (alongside households) who serves as an anchor client. Commercial clients can provide a stable revenue stream for the DRE operators and some companies have said that the revenue from the anchor load can even cover the annual operating expenses of the DRE utility.

Small utility B2C models

B2C companies can ensure a large market because they offer basic lighting services to households at a price competitive to that of kerosene. On average, un-electrified, rural households spend US$2-3 per month on kerosene. For US$1.70-2 per month, an off-grid consumer can get basic lighting and mobile charging for seven hours a day from a Pico power DRE enterprise (see Figure 18 below). With this model, consumers can simply replace an existing cost in their budget for a more convenient, and often more reliable service. For this reason, these models can reach many poor consumers in a short amount of time. The offering is affordable, and when combined with effective payment collection mechanisms, can ensure relatively high payment collection rates for the enterprise.

These companies are reducing plant size to keep capex to a minimum – the 240 W model, for example, costs only US$1,000 and can recover costs in 1-2 years.[24] Pico power DREs have solved the problem of high capex costs, by simply building smaller plants which cost less. They build plants large enough to provide basic electricity and mobile charging to 30-50 households in a small village. These plants have high operating profits (close to 70-75% of annual plant revenues) and can recover the initial investment in two to three years. Furthermore, because the cost of building a new plant is small, these B2C enterprises can grow rapidly by building more plants. Figure 19 shows the economics for a 240 W plant which costs US$1,000 and provides electricity to 30 households.[25]

[24] Interviews and analysis.

[25] Assumes a 95% collection rate and a monthly tariff between USD 1.70 - USD 2.5 per month.

Figure 18: B2C DRE model

Business model and consumer offering

240 – 1 kW plants

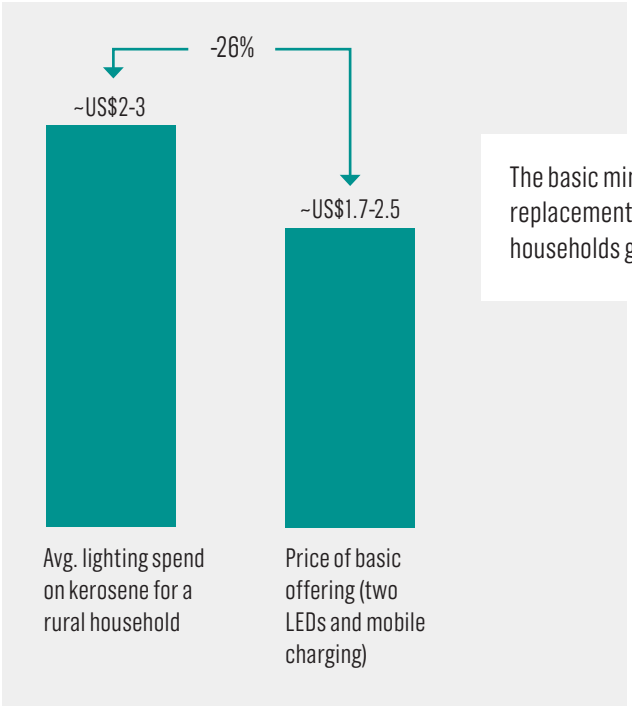
- Cost of asset: US$1,000-3,500
- Build-own-operate-maintain plants

30-50 households

One plant for a small village, multiple plants for larger villages

- Electricity supply for 6-8 hours per day per household
- Basic consumer offering that includes two LEDs and a mobile charging point
- Connection costs between US$8-16

Cost of DRE service for a household (US$ per month)



The basic mini-grid offering can be a total replacement of kerosene for mid-low income households given its competitive pricing.

Source: Interviews and analysis; company websites and online resources.

CASE STUDY

MERA GAO POWER CASE STUDY

Scaling small plants: Mera Gao Power

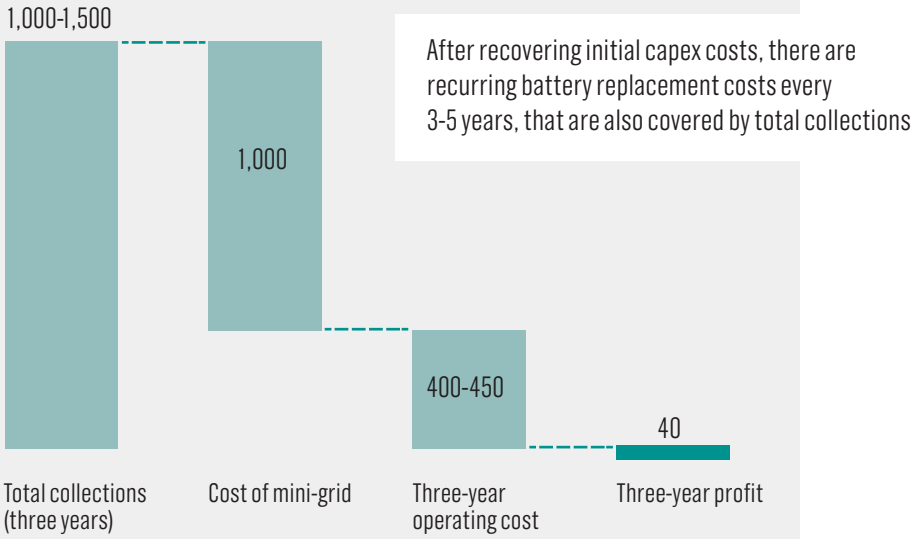
Mera Gao Power (MGP) is a build-operate-own-maintain (BOOM) solar DRE enterprise that operates in Western Uttar Pradesh. The enterprise currently owns and operates over 1,000 plants. Each plant has an installed capacity of 240 W and can provide power to a village of 30-100 households. Mera Gao offers each household two LED lights and mobile charging for seven hours a day for around US$0.42 a week or US$1.70 a month.

MGP collects payments from households by employing a human collection agent. Households using MGP's service are organized into groups similar to those formed by some microfinance institutions for loan collections. Households make their weekly payments in public meetings in front of their group. This model of group collection increases the social pressure to pay and lowers non-payment rates.

The plants built by MGP cost less than US$1,000 to build and can be built and made operational in just one day. Villagers find MGP's proposition attractive, because the cost of their service is less than the amount households pay for kerosene. Over the last two years MGP has almost tripled in size. This model is scalable due to the speed at which a plant can be built, made operational, and find customers to run the plant at optimal utilization. With low capital investment, Mera Gao can build plants quickly and expand into many villages.

Source: Interviews with enterprises and analysis

Figure 19: Illustrative economics for a 240 W plant providing basic lighting and charging (US$)



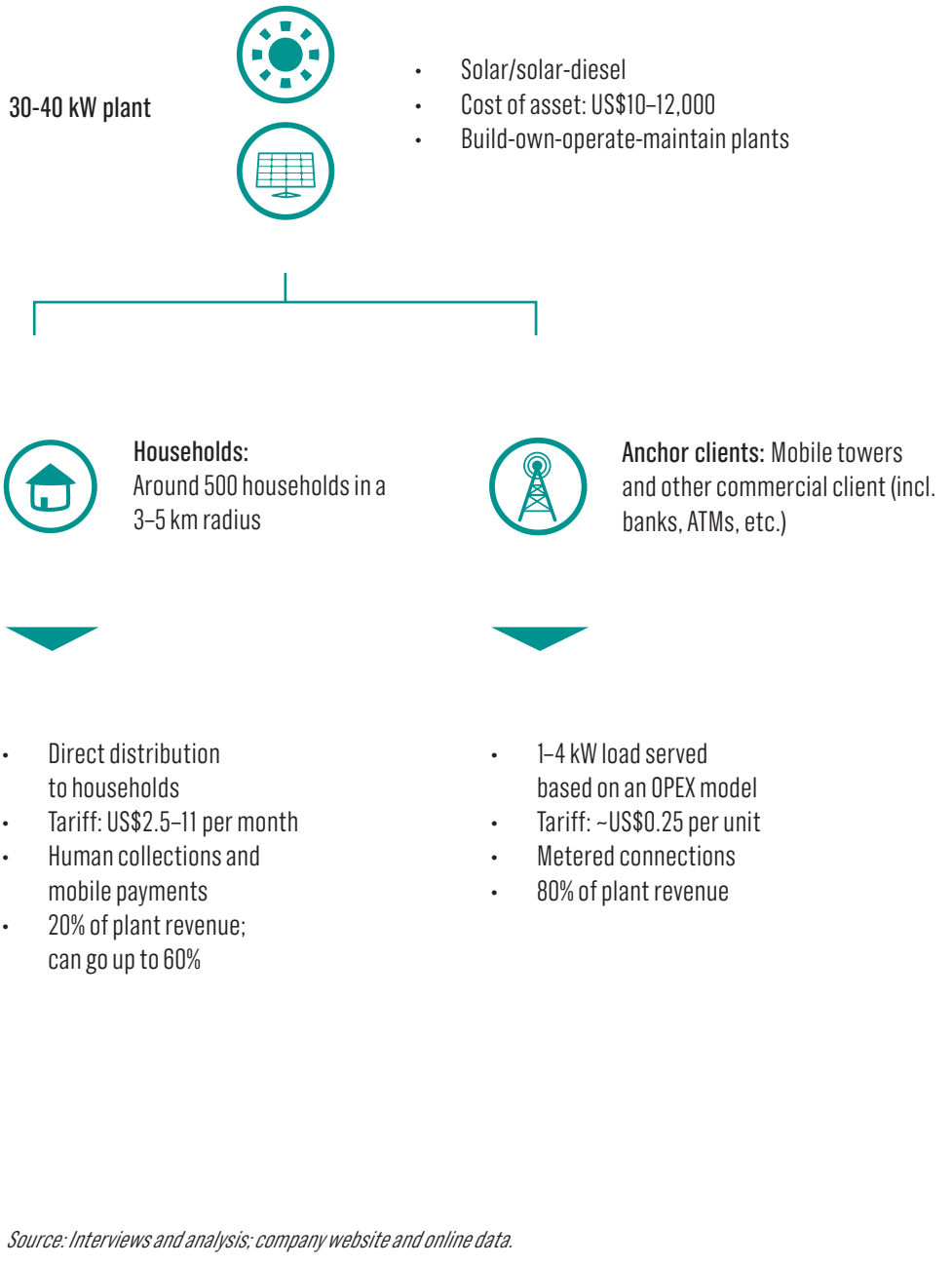
Source: Interviews and analysis; company websites and online resources.

B2B + B2C DRE models

B2B enterprises reduce risk by ensuring stable revenues from an anchor client. At the other end of the spectrum, large DRE operators have enough installed capacity to provide electricity to commercial clients like telecom towers, ATMs and petrol pumps, alongside rural households. The plants built by B2B players will typically have installed capacities greater than 25 kW. These clients can be used as anchor clients who provide stable demand and cash flow to the DRE enterprise because electricity is sold to anchor clients on a longer-term contract basis.

Figure 20: Overview of a B2B + B2C DRE offering

Overview of a B2B + B2C mini-grid offering

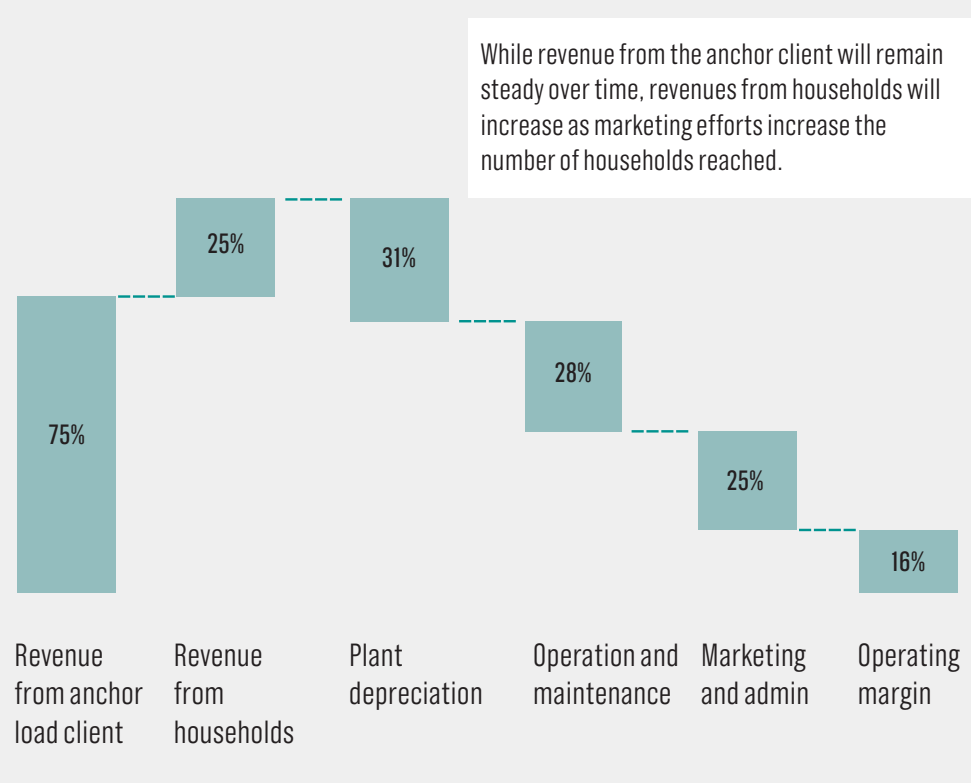


Source: Interviews and analysis; company website and online data.

The combination of B2B and B2C means the DRE enterprises can have stable revenues from the anchor client and also the ability to pursue larger profit margins from households. Anchor clients typically sign long term agreements to buy power at a price that is competitive with sources of energy such as diesel. Annual revenues from the anchor load can cover most of the operating expenses of the plant (see Figure 21). Profit margins for household consumers on the other hand are higher, given households pay a higher per unit cost, which is often benchmarked to traditional sources of lighting such as kerosene. As an established plant gains more household users over time, the plant will make bigger profits.

