





# Innovations for Scaling Green Sectors



MINISTRY OF FOREIGN AFFAIRS OF DENMARK  
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**Mailing Address:** MSN I9-900 1818 H St. NW, Washington D.C., 20433 USA

**Telephone:** (+1) 202-458-4070

**Website:** [www.infoDev.org](http://www.infoDev.org)

**Email:** [info@infodev.org](mailto:info@infodev.org)

**Twitter:** @infoDev

**Facebook:** /infoDevWBG

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# Abbreviations

ADB	Asian Development Bank	ETP	Effluent Treatment Plant
AMADER	Agency for Development of Household Energy and Rural Electrification	EWASA	E-Waste Association of South Africa
AMC	Annual Maintenance Contract	EWM	E-Waste Management
ARPU	Average Revenue Per User	FINGO	Financial Non-Government Organization
ATM	Automated Teller Machine	FISEA	Investment and Support Fund for Businesses in Africa
B2B	Business-to-Business	FRES	Foundation Rural Energy Services
BMGF	Bill and Melinda Gates Foundation	FX	Foreign Exchange
BoP	Bottom of the Pyramid	GBA	German Business Association
BVP	Bessemer Venture Partners	GCF	Green Climate Fund
CAGR	Compounded Annual Growth Rate	GEF	Global Environment Facility
CAPEX	Capital Expenditure	GIIN	Global Impact Investing Network
CCF	Climate Change Fund	GIZ	Gesellschaft für Internationale Zusammenarbeit
CETP	Common Effluent Treatment Plant	Global LEAP	Global Lighting and Energy Access Partnership
CIC	Climate Innovation Center	GLOWDEP	Global Women Development Partners
C-MET	Centre for Materials for Electronics Technology	GOGLA	Global Off Grid Lighting Association
CSR	Corporate Social Responsibility	ICT	Information and Communication Technology
CVF	Climate Venture Facility	ICVIT	Indo-Canadian Village Improvement Trust
CWIT	Countering WEEE Illegal Trade	IDCOL	Infrastructure Development Company Limited
CWP	Community Water Purification	IoT	Internet of Things
DBO	Design-Build-Operate	IRIS	Impact Reporting and Investing Standards
DBT	Design-Build-Transfer	IRR	Internal Rate of Return
DCA	Development Credit Authority	IT	Information Technology
DfD	Design for Disassembly	IWM	Industrial Wastewater Management
DFI	Development Finance Institution	JBIC	Japan Bank for International Cooperation
DFID	Department for International Development	KLD	Kilo Liters per Day
DWHC	Decentralized Water Health Center		
DWP	Dutch Water Partners		
EMI	Equated Monthly Installment		
EPR	Extended Producer Responsibility		
ESCO	Energy Service Company		





KPI	Key Performance Indicator
kW	Kilowatt
LAC	Latin America and the Caribbean
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MENA	Middle East and North Africa
MFI	Microfinance Institution
MLD	Million Liters per Day
MNO	Mobile Network Operator
MoLGRD	Ministry of Local Government and Rural Development
Mt	Million Metric Tons
MW	Megawatt
NAFA	Netafim Agricultural Financing Agency
NBFC	Non-Banking Financial Company
NGO	Non-Governmental Organization
O&M	Operations and Maintenance
OECD	Organisation for Cooperation and Economic Development
OEM	Original Equipment Manufacturer
OPIC	Overseas Private Investment Corporation
OWM	Online Platforms for Waste Management
PAYG	Pay-As-You-Go
PE	Private Equity
PHED	Public Health Engineering Department
PO	Partner Organization
PPA	Power Purchase Agreement
ppm	Parts per Million
PPP	Public-Private-Partnership
PRI	Program-Related Investment

PRO	Producer Responsibility Organization
PWD	Public Works Department
PWRF	Philippines-Water Revolving Fund Support Program
R&D	Research and Development
RECP	Renewable Energy Cooperation Program
RO	Reverse Osmosis
ROI	Return on Investment
SACCO	Savings and Credit Society
SAFL	Sustainable Agro-commercial Finance Limited
SAS	Solar-As-a-Service
SDG	Sustainable Development Goal
SHS	Solar Home Systems
SPI	Solar Power International
SPV	Special Purpose Vehicle
SWARM	Site Wizard for Analysis, Reconnaissance, and Mapping
TAPP	Tanzania Agricultural Productivity Program
TDS	Total Dissolved Solids
UAE	United Arab Emirates
UK	United Kingdom
USAID	United States Agency for International Development
VC	Venture Capital
VLE	Village Level Entrepreneur
W	Watts
WASH	Water, Sanitation and Hygiene
WBG	World Bank Group
WHO	World Health Organization
WRI	World Resource Institute

## Executive Summary

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Green sectors, such as renewable energy and sustainable agriculture, are some of the most important economic sectors for meeting the targets agreed in the Paris Climate Accord, achieving the Sustainable Development Goals (SDGs), and realizing overall development gains in the coming decades. Investment in green sectors in developing countries is expected to reach \$6.4 trillion over the coming decade, with \$1.6 trillion of that investment accessible to small and medium-sized enterprises.