Figure 21: Illustrative unit level economics of a year one plant with anchor load[26]

Illustrative unit level economics of a year one plant with anchor load (25–50 kW)
(% of total revenue)



Source: Interviews and analysis; company website and online data.

[26]Assumes a 40 kW plant with a single anchor client requiring 4 kW, paying Rs. 20 per unit, connection cost of Rs. 500 (US$8) and monthly tariff of Rs. 150 (US$2.5) for household offering. Also assumes 20 year plant life, with 10% residual value and an initial cost of plant at ~US$100,000. Battery is replaced every five years and O&M costs are 4% of total capex (est. based on industry benchmarks), while marketing and administrative costs are 10% and 15% respectively.

SOLAR IS MORE PREVALENT BECAUSE CURRENT REGULATIONS FAVOR SOLAR ENERGY OVER ALTERNATIVE FORMS OF RENEWABLE ENERGY

CASE STUDY

OMC POWER CASE STUDY

Anchor loads and community lighting: OMC Power

OMC Power was founded in 2011 as a mini-power, mini-grid enterprise. It builds, owns, operates, and maintains solar plants with an installed capacity greater than 25 kW. OMC is unique because it has been able to use rural telecom towers as anchor clients. Telecom companies in India will sign a contract with OMC to provide their mobile towers with electricity for a certain period of time, at a pre-determined price.

With the excess power generated from these plants, OMC reaches local communities who do not have access to grid-power. In these villages, OMC either connects households directly to their plants or hires a local village level entrepreneur (VLE). VLEs are often unemployed villagers or those with extra time for a side business. This entrepreneur will charge and rent out various consumer products like lanterns, fans and TVs and provide battery charging for mobiles and electric vehicles.

Given large contracts with anchor loads such as mobile towers, OMC has stable revenues that are likely to cover operational costs of the plant. OMC has been able to secure long term contracts with mobile tower companies, due to a strong management team that has significant experience in the telecom sector. The revenue stream from mobile towers is substantial and can help OMC break even faster than most other DRE utilities. OMC has thus been able to prove investor attractiveness and raised commercial funding to match ambitious growth targets of 260% over the next year.

Source: Interviews and analysis.

3.2.5 EVOLUTION OF THE DRE MARKET

DRE companies are exploring new technologies to increase operational efficiency. For commercial viability, it is crucial DRE enterprises have substantial cash flows that can recover high upfront installation costs. Increased operating profits mean a quicker break-even time for individual plants. For example, DRE companies have started to invest in payment technologies (such as smart metering and mobile payments) that automate the collection process. For off-grid DRE enterprises, payment collection has been a time consuming and labor-intensive process. Some DRE enterprises report a 60% reduction in collection costs through better payment systems.[27] The two newest innovations in the Indian market have been smart, wireless metering, and mobile payments (see Figure 22).

Other technology includes power management devices, networked meters, energy management software and mobile money payment processing.[28] Energy-as-a-service models require the deployment of low-cost DC power management devices which can monitor power usage and distribution. When combined with integrated energy management software like those that support mobile money payments and direct, over-the-air recharge of the customer's system, enterprises can create fully automated power management and payment collection systems. These systems greatly increase efficiency and lower overhead costs. The Climate Group and ISEP's[29] "Scoping Study on intersection of ICT and off-grid energy access in India" examines the role of information and communications technology (ICT) in enabling off-grid energy services, and details market opportunities and current challenges.

The ability to incorporate the latest technology is a skill that organizations looking to grow must develop. The most successful organizations will be the ones who have relevant expertise on their management team that enables them to stay abreast of new technology and effectively implement relevant solutions.

[27] Interviews and analysis.
[28] The Climate Group and ISEP, 2014.
[29] ICTs for Sustainable Energy Partnerships.

Figure 22: New payment and collection technology

Types of innovative technology for off-grid systems

SMART METERING

- Meters are wireless and can be monitored remotely
- Allows for pre/post pay as you go payments
- Power can be cut off remotely
- Example: Gram Power, Naturetech Infra, Simpa Networks

MOBILE PAYMENTS

- A SIM card is added to meter
- Consumers can buy prepaid credit
- Payment can be made by mobile phone
- Example: Naturetech Infra, OMC Power, Simpa Networks

Smart metering image credit: grampower.com.
Mobile payments image credit: exclusiveafrica.net.

Rural infrastructure is growing, offering a vibrant market for B2B energy services. Currently, commercial enterprises operating in off-grid or under-electrified regions rely on expensive diesel for electricity generation. These enterprises include mobile towers, ATMs, petrol pumps and other entities. The network of these rural establishments is likely to grow at rates between 5-20%.[30] These businesses also require substantial amounts of uninterrupted electricity, making them perfect for use as anchor clients.

DRE enterprises can find anchor clients and other sources of stable revenues through effective partnerships. Having management with experience in the anchor client sector will help organizations identify potential partners and develop long term relationships that can be turned into sales. Enterprises need to have an understanding of the anchor client's business so they can show how a DRE offering will be of benefit. Besides commercial clients, DRE enterprises are partnering with governments and large NGOs. These partnerships result in large contracts for building DRE plants and can lead to a steady pipeline for future business.

3.2.6 MARKET SIZE AND IMPACT

We conservatively estimate the B2C market size to grow to US$45 million by 2018. In 2014, around 100,000 households were served by a DRE utility[31] By 2018, the B2C market will grow to almost 900,000 households. Assuming an average monthly tariff of US$5 per household, this means B2C DRE enterprises made US$6 million in revenues in 2014, and could make close to US$45 million in revenues in 2018. Much of the growth in the B2C market will be driven by Pico power players who have smaller offerings but can reach many more households at a lower cost than DRE enterprises who deploy larger plants.

[31]Current number of households and market size is calculated based on numbers for the largest public and private DRE enterprises and projecting them forwards using historical and projected growth rates; An average monthly tariff rate of USD 5/household is used.

Currently the B2B market for rural DRE systems is small, but will drive growth in the future. We estimate that only 71 rural mobile towers are served by DRE systems, making a little more than US$150,000 in revenues.[32] However, we expect there to be rapid growth in the next five years. The Indian government has required telecom companies to migrate 50% of all rural cell towers to renewable or hybrid power by 2015. This would translate to over 120,000 towers and a B2B market worth ~US$500 million. Even at just 10% penetration of mobile towers, we expect DRE systems to serve over 33,000 mobile towers, generating more than US$95 million in revenues by 2018.

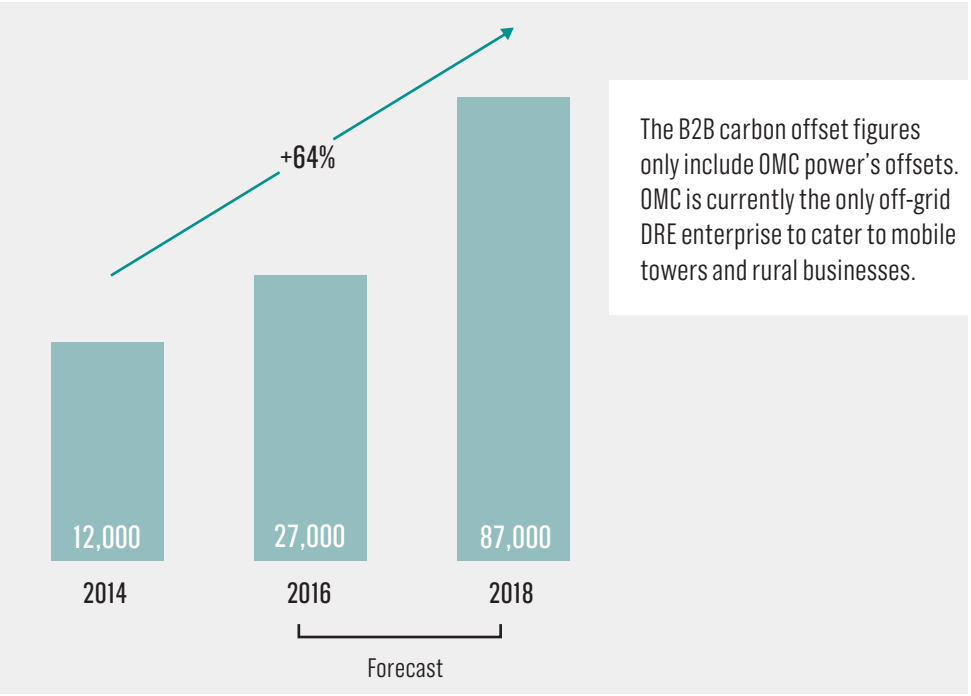
The electricity offerings of DRE players often replace kerosene use for households and diesel use for rural businesses. Both of these energy sources are large emitters of carbon. In 2014, the Indian B2B and B2C DRE market offset 12,000 tons of CO_2[33] equivalent. By 2018 this number will be more than 87,000 tons (see Figure 23) but could be even higher if government mandates for rural telecom towers are adhered to and more players enter the DRE space. DRE enterprises provided electricity access to 100,000 households in 2014. Access to electricity has helped micro-entrepreneurs and businesses improve productivity and incomes. In addition to this, construction, operations and maintenance of plants is likely to contribute to local income generation. We estimate that this extra economic activity added US$7 million dollars to local rural economies in 2014.[34]

WE CONSERVATIVELY ESTIMATE THE B2C MARKET SIZE TO GROW TO US$45 MILLION BY 2018

[32]Revenue is based on average demand of underserved towers of ~7,000 units a year and tariff rates of US$0.33 /unit likely to escalate at 5% annually.
[33]Compared to electricity/light generated from diesel or kerosene.
[34]Sum of 3 sources: a) money added to local economy through job creation, b) extra business income, and c) savings from switching away from kerosene. a) money added to the local economy is calculated as the amount spent locally for installation of new plants (10% of new capex and the amount spent locally for operations (2% of total existing capex) (~US$3million); b) uses a conservative estimate of the average monthly increase in income (US$3/month) that results from electricity access (IEG), multiplied by the 51% of households who are self-employed (~US$3 million); c) uses the number of households who pay less than the average amount spent on kerosene (US$3/month) for DRE electricity and multiplies that number by the amount saved per month by switching from kerosene (~US$1 million).

Figure 23: Environmental and social impact of Indian DRE enterprises

Environmental impact of Indian DRE markets: B2B and B2C (tons of CO_2 equivalent[1] avoided annually)



Current social impact (2014)

100,000 off-grid households have access to at least six hours of electricity per day

120 million additional hours of studying every year for close to 340,000 children[2]

US$7 million in additional income[3] for the local economy

Source: Analysis and interviews, NIRS, Impact Evaluation Group.
[1] As compared to electricity/light generation through diesel or kerosene.
[2] Calculated using the average number of children per household multiplied by the average number of extra hours of studying that results from electricity access.
[3] Sum of 3 sources: a) money added to local economy through job creation, b) extra business income, and c) savings from switching away from kerosene. a) money added to the local economy is calculated as the amount spent locally for installation of new plants (10% of new capex and the amount spent locally for operations (2% of total existing capex) (~US$3million); b) uses a conservative estimate of the average monthly increase in income (US$3 per month) that results from electricity access (IEG), multiplied by the 51% of households who are self-employed (~US$3 million); c) uses the number of households who pay less than the average amount spent on kerosene (Rs. 190/month) for mini-grid electricity and multiplies that number by the amount saved per month by switching from kerosene (~US$1 million).

IN 2014, THE INDIAN B2B AND B2C DRE MARKET OFFSET 12,000 TONS OF CO2 EQUIVALENT. BY 2018 THIS NUMBER WILL BE MORE THAN 87,000 TONS

INVESTORS AND OTHER PRIVATE SECTOR PLAYERS HAVE A SIGNIFICANT ROLE TO PLAY IN IDENTIFYING AND HELPING SCALE THE MOST PROMISING ENTERPRISES AS WELL AS IN ACCELERATING THE GROWTH OF THE OVERALL SECTOR

FOUR

4. POLICY ENVIRONMENT AND THE CASE FOR PRIVATE SECTOR INVESTMENT

4.1 GOVERNMENT POLICIES AND IMPLEMENTATION PROGRESS

Several policies have been designed to support rural electrification over the last 10 years, with a focus on decentralized models such as DRE utilities. Over and above efforts to extend the grid to rural areas, the government has initiated a number of important programs (see Table 1). Through de-licensing of electricity generation and distribution in rural areas, dedicated funding for R&D and clean energy ventures, as well as targeted programs for renewable energy (solar and wind) and decentralized systems such as the Jawaharlal Nehru Solar Mission and the National Wind Energy Mission, the Government of India has shown intent to promote renewable energy solutions.

Table 1: Key Indian government initiatives in rural electrification

Initiative	Implementing agency	Implementing agency for OGE businesses
Electricity Act 2003	Ministry of Power (MoP)	• Removed the need for licenses in order to generate power (in all areas) and distribute power (in rural areas only). • Allowed OGE businesses to more easily provide an alternative source of electricity.
Remote Village Electrification Program (RVEP) 2005	Ministry of New and Renewable Energy (MNRE)	• Initially supported the distribution of solar lanterns and home systems in remote villages. • Currently supports mini-grid installations in villages not covered under the central grid extension scheme and operated by VECs (Village Elected Councils). • Provided subsidies for villages to install DRE utilities up to 90%.
Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) 2005	Ministry of Power (MoP)	• Decentralized distributed generation (DDG) scheme outlined the importance of off-grid projects in areas where grid-extension was not considered feasible. • Provided subsidies to encourage off-grid franchise based projects in these areas.
Village Energy Security Program (VESP) 2005 - 2012	Ministry of New and Renewable Energy (MNRE)	• Capital subsidies of up to 90% offered to set up biomass-gasifier based DRE systems in off-grid regions. • Focus was on community partnerships and ownership of assets. • Demonstrated benefits of community-based models.
Jawaharlal Nehru National Solar Mission (JNNSM) 2010	Ministry of New and Renewable Energy (MNRE)	• In addition to an ambitious 20,000 MW target for grid-connected solar PV systems it aims to install 2,000 MW of off-grid solar PV systems, especially for providing electricity access. • The program offers capital subsidies for installation of solar plants. • Created the Indian Renewable Energy Development Agency (IREDA) responsible for re-financing solar energy projects. • Funding for subsidies (30%-90%) available for installing planned capacity. • Refinancing facility (IREDA) available to banks who provide loans to OGE enterprises and allow for low interest rates of less than 5%.

While multiple initiatives to encourage off-grid capacity have been announced, their implementation has been slow. For instance, JNNSM targeted the installation of 200 MW of off-grid solar by 2013. However, few, if any off-grid projects were completed, as the first phase of JNNSM (2010-2013) focused almost entirely on grid-connected projects. MNRE has announced ambitious targets for its new National Wind Energy Mission (100 GW of installed capacity by 2022) but feasibility of on-the-ground implementation remains to be seen.[35]

The government has also started initiatives such as the National Clean Energy Fund, but little funding has been disbursed to date.[36] In 2011, the National Clean Energy Fund was established to fund projects and research in renewable energy. The initiative taxes coal production to create a corpus of funds that would be available to government, public, and private sector players in the form of loans or viability gap funding for up to 40% of the total project cost. In 2014, the tax on coal was doubled to US$1.50 per metric ton of coal produced. This would mean that the fund which is already at US$2 billion would grow at more than US$1 billion per year. In spite of this, little funding has made it to projects due to a number of challenges in fund allocation. The fund is managed by the Ministry of Finance, but projects are approved by an inter-ministerial group (IMG). The Ministry of Finance has been slow to move money to the public account accessible to the IMG, to help the government understate overall budget shortfalls.[37] In addition, projects must be sponsored by an existing ministry or department of government, and as a result most approved funding has been for MNRE projects of the JNNSM and the National Wind Energy Mission. This requirement makes it difficult for private companies to make use of these funds without government connections.

In 2014, the government broadened the potential use for the fund from just clean energy to any clean environment project, which will limit the amount of funds that are available to off-grid renewable projects.

Recognizing the policy issues in the renewable energy sector, the Government of India plans to introduce a comprehensive Renewable Energy Act in 2015, to attract investment into the sector. The MNRE is organizing a Renewable Energy Global Investors Meet and Expo in February 2015. Right before this expo, the government plans to introduce an act that will clarify the regulations for renewable energy generation and distribution in India.[38] Currently, all renewable energy projects are governed by the 2003 Electricity Act. However, this act was made with traditional energy sources in mind. The new Renewable Energy Act would create a new framework to govern renewable energy and would include provisions to encourage investment in the sector. In addition, the government is asking the Reserve Bank of India to name renewable energy as a priority lending sector.

WHILE MULTIPLE INITIATIVES TO ENCOURAGE OFF-GRID CAPACITY HAVE BEEN ANNOUNCED, THEIR IMPLEMENTATION HAS BEEN SLOW

[35]Ministry of New and Renewable Energy (MNRE), Government of India.
[36]Press Information Bureau of India.
[37]CAG Audit Report 2013.
[38]VCCIRCLE.

In addition, the government can expand the REC (renewable energy certificates) mechanism to include smaller OGE enterprises and provide greater clarity around grid connectivity. Recently, the government allowed off-grid enterprises to receive and sell renewable energy certificates (RECs). The REC program was designed to help state electric companies and other institutions meet their renewable energy purchase obligations (RPOs). Enterprises who generate power from renewable sources are issued RECs which they can sell to institutions for fulfilment of RPOs. However, the registration and monitoring costs of REC issuance are too high for small and medium sized off-grid enterprises. Larger OGE enterprises might find RECs an attractive way of increasing the return on their investment. Furthermore, bundling of smaller projects could open the door for RECs to smaller OGE enterprises as well.

If an expanded REC policy is combined with greater clarity on feed-in tariffs and grid interactivity, then OGE solutions can become a complement rather than a competitor of grid electricity.
Currently, there is a perception that grid-extension is a large risk to off-grid energy enterprises. However, clearer policy around grid interactivity and RECs could make off-grid solutions a way of supporting the grid. Given the right incentives and policy environment, off-grid energy can become an important component in India's overall energy portfolio rather than being seen as only a stop-gap solution.

IF AN EXPANDED REC POLICY IS COMBINED WITH GREATER CLARITY ON FEED-IN TARIFFS AND GRID INTERACTIVITY, THEN OGE SOLUTIONS CAN BECOME A COMPLEMENT RATHER THAN A COMPETITOR OF GRID ELECTRICITY

GIVEN RENEWABLE ENERGY TARGETS SET BY THE GOVERNMENT, THERE IS A NEED FOR GREATER PRIVATE SECTOR INVOLVEMENT IN THE SPACE

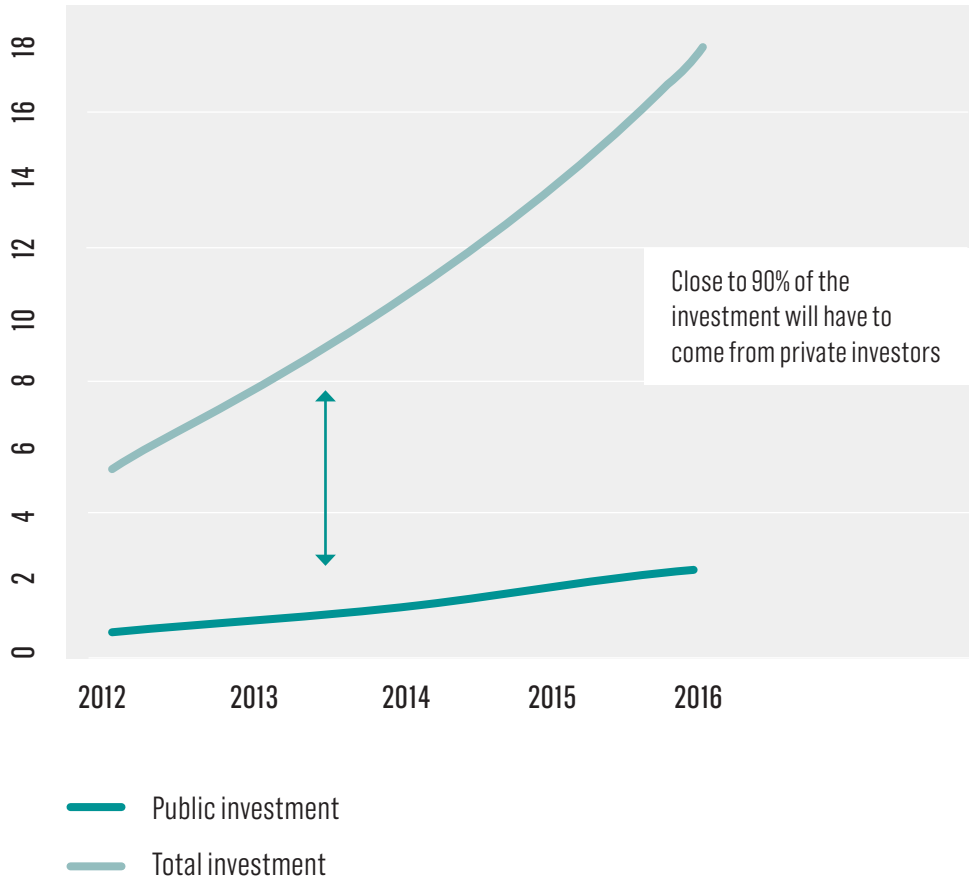
4.2 NEED FOR PRIVATE SECTOR INVOLVEMENT

Given renewable energy targets set by the government, there is a need for greater private sector involvement in the space. The Indian government has said that energy investment to keep up with population growth and expand access to off-grid households will need to total US$250 billion over the next five years.[39] Of this amount, US$100 billion will need to be investment in renewable energy. According to the Planning Commission, this means that India's annual investments in renewable energy would need to grow to US$18 billion by 2016. However, public sector investment is likely to grow to only US$2 billion by that year (see Figure 24). Therefore, close to 90% of renewable energy investment, US$16 billion, will have to come from the private sector.[40]

SMALLER INVESTMENTS IN THE OFF-GRID SPACE ARE GROWING

Figure 24: Expected investment in renewable energy in India

Required investment in RE infrastructure to achieve RE targets (US$ billion)



Source: Planning Commission, http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol1.pdf; http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol2.pdf exchange rate assumed INR60/USD; Global Trends in Renewable Energy Investment 2013, BNEF; Dalberg analysis
The Climate Policy Initiative, Meeting India's Renewable Energy Targets.

[39]Reuters 2014.
[40]Planning commission, Government of India.

Though only a small portion of the needed US$7.3 billion was invested in off-grid renewable energy in 2013, smaller investments in off-grid space are growing.[41] In 2013, US$7.3 billion was invested in the Indian renewable energy market. Most of this was in large grid-connected power plants. Furthermore, investment in the off-grid space has largely been from impact investors, and range from US$100,000 to US$5 million.[42] However, as off-grid enterprises have begun to scale, they have been seeking larger investments from the private sector. The need for investment and the growth potential of off-grid energy enterprises presents a promising opportunity for private capital.

Table 2: Examples of private sector investments in the off-grid renewable energy space

FUND	INVESTMENT
Acumen	A total of US$5 million invested in D Light, Avani Bio Energy, Husk Power Systems and Orb Energy
Bamboo Finance	Joined forces with Ashoka and the Canopus Foundation to launch the solar energy fund "Solar for all". Size of investments range from US$0.4-4 million
Ennovent	Investment in Barefoot Power
Invested Development	Clean technology focused investments in Simpa Networks and Promethean Power Systems
LGT Venture Philanthropy	Investment in Husk Power Systems of US$300,000 with three other VP funds
Unitus Group	Investment in Simpa Networks
Ventureast	Bharat Light and Power and Intelizon Energy
Firstlight Ventures	Investment in Promethean Power Systems, Anthro Power and Excellent Renewable

Source: Organization websites; The Economic Times; Yourstory.com.

[41] Bloomberg new energy finance; Planning commission data, Government of India.
[42] Enterprises websites, interviews.

Investments in the off-grid energy space have largely been restricted to equity instruments, and debt remains the primary unmet need for off-grid enterprises. These investments have come from impact investors, development banks, and donor/government agencies. Few enterprises have been able to raise large scale equity investments. For example, Simpa Networks received a US$2 million equity infusion from the Asian Development Bank in 2013. Given the need for raising inexpensive debt, some enterprises are considering approaching foreign lenders. However, companies who have no off-shore offices find it hard to raise foreign debt because of regulatory requirements. The following section elaborates on some of the challenges that need to be overcome.

4.3 CHALLENGES FOR INVESTMENT

Given fragmented policy, off-grid enterprises and investors have found it hard to tap into this opportunity. There have been a number of challenges in implementing subsidies to encourage investment in the off-grid energy space. Applications for such subsidies require a large amount of paperwork and must go through several layers of bureaucracy before they are approved. Even then, subsidies are often delayed or not disbursed at all to implementing banks. For many enterprises these delays result in liquidity constraints, placing pressure on the day-to-day operations of their business.

Incentives for lending to OGE enterprises are undermined by other regulations in domestic and foreign lending. There are incentives for foreign and domestic lending to OGE enterprises, some of which are outlined in Figure 25.

However, there are many challenges to both receiving loans as an OGE enterprise and in lending to OGE enterprises. According to those interviewed, enterprises face interest rates of 13-18% in the domestic market, which are perceived as prohibitively high. On the other hand, foreign lenders such as impact investors have a hard time getting RBI approval to lend in the Indian market. Foreign loans can also only be used on a project basis. So enterprises must look elsewhere to finance needs such as working capital. Most banks are not willing to lend to OGE enterprises even at higher interest rates because the ticket sizes of loans is too small. Banks and other financial institutions willing to lend to OGE enterprises have found it difficult and time consuming to get approval for projects and apply for benefits like subsidies. Due to these difficulties, most OGE enterprises raise funds through a mixture of grants and equity.

Figure 25: Incentives for lending

	POLICY	INCENTIVE TO LEND	CHALLENGES IN LENDING
Domestic and foreign banks in India	Priority sector lending	• 40% of bank lending must be to "priority sectors" (as defined by RBI[1]) which include off-grid renewable energy.	• There is little priority sector lending for OGEs given perceived risk. • Applying for refinancing is time consuming. Benefits are often delayed. • Interest rates are too high for most OGE enterprises.
	IREDA[2] refinancing	• Refinancing facility is available for loans made to off-grid solar projects.	
Foreign lending	Rupee loans	Foreign lenders can give Rupee loans to enterprises through currency swaps.	• RBI approval is very difficult and time consuming unless foreign lender is large institution or significant equity holder of borrower.
	Repatriation	Funds are completely repatriable (as compared to equity which has restricted repatriability).	• Foreign loans can be used for project finance but not working capital.

Given these challenges, OGE enterprises have mostly used equity to raise funds.

Source: Analysis, NitishDesai Associates, RBI, Partnership to Accelerate Clean Energy Program (USAID).
[1] Reserve Bank of India.
[2] Indian Renewable Energy Development Agency.
[3] Jawaharlal Nehru National Solar Mission.