Despite the enormous economic potential of green sectors and the efforts led by governments, donors, and other stakeholders to boost the growth of these sectors, many green sectors have not achieved scale, as defined by multiple sustainable green enterprises competing in the same markets and reaching millions of consumers.

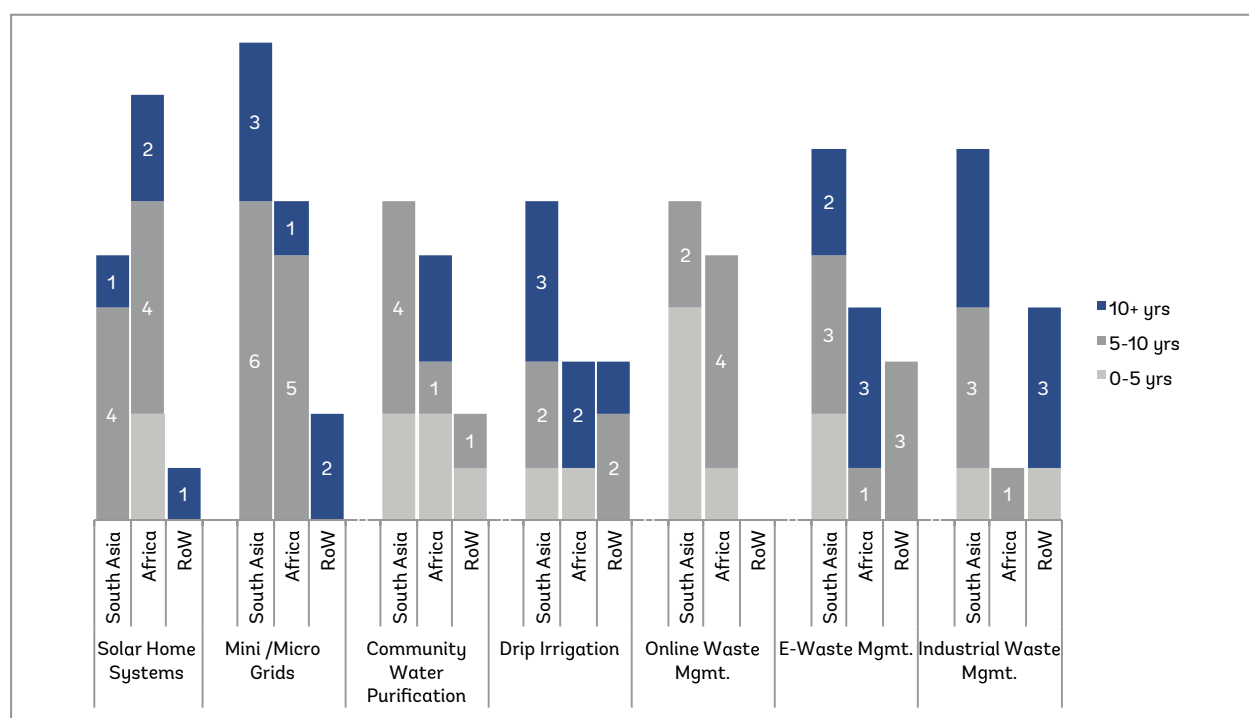
What does it take to scale up the growth of green sectors? This study was initiated to shed light on the common challenges that have limited the scaling of green enterprises and the emergence of competitive green sectors in developing countries. It also aims to uncover and catalog emerging opportunities that offer potential for enabling the scale up of these sectors in ways that might not have been possible in the past due to lack of a technology platform, mature business model, or other emerging opportunity. Finally, the study offers key recommendations for donors, governments, development finance institutions (DFIs), and entrepreneurial supports organizations that support green enterprises and seek to scale green sectors in developing countries.

The study focuses on enterprises operating across five green sectors—climate-smart agriculture, renewable energy, solid waste management, drinking water purification and management, and wastewater management. Within these five sectors, the study takes a deeper dive into seven subsectors that provide an interesting mix of business models, some of which are scalable and replicable, offer insights for other subsectors, and highlight innovative responses to the common challenges that green sectors face. These subsectors are solar home systems (SHS), mini/micro grids, community water purification, drip irrigation systems, online platforms for waste management, e-waste management, and industrial wastewater management.



The case studies exploring the seven subsectors used business models as the unit of analysis to examine and understand how green enterprises design the successful operation of their business, identify revenue sources, customer base, and details of financing. As such, 15 business models were analyzed across the seven green subsectors to better understand the various internal and external factors that impact the ability of green enterprises to scale up (within a single market) and scale out (replication across countries). Establishing scalable or replicable business models has been demonstrated as an important path to deliver market-oriented solutions at scale in lower income markets. The case studies included primary interviews with 66 green enterprises, secondary research of 34 additional green enterprises, and a literature review focused on the seven subsectors.