Lack of reliable data and little technical expertise makes financial institutions wary of investing in an unknown space. For most traditional financial institutions, renewable energy is not a space they have historically invested in. The lack of quality data in the public domain on the current gap between demand and supply, benchmarks on costs and projected returns, and case studies of successful renewables enterprises has discouraged investors – especially commercial investors. Combined with a lack of internal expertise to evaluate renewable energy firms, this makes financial institutions less willing to invest in renewable energy products. Financial institutions do not understand the nuances of the market, including viability of different technologies, implications of different business models and ways to assess future profitability of specific investments. Because of the low perceived value of the sector, financial institutions are not prioritizing it as an area to develop technical expertise.

In addition, government policy and plans around grid-extension and potential for interactivity with DRE utilities are still unclear. It is difficult to find out when and where the government will actually extend the grid and whether such extension can be complemented by off-grid solutions like DRE utilities. OGE enterprises cannot directly compete with cheaper, subsidized grid power, and in many cases would face substantial losses if the grid were extended to areas where they operate. This risk makes financial institutions even more hesitant to finance renewable energy projects and firms.

4.4 SPECIFIC FINANCING NEEDS OF OGE ENTERPRISES

The majority of OGE enterprises express a need for long tenure finance and debt. Debt financing is the primary unmet need in the OGE sector. DRE enterprises need long term debt and soft loans to finance expansion and scale up, while SHS enterprises are looking to cover working capital needs and operational costs through debt. While requirements for SHS enterprises are small at US$200,000 to US$3 million, individual DRE enterprises have expressed debt financing needs of up to US$25 million.[43] Due to high costs of debt in India, a few enterprises are also actively exploring sources of foreign debt.

Potential financial solutions in the rural off-grid space need to be designed keeping in mind certain constraints faced by enterprises. OGE enterprises face several challenges in accessing enterprise finance. Some of these are outlined below.

- **Little historical performance data.** Enterprises in this space are still in their early stages of growth. As a result, they have little historical data on cash flows. However, most domestic banks require at least three years of positive cash flows, detailed credit histories, as well as profitability before they are willing to lend.
- **Irregular cash flows.** In addition, difficulties in rural operations and collection of payments as well as seasonal variations result in unstable cash flows that often affect repayment ability. Any potential financial solution for this space must be flexible in its requirements to show recent history of profitability and positive cash flow.
- **No secondary market for assets.** Assets held by OGE enterprises would include inventory, equipment, and plant utilities for DRE enterprises. Since these assets are illiquid (they can't be sold quickly) and do not have developed secondary markets associated with them, they are generally not accepted as collateral by domestic financial institutions. This means potential financing solutions would need to be able to accept such assets as collateral or be able to find other ways of backing the financial product and managing the associated credit risk.
- **Regulatory concerns.** Any potential solution also needs to be feasible under RBI regulations for financial products. As mentioned in section 4.3, RBI regulations have made it difficult for OGE enterprises to get domestic and foreign debt, especially for working capital purposes.

THE MAJORITY OF OGE ENTERPRISES EXPRESS A NEED FOR LONG TENURE FINANCE AND DEBT

[43] Interviews with off-grid enterprises.

PRIVATE SECTOR PLAYERS CAN HELP INDIVIDUAL OGE ENTERPRISES BY ADDRESSING THE KEY NEED FOR AFFORDABLE, LONG TENURE FINANCE AND DEBT

While private sector players are well placed to address some of these challenges through innovative financing products, they need support in developing an improved understanding of the off-grid space, high potential business models, and evaluation methodology for investments in the space.

Companies have evaluated the potential for carbon financing but have not found it to be attractive given the low cost of carbon credits and the high cost of carbon project preparation. The primary source of carbon revenue for Indian enterprises is the regulated clean development mechanism (CDM) market. The price of carbon offsets (CERs) are currently less than US$1 per metric ton of CO_2 equivalent, given low demand from developed country buyers. At this price the entire carbon market for the Indian off-grid space is only worth ~US$50,000 today and likely to grow to ~US$320,000 by 2018. SHS and DRE enterprises therefore do not see carbon finance as a substantial revenue stream in the near future. Also, costs to just register, audit and receive credits are far greater than receivable carbon financing for an Indian OGE enterprise. Potential solutions to address these challenges could include innovative ways of aggregating multiple projects, and lowering associated costs to monitor and evaluate projects through standardized procedures and benchmarks.

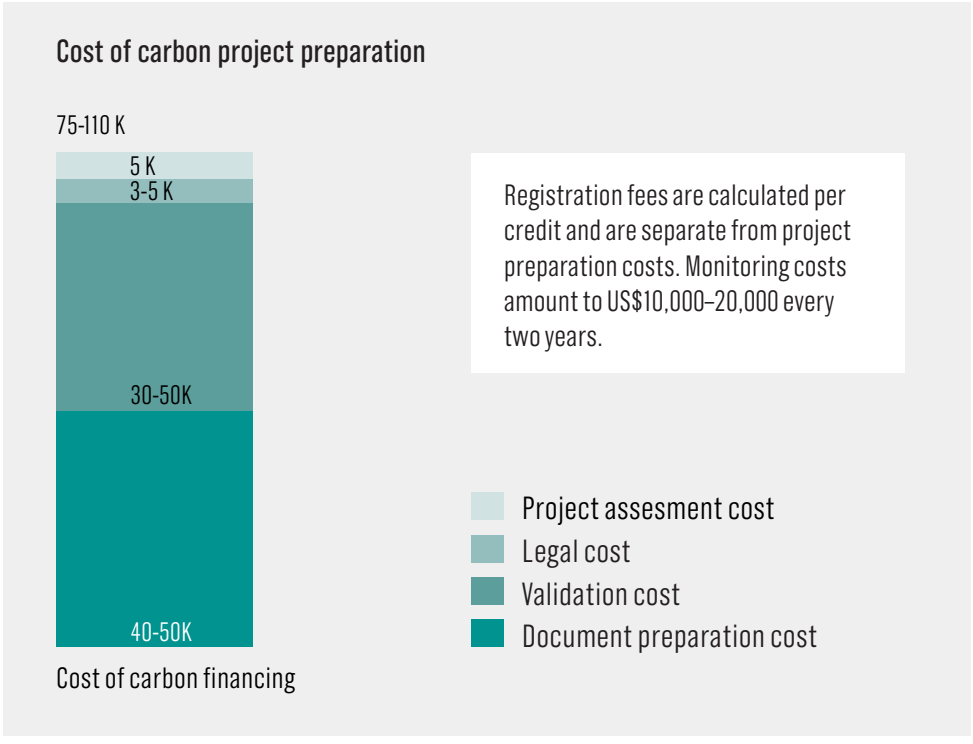
Voluntary carbon markets are significantly smaller than the CDM market and typically target larger carbon offsetting projects. In 2008, 46% of the transaction volume for the voluntary market was generated by large projects (more than 500,000 tCO2 per year).[44] To put this in perspective, an off-grid 500 kW plant will offset close to around 550 tCO2 a year. The willingness of voluntary market buyers to fund smaller projects is therefore unclear.

[44]Overseas Development Institute (ODI).

GOVERNMENT POLICY AND PLANS AROUND GRID-EXTENSION AND POTENTIAL FOR INTERACTIVITY WITH DRE UTILITIES ARE STILL UNCLEAR

Figure 26: Cost of carbon financing

Yearly cost of and potential funding through carbon financing[1] (2014) (US$=)



COMPANIES HAVE EVALUATED THE POTENTIAL FOR CARBON FINANCING BUT HAVE NOT FOUND IT TO BE ATTRACTIVE

Source: Interviews with enterprises; Department of Parliamentary Services, Australia.
[1] Uses a carbon emissions reduction (CER) Price of $0.65-$1/tCO$_2$

FIVE

5. RECOMMENDATIONS TO DRIVE MARKET GROWTH

5.1 PROMOTING PRIVATE SECTOR FINANCING

Financial players currently active in the off-grid renewable energy sector include impact investors, public sector banks and development finance institutions. Impact investors (e.g., Bamboo Finance) have been actively involved in the off-grid space and show an inclination to increase equity investments in the sector. Public sector banks (e.g., State Bank of India) have primarily been involved in disbursing debt products, while multilateral banks (e.g., Asian Development Bank) have established credit lines to government bodies such as SIDBI[45] and IREDA,[46] and have also made equity investments in high potential enterprises.

INNOVATIVE FINANCIAL INSTRUMENTS MAY BE SUITABLE ALTERNATIVES TO TRADITIONAL DEBT OR EQUITY INVESTMENTS

Private sector players can help individual OGE enterprises by addressing the key need for affordable, long tenure finance:

- **Long term debt and soft loans.** Early stage OGE enterprises are looking for financing products with a flexible tenure (typically 5-10 year tenure) and low interest rates. Solar home system players specifically are looking to address significant working capital constraints, while several high potential DRE players are looking to finance expansion and scale up. Enterprises in the OGE space have raised debt with ticket sizes ranging between US$100,000 to US$4 million[47] from DFIs,[48] public and private sector banks as well as other impact focused lenders. While public sector banks have provided collateral such as free loans and soft loans to OGE enterprises, private sector banks show limited involvement and foreign banks have no presence in the sector. Impact focused lenders have explored multiple instruments including venture debt, and hybrid products such as convertible debt.

- **Long tenure equity.** Historically, OGE enterprises have raised finance from impact investors who are usually more patient with capital, and angel investors who are willing to take on more risk in the early stage of an enterprise. Equity investments do not require collateral and the enterprise gives the investor a share in the venture. In addition, RBI regulations around equity are more flexible especially with respect to foreign investors. However, equity investments in the OGE sector very rarely have suitable exit timelines (three to five years as opposed to seven years or more as preferred by OGE enterprises).[50] Given that enterprises are largely in their early stages, traditional exit strategies of an IPO or buyout by a larger firm are not common.

Innovative financial instruments may be suitable alternatives to traditional debt or equity investments. Innovative financing through products like demand dividend notes, venture debt, lease financing and large scale securitization could provide OGE enterprises with greater access to capital while also being customized to the needs of investors and enterprises. Some of these, such as venture debt, have been used by financiers to fund OGE enterprises, while the potential for other options, such as large scale securitization, must be explored further.

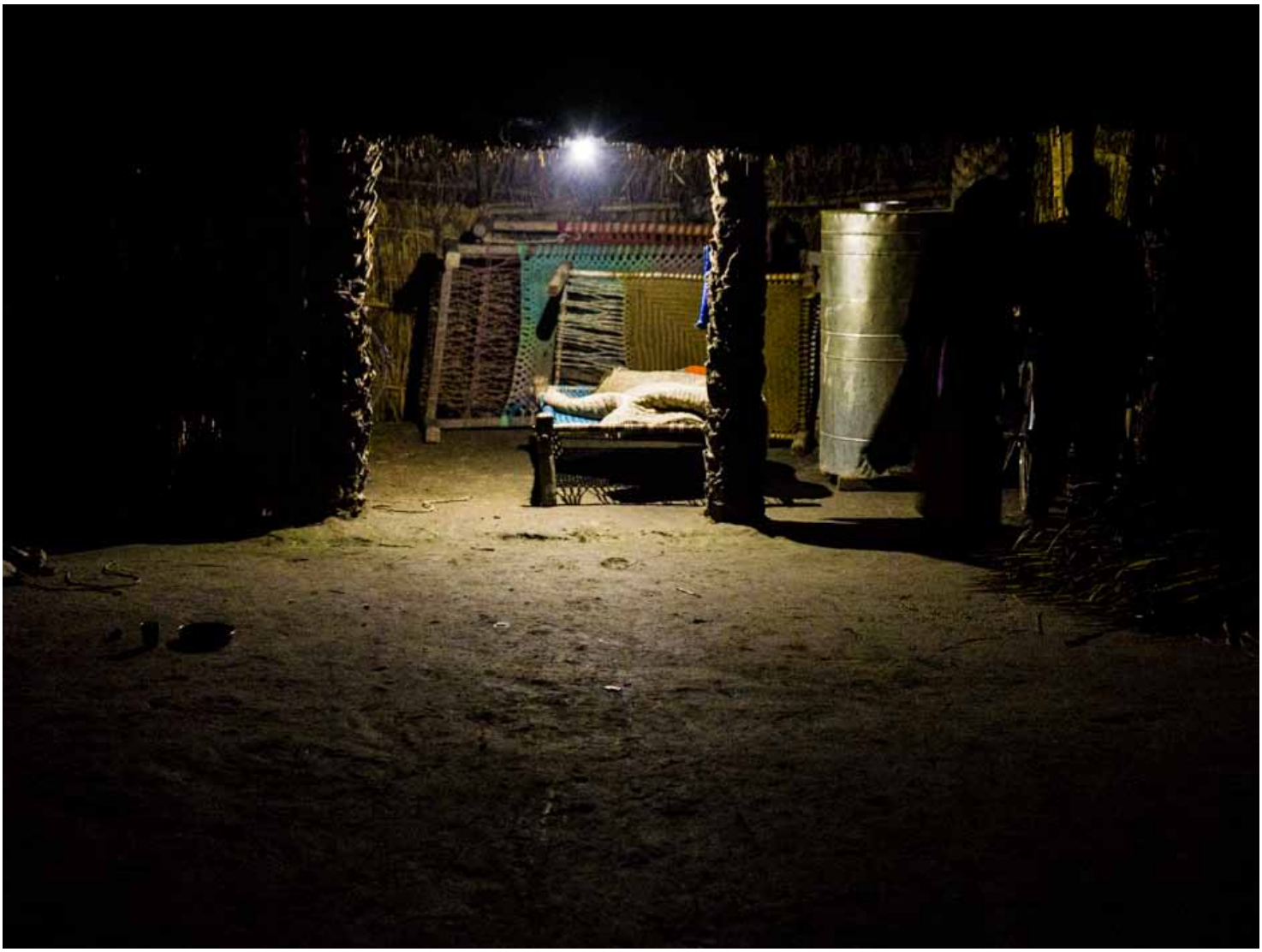
[45] Small Industries Development Bank of India.
[46] Indian Renewable Energy Development Agency Ltd.
[47] Not exhaustive.
[48] Development Finance Institution.
[50] Interviews with off-grid enterprises.

Table 3: Potential financial instruments for OGE enterprises [not exhaustive]

Instrument	Description	Applicability	Challenges	Relevance to OGE enterprises
Demand dividend note	• Honeymoon period of no payments. • The enterprise pays a fixed percentage of free-cash flow.[51] • Payments continue until the investor recovers a fixed multiple of his initial investment.	• Early stage companies that are a few years away from positive cash flow. • Enterprises with established business models who want to deepen existing operations.	• Does not work with high capex enterprises. • Can be difficult to forecast future cash flows.	• SHS enterprises that have seen some scale but want to invest in future expansion.
Venture debt	• Specialized banks and non-bank lenders provide debt to venture backed companies. • Debt can be combined with warrants (right to purchase equity) to compensate for higher risk of default.	• Enterprises looking for expansion or working capital. • Enterprises without collateral. • Investors who want a clearer exit timeline with the opportunity for higher future returns.	• Venture debt provides financing to enterprises who have little access to traditional debt and no collateral. • Given it is a riskier investment for financial institutions, interest rates are typically higher than traditional debt.	• Applicable to a wide range of SHS and DRE enterprises. • Probably less applicable for enterprises with very strong, stable cash flows who can access cheaper debt.
Lease finance	• Investors set up an independent leasing company in partnership with equipment manufacturers. • The leasing company buys equipment and leases to the enterprise. • Enterprise pays back in installments, and acquires ownership over time.	• Enterprises with high capital expenditure.	• Lack of secondary markets for capital.	• Applicable to DRE enterprises who want to build new plants.

[51]Free cash flow is operating cash flow minus capital expenditure.

Instrument	Description	Applicability	Challenges	Relevance to OGE enterprises
Asset backed securitization	• Income generating assets are pooled and sold to special purpose vehicle (SPV). • SPV creates securities and sells to investors. • Original enterprise collects income from asset for SPV, who uses funds to make interest payments to investors.	• Enterprises that have a source of stable long term cash flows. • Enterprises with many income-generating assets that are similar enough to be pooled together. • Enterprises looking for cheaper debt, but lack collateral. • Investors who do not want to assume all the credit risk of debt.	• Details around asset ownership, level of homogeneity of business models in the DRE space, and security creation need to be addressed.	• DRE enterprises with anchor clients who can provide stable cash flows.



INVESTMENTS IN THE OFF-GRID ENERGY SPACE HAVE LARGELY BEEN RESTRICTED TO EQUITY INSTRUMENTS, AND DEBT REMAINS THE PRIMARY UNMET NEED FOR OFF-GRID ENTERPRISES

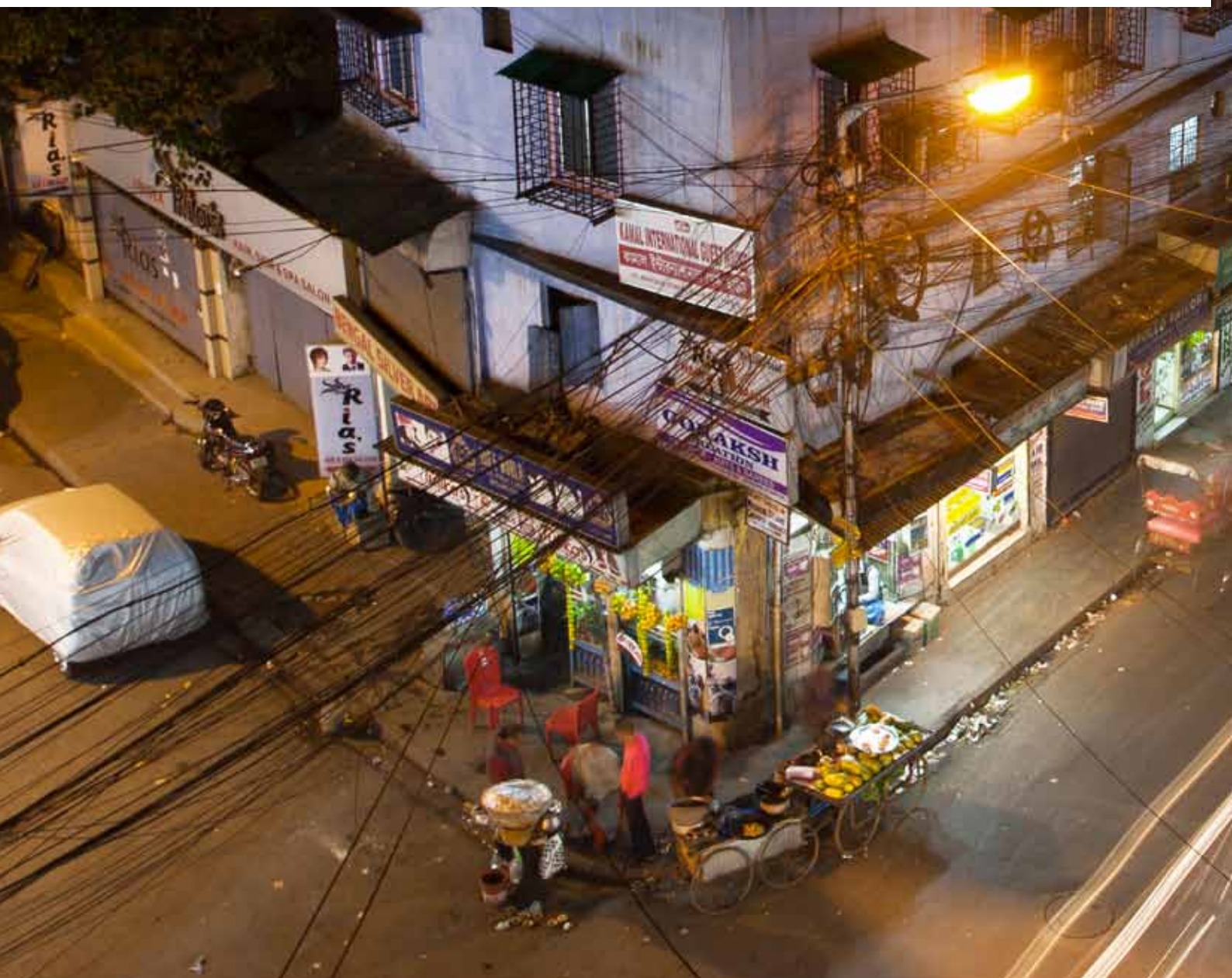


Figure 27: Securitizing DRE enterprise assets

The securitization process

1 Transfer of assets to issuing vehicle (e.g., SPV)
- Assets are immune to bankruptcy of a mini-grid company
- The mini-grid company retains no legal interest in assets

2 Special purpose vehicle (SPV) issues asset backed debt securities
- Securities are rated by one or more rating agencies and are structured into various tranches as per risk-return profile
- Investors receive fixed or floating rate payments from cash flows generated by underlying assets (e.g. revenue streams from large anchor load clients)

Advantages of securitization

- Potential for financing large scale projects, e.g., capital intensive projects with a requirement of over US$20 million
- We expect B2B mini-grid companies typically to require large scale financing to fund scale up (e.g., 1,000 40 kW mini-grids require over US$100 million + in financing)
- Reduces risk to the financier by pooling the assets and spreading risk among multiple investors
- The underlying cash flows from mini-grid anchor clients are very stable and could be attractive to institutional and retail investors

Areas that need to be probed further...

- Optimal level of conformity of business models to pool securities
- Issues around ownership of assets and enforceability of new contracts in rural India

LARGE SCALE SECURITIZATION COULD HAVE THE POTENTIAL TO TRANSFORM THE B2B DRE MARKET

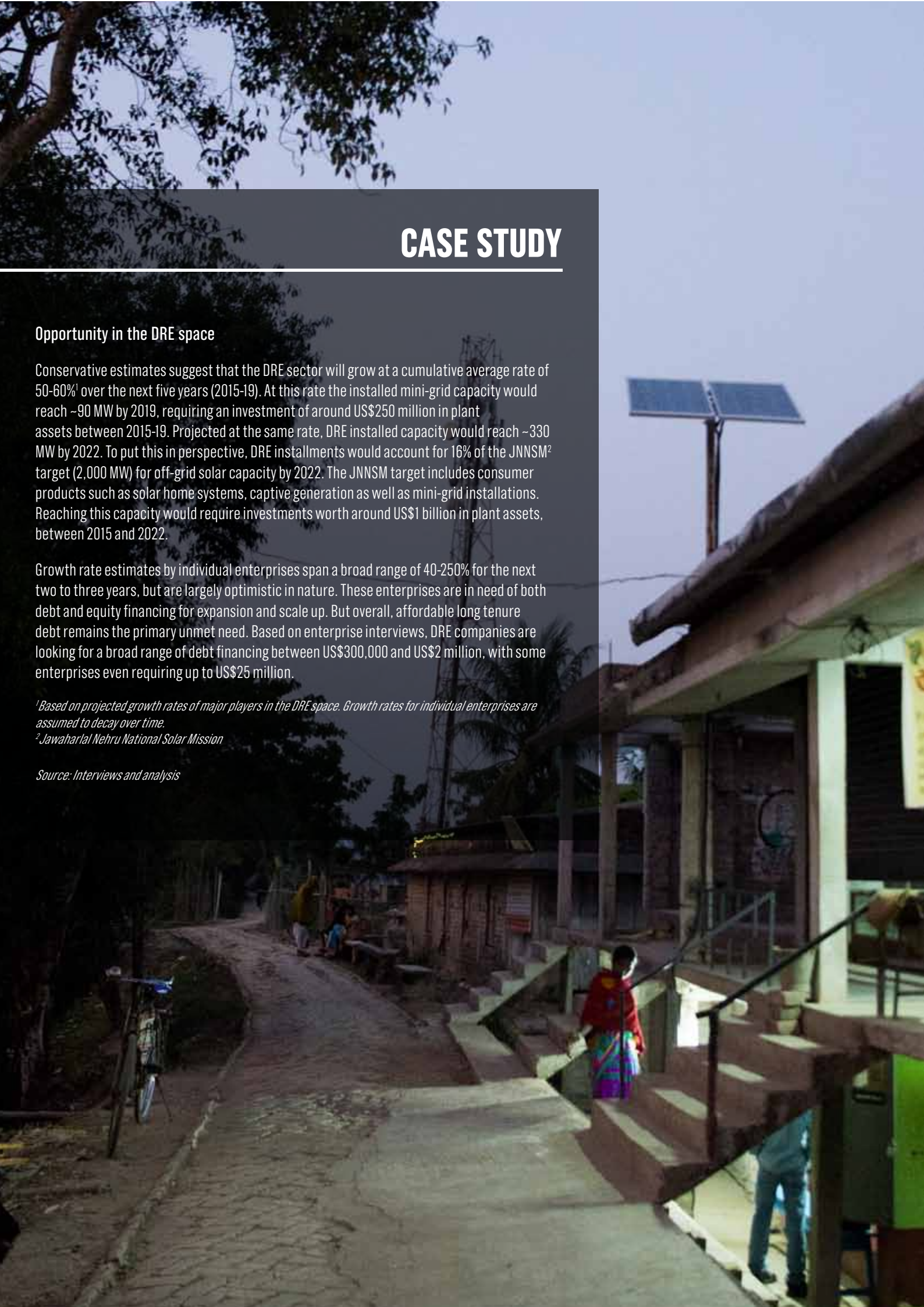
Venture debt can be used to fund high growth start-ups and provide working capital, which most interviewed enterprises pointed out is their biggest need. Enterprises need working capital to finance inventory carrying costs, to provide customer credit and for forward investing in people and capex. Today early stage companies end up having to fund working capital and asset purchases through expensive equity capital. A dedicated fund can provide debt to investor backed enterprises that have received equity and are now looking for debt. Venture debt funds can offer non-collateralized loans on the basis of the viability and vision of a business, scalability and cash-flow. Timely debt can help these enterprises gain access to other commercial debt and scale. There is currently a very low supply of venture debt in India, but financing companies such as IntelleGrow have seen success in investing in small and medium enterprises in off-grid energy, rural healthcare and financial inclusion.[52] Venture debt is generally riskier for lenders and more expensive for enterprises than other forms of debt. But innovative vehicles such as a cheaper venture debt fund can help enterprises access cheaper forms of debt in the future.

Additionally, large scale securitization could have the potential to transform the B2B DRE market. B2B enterprises are particularly well-suited for large-scale securitization, given the large and steady streams of cash flows generated through the anchor load. The cash flows from various clients across many plants could be pooled by financial institutions who could then create asset backed securities that could be sold to retail investors. DRE enterprises, especially those looking to scale rapidly will be in need of large sums of capital (e.g. a DRE operator looking to add 1,000 40kW plants could need more than US$100 million of financing)[53] and could find this to be a particularly appealing opportunity. As the primary and secondary markets for such products grow, DRE enterprises can access much more capital.

The potential for this opportunity needs to be further explored through discussions with financial institutions, B2B DRE players and large B2B consumers such as mobile network operators. Beyond this, challenges that must be addressed include Indian regulations around securitization, the enforceability of new contracts in rural markets and little uniformity in the DRE space for pooling of securities with similar risk-return profiles.

Private equity and venture capital could be suitable for leading SHS players which have a strong reputation among customers and a growing product portfolio. Since lanterns and solar home systems are typically the first white goods an off-grid rural consumer will buy, companies who develop strong brands through quality lighting products and after-sales service will be best positioned to earn consumer trust. Consumer trust combined with rural networks for distribution and access to consumer financing can help SHS enterprises diversify their product portfolios and sell other products (such as TVs, fans and cooling systems) through their existing sales infrastructure. Private equity and venture capital players can play a strong role in identifying and scaling such companies. Currently many investments within the space are led by impact investing and development finance institutions. But as companies grow and need funding beyond the first few rounds, commercial private equity is likely to provide continuity in financing support and help these companies grow to produce sizeable returns. In addition, these companies could be attractive acquisition targets for larger electronics companies, who have so far struggled to effectively tap the rural market,[54] opening interesting exit opportunities for investors.

[52] Livemint, 2013.
[53] Assuming a cost of installation of US$3 (INR 200)/Watt.
[54] For example, Schneider Electric, Philips and Panasonic have all tried to enter the rural market but have struggled to make any inroads.



CASE STUDY

Opportunity in the DRE space

Conservative estimates suggest that the DRE sector will grow at a cumulative average rate of 50-60%[1] over the next five years (2015-19). At this rate the installed mini-grid capacity would reach ~90 MW by 2019, requiring an investment of around US$250 million in plant assets between 2015-19. Projected at the same rate, DRE installed capacity would reach ~330 MW by 2022. To put this in perspective, DRE installments would account for 16% of the JNNSM[2] target (2,000 MW) for off-grid solar capacity by 2022. The JNNSM target includes consumer products such as solar home systems, captive generation as well as mini-grid installations. Reaching this capacity would require investments worth around US$1 billion in plant assets, between 2015 and 2022.

Growth rate estimates by individual enterprises span a broad range of 40-250% for the next two to three years, but are largely optimistic in nature. These enterprises are in need of both debt and equity financing for expansion and scale up. But overall, affordable long tenure debt remains the primary unmet need. Based on enterprise interviews, DRE companies are looking for a broad range of debt financing between US$300,000 and US$2 million, with some enterprises even requiring up to US$25 million.

[1] Based on projected growth rates of major players in the DRE space. Growth rates for individual enterprises are assumed to decay over time.
[2] Jawaharlal Nehru National Solar Mission

Source: Interviews and analysis

INVESTMENTS IN INCREASING INFORMATION FLOW AND CAPACITY BUILDING OF FINANCIAL INSTITUTIONS ARE PARTICULARLY CRUCIAL

5.2 PROMOTING PRIVATE SECTOR ENGAGEMENT

Broader, sector-wide initiatives can transform the OGE ecosystem. Beyond making direct investments in individual OGE enterprises, private sector players can engage in targeted initiatives to support the overall ecosystem. A few ideas include funding recurring industry reports to provide up-to-date information to entrepreneurs and investors, spurring innovation through a fund or prize, and supporting initiatives to make carbon financing more attractive to enterprises. While the Bijli Off-Grid Energy Challenge and this report aim to make inroads, much more work can be done at a larger scale and by many partners. Figure 28 summarizes these three initiatives, provides past examples and suggests next steps for each initiative.

Investments in increasing information flow and capacity building of financial institutions are particularly crucial. Dissemination of information on technology, business models and expected returns can help investors better understand and evaluate potential investment opportunities in the sector. In addition, increasing awareness on new financial solutions can help address specific enterprise needs. This will lead to a change in the perception of financial institutions, directly affecting risk-return expectations. Public agencies can organize seminars and specific training workshops as well as publish case studies or relevant market information for both financial institutions and enterprises.

Figure 28: Potential ecosystem building initiatives in the OGE sector

	Description		Past examples	Potential next steps
Increasing information flow	• Industry coverage reports on new technology, products and successful companies in the off-grid space can encourage new entrants and investors.	Lighting Asia	• Reports by IFC's Lighting Africa initiative have resulted in greater private sector investment in the off-grid space and growth in the solar lantern market in Africa.	• Engage experts to conduct market research (updated periodically) and dissemination products. • Conduct targeted workshops for entrepreneurs/investors to highlight off-grid opportunity and innovative ways of tapping it.
Spurring innovation	• Private and public funds could be used to highlight and reward innovation in off-grid technology and its deployment through large, visible competitions.	XPRIZE	• Sponsored by private companies, the Xprize has run competitions to encourage innovation. • The Ansari Xprize for Suborbital spaceflight resulted in US$100 million of investment toward the prize between 1996-2004.	• Engage relevant experts to identify donors, design and launch the fund. • Develop format for competitions and sourcing of innovative ideas. • Organize competitions on a regular basis and monitor impact.
Reducing barriers to financing carbon offsets	• Standardizing baseline emissions and impact by region, sector, and technology to make the auditing and M&E[1] processes for carbon financing less expensive.	MUFG	• Mitsubishi UFJ Morgan Stanley funded a study on estimation of standardized baselines in Uzbekistan. • Uzbekistan developed standardized baselines for both the energy efficiency and power generation sectors.	• Engage technical experts to conduct separate regional studies that develop standardized methods to calculate baselines and post-intervention impact. • Deploy monitoring and evaluation[1] (M&E) pilots to test applicability of methods. • Engage with relevant public/private sector stakeholders to encourage adoption of standardized methods in carbon markets.

[1] *Monitoring and evolution.*
Source: http://www.un-redd.org/AboutUN-REDDProgramme/tabid/102613/Default.aspx; http://rsr.akvo.org/projects/all/

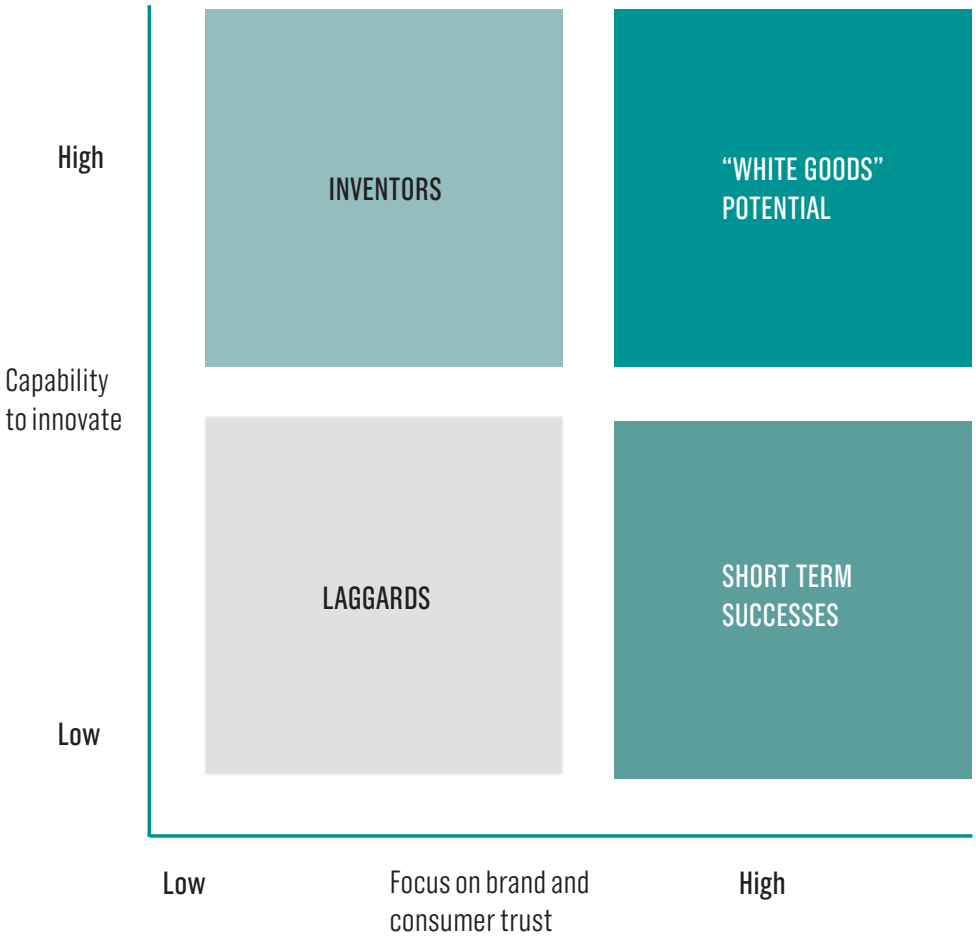
SIX

6. CONCLUSION

Renewable energy products and services in India is set to be a healthy market because demand for energy provision will remain strong, the ability of rural households to pay for products and service will increase, and the reach and awareness of these products is growing rapidly. SHS and DRE enterprises in particular, are capable of serving the evolving needs of a diverse set of Indian consumers.

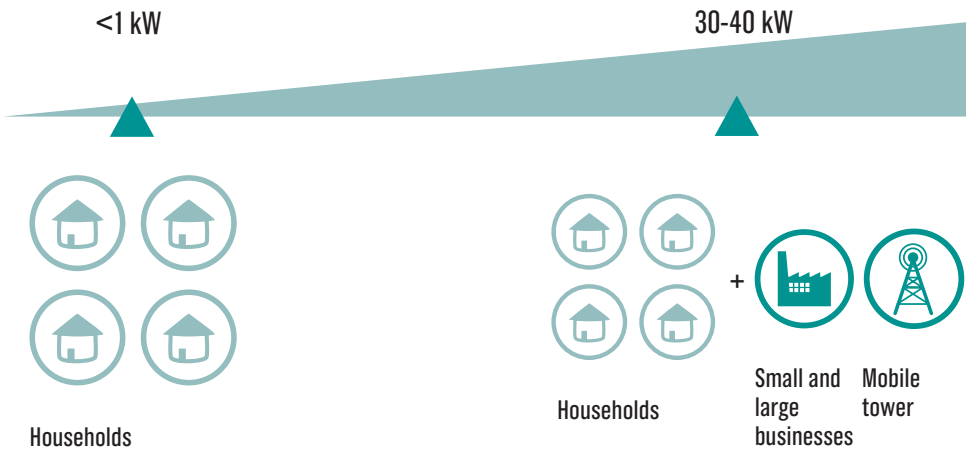
The truly successful SHS enterprises will be those that can leverage initial relationships with the consumer to cross-sell and up-sell other low energy appliances, such as DC TVs, fans and cooling appliances, to create a diversified "white goods" style company. These will be companies that have a strong focus on brand building and consumer trust as well as the capability to innovate. "Inventors" that focus only on innovation and not on branding may develop interesting products, but are likely to be copied by other enterprises. Those enterprises who develop good branding and consumer trust but do not innovate may see short term success, but will find it hard to keep up with rapidly evolving technology and to meet changing customer needs.

Figure 29: Categories of SHS enterprises



While the more nascent DRE space has not settled on any particular business model, we expect the industry to start consolidating in the near future. B2C models currently struggle with unreliable demand, payment collection and enforceability of contracts in rural remote regions. Asset-light B2C models (or small capacity micro-grids) that can cost as low as US$1,000 and provide affordable basic lighting, overcome the need to invest large amounts of risky capital. B2B + B2C models on the other hand can get large stable revenues from an anchor client, but require larger, more expensive plants. In terms of financing needs, small B2C models need debt in the form of working capital to set up plants in multiple locations, whereas B2B + B2C models need project based financing to finance high installation costs.

Figure 30: High potential DRE business models



	Small plant B2C	Large plant B2B + B2C
Advantages	• Low upfront plant installation costs • Low maintenance costs • High scalability to installing multiple plants	• Stable revenues and cash flows • High profit margin from household consumers (per unit of electricity)
Financing need and possible options	Scale to increase cash flow • Hybrid financing • Affordable debt • Equity	Funding upfront costs • Long tenure debt • Securitization

This is an opportune time for investors to become more engaged; companies are seeking investment, proving the viability of their business models and making meaningful inroads in distribution. Investors and other private sector players have a significant role to play in identifying and helping scale the most promising enterprises as well as in accelerating the growth of the overall sector. While debt financing will fill the most immediate short-term needs of businesses, a broad range of innovative financing mechanisms such as venture debt funds, lease financing and large scale securitizations could also be applicable. Beyond this, ecosystem players such as non-profits, multilateral agencies and public institutions can engage in a series of targeted initiatives, ranging from supporting research initiatives to galvanize and bring new stakeholders to the table, to supporting cutting edge innovations to make products relevant to the Indian consumer.

Aside from technological innovation, there is likely to be an inflection point where current off-grid models of power supply are realized as not just being "stop-gap" solutions to grid-connectivity but a relevant complement to grid extension in rural and remote far-flung areas. There has been initial evidence of such an inflection with the Government of India's regulatory support for distributed renewable energy generation, especially in remote areas. Government affirmation of off-grid models being a complementary way of viable electricity provision will be critical to unlocking market potential.

India has a large energy need for both household and commercial consumption, and it is becoming increasingly difficult to meet these needs through traditional forms of power generation. India has an abundance of resources such as solar, wind and biomass, and yet spends a lot of money on importing oil, coal, and natural gas. A decentralized renewable energy model, bolstered by the support of investors and other private sector players, can make clean, healthy, reliable and equitable energy access a near-term possibility.

A DECENTRALIZED RENEWABLE ENERGY MODEL, BOLSTERED BY THE SUPPORT OF INVESTORS AND OTHER PRIVATE SECTOR PLAYERS, CAN MAKE CLEAN, HEALTHY, RELIABLE AND EQUITABLE ENERGY ACCESS A NEAR-TERM POSSIBILITY

ANNEX

ANNEX

ANNEX 1.1: SUMMARY OF OPPORTUNITIES AND CHALLENGES IN THE SHS AND DRE SECTORS

Figure 31: Opportunities and challenges in the SHS space

CONSUMER/GROWTH	REGULATIONS	COST/FINANCIALS	IMPACT	INVESTOR INTEREST
40-80% awareness of solar lighting	Government efforts have promoted solar lighting through procurement of street lighting, lanterns and SHS	Costs of solar technology is likely to fall	By 2018 the SHS market will have expanded electricity to over 25 million people	The SHS space is lower risk, higher return compared to other small/medium RE businesses
Widespread availability of solar lanterns have increased awareness of solar lighting	30% NABARD subsidy for consumer products through rural banks	Innovative partnerships and technology can reduce cost of distribution and payment collection	Between 2014-18, the market will add over US$300 million to local economies	SHS are strong candidates for standalone commercial angel/equity funding
Market is likely to grow ~60% per year over next five years	Subsidies are often delayed	Enterprises can expand to other products	Between 2014-18, SHS enterprises will offset 550,000 tons of CO_2 equivalent	There is a need for more patient capital
Awareness varies greatly by region		There is already a profitable enterprise in the space		
Village level penetration is low		Margins are thin		
		Battery prices still high		

STRENGTHS

WEAKNESSES

Figure 32: Opportunities and challenges in the DRE space

CONSUMER/GROWTH	REGULATIONS	COST/FINANCIALS	IMPACT	INVESTOR INTEREST
Village level penetration can be as high as 40-60%	Targeted efforts to promote solar and wind energy at a large scale through subsidy and loan refinancing	Technology like hybrid or smaller size plants can reduce cost	By 2018 the SHS market will have expanded electricity to over 4.5 million people	High potential enterprises have raised a significant amount of equity
Enterprise growth rates range between 70-250%	There is a push towards adopting mini-grid models in remote and rural off-grid areas	New payment collections technology can increase efficiency	Between 2014-18, the market will add over US$100 million to local economies	Demonstrated success of exits by prominent impact investors is likely to spur future investment
Several high potential enterprises show strong historical growth rates	Subsidies are often delayed	Operational profit up to 70%	Between 2014-18, mini-grid enterprises will offset 150,000 tons of CO_2 equivalent	There is a need for more debt
Total market penetration is low	Policy on grid expansion and interactivity is unclear	Small mini-grids can break even in two years		
		Stable cash flows from anchor clients		
		No economies of scale for >1 kW		
		Battery prices are high		

STRENGTHS

WEAKNESSES

Source: Interviews and analysis.

ANNEX 1.2: SUMMARY OF BUSINESS MODELS OF INTERVIEWED ENTERPRISES

	SHS – Selco	SHS – Simpa	SHS – Onergy	SHS –Boond	SHS – E-Hands
Business overview	Assembly/distrib; dealers/agents	Assembly/distrib; regional branches	Assembly/distrib; regional branches	Assembly/distrib; Local sales agents	Distrib/services provider
Customers	Rural households (off-grid and under-electrified)	Rural households; SMEs (off-grid and under-electrified)	Rural households; communities	Rural households (off-grid and under-electrified)	Rural households and businesses, MFIs
Existing energy sources	Subsidized kerosene and intermittent access to electricity in under-electrified areas	Subsidized kerosene and intermittent access to electricity in under-electrified areas	(Subsidized and black market) kerosene	Subsidized kerosene and intermittent access to electricity in under-electrified areas	Subsidized kerosene and intermittent access to electricity in under-electrified areas, diesel generators
Products	10 W DC–200 W; lanterns' product warranty	40 W per customer	20 W DC–200 W SHS; TVs, fans	20 W DC–200 W; lanterns; DC TV/ appliance; product warranty	Customizable SHS; micro wind/hybrid turbines (600 W–20 kW)
Price	US$100–3,000	US$350	US$80-850	US$130–1000	SHS: US$150-500
Consumer financing	"Loans"; partners – rural banks and MFIs	"Pay as you go"; prepaid payments based on consumption until paid in full	"Loans"; secure loans and subsidies for consumers	"Loans"; partners – rural banks and MFIs and NABARD (National Bank for Agriculture and Rural Development)	"Loans"; through MFI partners
Payment collection	Sales agents collect down payment, rural banks deal with the rest of the payment/ interest	(Smart meters); cash payments at payment points in a village (INR 600–750 per month); notifications are sent via mobile phone (at the payment point)	Sales executives collect down payment, partnering financing institution collects the rest of the payment/ interest	Village level entrepreneurs act as sales agents and collect down payment, rural banks deal with the rest of the payment/interest	MFIs handle payment collections
Geography	Karnataka, now expanding to other regions	Western UP	West Bengal, Odisha, Jharkhand	UP, Uttarkhand, Rajasthan	Not known
Government subsidies	Consumer subsidies provided by NABARD	No subsidy	Consumer subsidies provided by NABARD	Consumer subsidies provided by NABARD	Not known

	SHS – Visionary Lighting and Energy	DRE – MeraGao	DRE – NatureTech	DRE–OMC
Business overview	Assembly/distrib; regional branches	BOOM; microgrids	BOOM; AC microgrids	BOOM microgrids/anchors
Customers	Rural households; communities; urban under-electrified	Rural off-grid households	Rural off-grid households	Anchor loads; sells excess to rural households (~500 in 3-5 km radius)
Existing energy sources	Subsidized kerosene and intermittent access to electricity in under-electrified areas	(Subsidized and black market) kerosene	(Subsidized and black market) kerosene	(Subsidized and black market) kerosene for households; diesel for anchor loads
Products	15 W DC–100 W SHS; TVs, radios, water heater, lantern	240 W; 2 lights; mobile	1-3 kW solar AC; lights; appliances	36 kW solar; 2-9 lights
Price	US$65-700	(US$0.4 – 0.5 per week fixed)	US$25 one time connection fee plus US$5 per month	US$2.5 – 11 per month; fixed
Consumer financing	Mostly upfront payment		"Pay as you go"	
Payment collection	Field staff collect upfront payment	Field collection agents; weekly group collections based on MFIs; 80% collection rate	Prepaid SMS system and smart metering; recharge agents	Human collections
Geography	Bihar, MP, Chattisgarh	UP	Western UP	UP
Government subsidies	Tried to get subsidies but have had trouble	Capital subsidy	Capital subsidy	No subsidy

	DRE – Biotech India	DRE– Gram Oorja	DRE–Avani Bio Energy	DRE–Gram Power
Business overview	BOOM; microgrids	BOOM; AC microgrids	BOOM; AC power plant	BOOM; microgrids
Customers	Large institutions, markets, slaughter houses	Rural off-grid households	Local power distribution companies	Rural households
Existing energy sources	Diesel generators	(Subsidized and black market) kerosene	(Subsidized and black market) kerosene for households, some grid electricity	(Subsidized and black market) kerosene for households
Products	5 kW and biogas plant	10 kW solar	200 kW biomass	1-5 kW DC solar
Price	US$2,500	US$0.25/unit	US$0.08 per unit, feed-in tariff	US$1.50–4.30 /month
Consumer financing	Upfront payment			
Payment collection	Upfront payment	Human collections	MOU with local power distribution company	Smart grid, human collector
Geography	Kerala, Karnataka	MP, Rajasthan, Odisha, Jharkhand	Uttarkhand	Rajasthan
Government subsidies	Some, but there aren't as many for biogas	Capital subsidy	No subsidy	Capital subsidy

ANNEX 1.3: SUMMARY OF PEOPLE AND ORGANIZATIONS INTERVIEWED

Name	Organization	Title
Ritesh Singhania	Avani Biotechnology	Head, Operations and Finance
Dr. A Sajidas	Biotech India	Managing Director
Simran Grover	Boond	CTO
Raghuraman	E-Hands Power	Founder and CEO
Sameer Nair	Gram Oorja	Co-founder
Kunjan Gandhi	Gram Power	VP Business Development
Nikhil Jaisinghani	Mera Gao Power	Co-founder and Director
Shyam Patra	Naturetech Infrastructure	Director and Founder
Pranav Tripathi	OMC Power	Head of Business Development
Vinay Jaju	Onergy	COO and Co-founder
Piyush Jaju	Onergy	CEO and Co-founder
Alok Piri	Onergy	VP Sales and Marketing
Sudipta Dawn	Onergy	GM - Operations
Sudipta Ghosh	Selco	Assistant General Manager - Operations
Revathi Kannan	Selco	President
Sarah Alexander	Selco	Advisor on Sustainable Energy Policy
Piyush Mathur	Simpa Networks	CFO
Sanjay Bharti	Simpa Networks	VP Sales and Marketing
Paul Needham	Simpa Networks	President and Co-founder
Sridhar Ponugupati	Visionary Lighting and Energy	Chief Executive Officer

In addition the offices and sites of three enterprises were visited during the course of the study.

SOURCES

SOURCES

1. 2013 Union Audit Report: Chapter 2 Comments on Accounts. Comptroller and Auditor General of India. SAAIINDIA.gov.in. 2013. http://www.saiindia.gov.in/english/home/Our_Products/Audit_Report/Government_Wise/union_audit/recent_reports/union_financial1/2013/Civil/Report_1/chap_2.pdf.

2. About REDD+. UN-REDD Programme. UNDP. Un-redd.org. 2009. http://www.un-redd.org/AboutREDD/tabid/102614/Default.aspx.

3. Aravamudan, Ananth. Testing with the Tech&Design Team. Selco Foundation Blog. Selcofoundation.org April 1, 2014. http://www.selcofoundation.org/2014/04/01/testing-techdesign-team/.

4. Chaudhary, Deepti. IntelleGrow Raises Rs10 Crore from MSDF. Livemint. Feb 11, 2013. http://www.livemint.com/Companies/NN4inbcKmxFJV5ULIbCpuJ/IntelleGrow-raises-Rs10-crore-from-MSDF.html.

5. Creation of National Clean Energy Fund. Press Information Bureau of India. 2011. http://pib.nic.in/newsite/erelease.aspx?relid=71517.

6. Desai, Nitish. Private Equity and Private Debt Investments in India. Nitish Desai Associates. July 2014. http://www.nishithdesai.com/fileadmin/user_upload/pdfs/Research%20Papers/Private_Equity_and_Private_Debt_Investments_in_India.pdf.

7. d.light Hits 125,000 Solar Home Systems Milestone. dlightdesign.com. May 8, 2014. http://www.dlightdesign.com/wp-content/uploads/2014/05/d.light-125K-SHS-Milestone-5.7.14.pdf.

8. Financing Renewable Energy in India. Partnership to Accelerate Clean Energy Program (USAID). Ministry New and Renewable Energy, Government of India. October 2013. http://www.pace-d.com/wp-content/uploads/2013/10/RE-Finance-Report.pdf.

9. Global Trends in Renewable Energy Investment 2014. Bloomberg New energy Finance. Frankfurt School of Finance & Management. 2014. http://www.unep.org/pdf/Green_energy_2013-Key_findings.pdf.

10. Greenhouse Gas Equivalencies Calculator. United States Environmental Protection Agency. EPA.gov. 2014. http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

11. Heinisch, Marianne. 8 Social Venture Funds that Invest in India's Clean Energy Sector. Social Story. Aug 29, 2013. http://social.yourstory.com/2013/08/social-venture-funds-invest-indias-clean-energy/.

12. International Finance Corporation. Assessment of the Off Grid Solar Appliance Lighting Market in India. Market research report, New Delhi, India, 2015

13. Jai, Shreya. Asia Development Bank Injects Rs 310 Crore into Welspun's Clean Energy Firm. The Economic Times. Jun 20, 2014. http://m.economictimes.com/industry/energy/power/Asian-Development-Bank-injects-Rs-310-crore-into-Welspuns-clean-energy-firm/articleshow/36877178.cms.

14. Jai, Shreya & Patil, Gandhagar S. Of Rs 40k-crore National Clean Energy Fund, only Rs 1.6 crore spent in Projects in Last 3 Year. The Economic Times. Jun 13, 2014. http://articles.economictimes.indiatimes.com/2014-06-13/news/50564444_1_the-ncef-national-clean-energy-fund-rs-500-crore.

15. Nelson, David et al. Meeting India's Renewable Energy Targets. Climate Policy Initiative. December 2012. http://climatepolicyinitiative.org/wp-content/uploads/2012/12/Meeting-Indias-Renewable-Targets-The-Financing-Challenge.pdf.

16. Renewable Energy Act on the Anvil. Press Trust of India (PTI). VCCIRCLE. September 30, 2014. http://www.vccircle.com/news/power/2014/09/30/renewable-energy-act-anvil.

17. Scoping Study on Intersection of ICT and Off-grid Energy Access in India. The Climate Group and ISEP. 2014.

18. Sovacool, Benjamin K. Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey. Energy Policy 36.8: 2950-963. 2008.http://www.nirs.org/climate/background/sovacool_nuclear_ghg.pdf.

19. Standardized Baseline: Way to Attract Investors. Low-Emission Development Path. Akvo.org. Jun 25, 2013. http://rsr.akvo.org/project/528/update/3210/.

20. Twelfth Five Year Plan (2012-2017) Faster, More Inclusive and Sustainable Growth Vol. 1. Planning Commission. Government of India. Sage Publication. New Delhi. 2013. http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol1.pdf.

21. Twelfth Five Year Plan (2012-2017) Faster, More Inclusive and Sustainable Growth Vol. 2. Planning Commission. Government of India. Sage Publication. New Delhi. 2013. http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol2.pdf.

22. Understanding the Social Opportunities and Risks in Forestry and Bioenergy Carbon Offset Projects. Overseas Development Institute (ODI). Ford Foundation.

23. The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits. Independent Evaluation Group (IEG). The International Bank for Reconstruction and Development/The World Bank. Washington DC. 2008. http://siteresources.worldbank.org/EXTRURELECT/Resources/full_doc.pdf.

24. Wilkes, Tommy. Power Minister Says $250 Billion Needed to Tackle Energy Crunch. Reuters. New Delhi. Nov 6, 2014. http://in.reuters.com/article/2014/11/06/india-energy-investment-idINKBN0IQ0AK20141106.

INTERNATIONAL EXPERT PANEL

Ankur Trehan
Executive Director, Investment Banking Division,
Goldman Sachs (India) Securities Private Limited

Ankur has been with Goldman Sachs India since 2005 and has been instrumental in various landmark M&A and equity capital market transactions across India and Asia.
Ankur was certified as a chartered accountant in 2004 by the Institute of Chartered Accountants of India. He graduated with a degree in commerce from Venkateshwera College, New Delhi, in 2004.

Brinda Ganguly
Associate Director, Rockefeller Foundation

Brinda Ganguly joined the Rockefeller Foundation in 2008. As an Associate Director, she manages the Foundation's Program Related Investments (PRI) portfolio and works on the Impact Investing initiative, which seeks to catalyze an efficient industry that can deploy investment capital to solve social challenges at scale. Prior to joining Rockefeller, Ms. Ganguly was a Vice President in Citigroup's Corporate Bank, where she provided corporate finance solutions to healthcare clients. Earlier in her career, she worked at the Soros Foundation, originating and executing PRIs on behalf of the Soros Economic Development Fund, and at Charles River Associates as an economic consultant.
Ms. Ganguly serves on the Executive Committee of Mission Investors Exchange, an organization that promotes impact investing, as well as on the President's Advisory Council for Bryn Mawr College. Ms. Ganguly received a bachelor's degree in Economics and Spanish from Bryn Mawr and an MBA from Columbia Business School. She lives in Brooklyn with her husband and daughter.

Gauri Singh
Director of Country Support and Partnerships,
International Renewable Energy Agency (IRENA)

Guari Singh joined IRENA in 2011 and has been leading the work with different countries. Her division supports countries in the development and implementation of national and regional renewable energy strategies. Its activities enable a systematic overview of country and regional needs, experiences and trends to help facilitate cross-pollination of best practices between countries and regions, and shape IRENA's future programmatic priorities. The division is also responsible for conducting the Renewables Readiness Assessments, a country-led process, which provides a holistic assessment of conditions for renewable energy deployment in a country by identifying the actions necessary to increase readiness and overcome the main barriers to the deployment of renewable energy technologies. Her division also leads regional initiatives on clean energy corridors, like the African Clean Energy Corridor and the capacity-building efforts of the agency.
From 2007 to 2010, she was the Joint Secretary in India's Ministry of New and Renewable Energy. Her responsibilities included all policy formulation and international cooperation. She was responsible for the development and implementation of the policy framework of the National Solar

Mission to generate 20,000 MW of solar power by 2022. She was responsible for the policy that led to creating a level playing field for foreign direct investment companies and independent producers to double the annual installed wind capacity. She also created the policy framework that led to the paradigm shift in the off-grid policy to upscale the deployment of renewable energy systems. She was also in charge of designing the framework for renewable energy certificates.
Ms Singh holds a Bachelor of Economics from Delhi University and an MBA.

Jessica L Long

Managing Director, Accenture, Global Solutions & Partnerships
Accenture Development Partnerships (ADP)

Jessica Long is a Managing Director with Accenture and has over 15 years of national and international experience in strategy, program delivery and technology within the corporate, government and development sectors. Jessica is on the global leadership team of Accenture Development Partnerships, a not-for-profit group within Accenture which provides business and technology services to the international development sector.
Jessica leads Accenture Development Partnerships' suite of solutions across Program Innovation & Impact, Partnership Services and Organizational Strengthening & Enablement. In this role, Jessica also leads our team focused on co-creating, incubating and scaling cross-platform solutions for development.
Jessica previously led Accenture Development Partnerships' work across Africa and the Americas, and globally with Donors, Foundations and Emerging Country Governments. She has led transformation and development projects for international NGOs, governments and multi-national donors, with a focus on innovation, IT & growth strategy, shared value and collaborative partnerships. Within the last several years, Jessica has lived and worked in several countries across North America, South America, Africa and Europe.
Prior to working with Accenture Development Partnerships, Jessica was a strategist in Accenture's Strategy practice, leading strategy and transformation engagements with large government, healthcare and pharmaceutical companies. Before joining Accenture, Jessica worked in the United States Senate as a Constituent Advocate and with Media Relations.
Jessica has received several awards while working with Accenture, including the Inspiring Leader Award, Innovation Award and Inventor's Award. Jessica speaks regularly at local and global conferences on the topics of IT-enabled Transformation, Shared Services, Cross-sector Partnering and Innovation for Development. She also teaches several times per year at Accenture Strategy College in St. Charles, Illinois and serves on the Leadership Council of Raise DC. She has been honored by the World Economic Forum as a Young Global Leader in 2014.

Mark Kenber
CEO, The Climate Group

Mark Kenber is an economist who has worked on climate change for nearly 20 years and is an expert on international climate policy. Before becoming CEO in 2011, Mark was The Climate Group's Deputy CEO and Policy Director.
In his role as Policy Director, Mark advised former UK Prime Minister Tony Blair in the joint policy initiative Breaking the Climate Deadlock (2007-2009), which produced a series of high-level reports outlining the economic and technological rationale for a global climate deal and its key components. He also co-founded the successful Verified Carbon Standard (formerly Voluntary Carbon Standard - VCS), now the most popular kite mark for the US$400 million voluntary carbon market.
Immediately prior to joining The Climate Group, Mark was Senior Policy Officer at WWF's International Climate Change Programme, focusing on carbon market and finance issues. During this time he worked on the creation of the CDM Gold Standard, a tool for channelling carbon market investments into sustainable clean energy projects. He has also served as Director of Planning at Fundacion Natura, Ecuador's largest environmental organization, and climate change advisor to the Ecuadorian government.
Mark has taught at universities in both the UK and Ecuador and is a frequent speaker at public events. He has published widely on environmental policy and climate change and is a regular commentator in the press. He lives in Brighton and is married with one daughter.

Namita Vikas
Senior President and Country Head- Responsible Banking & Chief Sustainability Officer
YES Bank Ltd

Namita Vikas spearheads YES BANK's Version 2.0 Vision & Strategy of further strengthening the bank as a commercially viable financial institution with sustainability principles incorporated within its core operations. Mainstreaming sustainability and creating stakeholder value through sustainable development and finance are her key focus areas. Her work involves overall Sustainability Management, Research, Triple Bottom-line Accounting, Responsible Finance/Investing and CSR.
In her current role, she also serves as a Board Member of "YES FOUNDATION", which she set up and now guides its overall strategy. She is elected to United Nations Environment Programme Finance Initiative (UNEP FI) Global Steering Committee and is the Vice Chair of UN Natural Capital Declaration (NCD). Besides this, she sits on advisory boards of Responsible Investment Research Association (RIRA), UNEP-FI Banking Commission, World Resource Institute - India GHG Program, Indian Centre for CSR (ICCSR) and Enactus India. Committed to sustainability, she has been serving as a member of UNGC, TERI-BCSD, Environment, Innovation, CSR & Sustainability Committees of Industry bodies, besides being a Jury on several sustainability awards like the World Bank's Development Market Place Initiative for India and Tata Group Innovista Awards.
Given her in-depth understanding, she is often invited to speak on sustainability and CSR at large international and national platforms. She was a part of the committee set up by Ministry of Corporate Affairs, Government of India in drafting the CSR rules for India.
With a well-rounded experience of 24 years in Sustainable Development, CSR and policy advocacy, she has successfully held leadership positions with Marico, Microsoft Corporation and Confederation of Indian Industry (CII). Prior to joining YES BANK, she was the CEO of Marico Innovation Foundation.

A lateral thinker and strategic in her approach, Namita has an Advanced Management Degree in CSR and Leadership from Swenska Institute, Sweden, Bachelor degree in Economics from Mumbai University. She is a certified Independent Director.
Namita lives in Mumbai with her husband, Vikas Phadnis, a successful entrepreneur, and one of the promoters at Eurokids and Euroschools in India.

Dr Pankaj Agarwal
Chief Executive Officer, PRM Power Holding AG

Pankaj is a cleantech expert and entrepreneur with over 20 years' experience in financing, business development and commercialization of new technologies in the renewable energy sector with particular emphasis on renewable energy (solar and wind) and fuel cell technology.
He is the founding partner at PRM Partners, which is establishing a fund is to promote innovative business models for establishing renewable energy distributed power. He is also the founder and Managing Director of Panitek AG, an investment advisory firm, based in Liechtenstein and India and active in the field of clean tech, new materials and deployment of new and sustainable technologies worldwide.
In 2007 he co-founded Indian Energy Limited, an Indian focused renewable energy independent power producer which listed on the London Stock Exchange (AIM) in 2009 and acquired by Infrastructure India PLC in 2011. He is on the board of Sinmat Inc., a US-based nanotechnology company and is an advisor to Next Hydrogen, a Canadian electrolyzer manufacturer.
Pankaj has a Ph.D. in Chemical Engineering from University of Florida, Gainesville, MBA from the Rotterdam School of Management and Bachelors in Chemical Engineering from the Indian Institute of Technology, Kanpur, India. Pankaj has published over 40 papers in International Journals, holds one patent and has been a speaker at several international conferences and events. He is on the scientific committee of the 3rd Intl. Conference UNESCO Chair in Technologies for Development, Lausanne, 2014. He is on the executive committee of Swiss India Business Forum (SIBF) a Lausanne based association with the objective of promoting business links between India and Switzerland. He speaks English, French, German, Hindi and Bengali.

Uday Khemka
Vice Chairman, SUN Group

Mr. Uday Khemka is Vice-Chairman of the SUN Group of companies and has more than 24 years of investment, investment banking and entrepreneurial experience in varied emerging markets with a particular focus on India and the countries of the former Soviet Union.
Prior to SUN, Uday Khemka worked with Credit Suisse First Boston and Morgan Stanley in London and New York and then established and led Morgan Stanley's investment banking operations in India.
Uday has been deeply involved in the Group's principal investments in the food and beverage, oil and gas, mining and real estate sectors and is a Director of SUN Gold. He has also led SUN's investment management activities and the creation of focused fund franchises in SUN's core markets, including joint ventures with Apollo Real Estate Advisors (AREA), Sequoia Capital and others.
Uday is on the Board of Governors of the Indian School of Business (ISB) in Hyderabad, the Board of The Synergos Institute in New York and has been elected a Young Global Leader at the World Economic Forum in Davos.
Educated at Eton College, he received his undergraduate and Masters degrees at Cambridge University and received an MBA with distinction from Harvard Business School (Baker Scholar).

ACKNOWLEDGEMENTS

This report is the product of valuable contributions and insights of a large number of people who participated in its research, writing and review. We are especially grateful to our partners:

Goldman Sachs Center for Environmental Markets

The Goldman Sachs Center for Environmental Markets partners with corporations, academic institutions, and non-governmental organizations to conduct research and develop pilot projects that inform public policy and help further market-based solutions to environmental challenges. The Center shares its findings though publications, research papers, conferences, and targeted outreach. Since its inception in 2006, the Center has focused on global partnerships to address clean energy, energy efficiency, and market solutions surrounding greenhouse gas emissions, forest carbon and ecosystems, and water.

Dutch Postcode Lottery

Principal partner of Bijli – Clean Energy for All

The Dutch Postcode Lottery (Nationale Postcode Loterij) has been raising funds since 1989 to support organisations working towards a fairer and greener world. Fifty percent of the lottery's annual turnover goes to charity. The lottery has steadily grown to become the biggest charity lottery in the Netherlands and supports 92 non-governmental organisations. Since its founding, the lottery has dispensed over 4.4 billion euros to its beneficiaries.

For 2014, thanks to its 2.5 million participants, who bought more than 4 million lottery tickets collectively in 2014, a total of 312 million euros is distributed to non-governmental organisations.

EXTERNAL CONTRIBUTORS:

We would like to thank Gaurav Gupta, Swetha Totapally, Pallavi Jayannavar and Kishan Shah from Dalberg Global Development Advisors for their expertise in researching and writing as well as the guidance and leadership from the International Expert Panel members detailed from page 91.

Numerous individuals and corporates have contributed to this report with their expertise through interviews and thoughtful suggestions. We are grateful for their support and guidance throughout the process and recognize that they have not seen the entire report and may not subscribe to its outcome.

THE CLIMATE GROUP CONTRIBUTORS:

Amy Davidsen, Krishnan Pallassana, Jarnail Singh, Jay Shiv, Paul Walker, Sarah Parrish, Subaskar Sitsabeshan

Editor - Clare Saxon Ghauri
Designer - Jo Violaris
Photography - (cover image and images on pages: 04, 05, 06, 21, 25, 27, 28, 29, 30, 37, 42, 47, 72 and 77) - © Jarnail Singh

ABOUT THE CLIMATE GROUP:

THE CLIMATE GROUP

The Climate Group is an award-winning, international non-profit. Our goal is a prosperous, low carbon future. We believe this will be achieved through a 'clean revolution': the rapid scale-up of low carbon energy and technology.

We work with corporate and government partners to develop climate finance mechanisms, business models which promote innovation, and supportive policy frameworks. We convene leaders, share hard evidence of successful low carbon growth, and pilot practical solutions which can be replicated worldwide.

Our offices are in Greater China, North America, India and Europe. 2014 was The Climate Group's 10th Anniversary.

CONTACT INFORMATION

Europe
Second Floor, Riverside Building
County Hall, Belvedere Road
London, SE1 7PB, United Kingdom
Tel: +44 (0) 20 7960 2970
Fax: +44 (0) 20 7960 2971

India
Room Number 1203, 12th Floor,
Chiranjiv Tower, 43, Nehru Place,
New Delhi, 110019, India
Tel: +91 11 4200 3342 / +91 11 4200 3343

North America
145 West 58th Street, 2A,
New York City, NY, 10019, USA
Tel: +1 (646) 233 0550

Greater China (Incl. Hong Kong)
Suite 1501 Golden Tower, 1 Xibahe South Rd,
Chaoyang District, Beijing, 100028, China
Tel: +86 10 64403639

TheClimateGroup.org

Feedback and requests for information should be sent to:

info@theclimategroup.org

Follow Twitter.com/ClimateGroup for daily #CleanRevolution news