Figure ES1. Sectoral and Geographical Distribution and Age of Green Enterprises Reviewed



### What Makes Green Sectors Different?

Green sectors – from clean energy to climate smart agriculture – share some common features that set them apart from other sectors. First, the majority of green enterprises deliver physical products to market, whether they are cook stoves, drip irrigation systems, or water purification products. Second, green enterprises are highly dependent on regulatory regimes and the public sector more generally. Third, green enterprises have high upfront capital needs related to the need for prototyping, development, and testing, and financing distribution of physical products. Finally, green enterprises typically take longer than average enterprises to reach profitability and the steep part of the enterprise growth curve.

Figure ES2. What Makes Green Sectors Different?

 <b>What Makes Green Sectors Different?</b>	
<b>Need of last mile delivery</b> Green enterprises deliver physical products to market	<b>High dependency on policy support</b> Green enterprises are highly dependent on regulatory regimes and the public sector more generally
<b>Capital intensive</b> Green enterprises have high upfront capital needs	<b>Green enterprises take longer to reach profitability</b> Green enterprises, on average, have longer “gestation” periods before they reach profitability and the steep part of the enterprise growth curve

## The Challenge of Scaling Green Sectors

The case studies and other research conducted for this study revealed several common challenges for scaling green sectors:

- » **Green markets are “push” markets, still immature and in need of nurturing.** While green markets overall are large in developing countries, they are still in very early stages of development. Most product offerings are not widely known in the marketplace and the demand for these products is not well articulated. Hence, green markets tend to be “push” markets—enterprises and other like-minded stakeholders must work actively to build the market, rather than simply addressing an existing market with new offerings.
- » **Green businesses launch but few commercialize.** Compared to non-green sectors, relatively few green enterprises in the subsectors studied move beyond the startup phase into successful growth and commercialization stages. Moreover, many enterprises reported growth rates of less than 10 percent after the initial four to five years of operation, a pace not commensurate with achieving wide-scale impact or accessing traditional investment opportunities. Various factors common to green businesses, including long gestation periods, high upfront capital costs, and policy dependence, eliminate a high percentage of businesses after initial startup.
- » **Green businesses are not venture capital-style investment opportunities and need different types of financing suitable to the characteristics of the sector.** Many of the existing financing instruments in place for green businesses seek to replicate the angel, venture capital, and private equity models that have been successful in building the software and electronics sectors in developed countries. However, evidence suggests that venture capital, even in developed countries, is the wrong model of financing for green enterprises that are capital intensive, have a longer timeframe of growth, and cannot deliver the outsized returns required by the venture capital model. This study reveals that this is particularly true in developing countries, where the additional challenges of those markets lead to generally slower growth and longer investor payback periods. Different types of financing suited to the needs of the green sectors are lacking.



» **Green sectors cannot grow without proper regulations and, in some cases, subsidies.**

Every green sector is heavily regulated. Governments play key roles of regulators, enablers, and, at times, customers for these sectors. As a result, without clear and well-implemented regulations, it is difficult for green businesses to grow and scale. The reality is that, in developing countries, regulations in green sectors are generally incomplete, unclear, and applied inconsistently. While subsidies have played an important role in scaling some green subsectors, it is important to keep in mind that subsidies, if not well-thought out and smartly implemented, can create market distortions and impose fiscal costs.

Table ES1. Common Challenges for Scaling Green Sectors

Challenge	What Does This Mean?
<b>Green Markets are “Push” Markets: Still Immature and In Need of Nurturing</b>	<ul style="list-style-type: none"> <li>• The customer base in most green sectors is fragmented</li> <li>• There is low customer awareness of both green product markets and specific products in the marketplace</li> <li>• A flood of low quality green products that are being widely distributed in developing countries creates additional market barriers</li> <li>• Green markets are frequently distorted by a myriad of government and donor funded programs</li> </ul>
<b>Green Businesses Launch but Don’t Grow: Few Move Into Commercialization</b>	<ul style="list-style-type: none"> <li>• Green sectors might attract fewer high quality, experienced entrepreneurs, and strong management teams</li> <li>• Green businesses face inadequacies in infrastructure and logistics services</li> <li>• Green technologies and markets are immature, with businesses still struggling to work through business models, master the technologies, and adapt them for sale in those markets</li> </ul>
<b>Green Businesses Are Not Venture Capital-Style Investment Opportunities: Different Types of Financing Suited to the Characteristics of the Sector are Needed</b>	<ul style="list-style-type: none"> <li>• There is a gap in the availability of early stage risk capital in a form that is appropriate for the capital-intensive, slower growth nature of green businesses</li> <li>• There is a gap in availability of non-equity forms of capital -- working capital, debt, and consumer financing -- for green enterprises at the growth stage</li> <li>• Currency and convertibility risk can hamper the roll out and growth of green business in developing countries</li> </ul>
<b>The Private Sector Cannot Go It Alone: Green Sectors Do Not Grow without Proper Regulation (and Subsidies)</b>	<ul style="list-style-type: none"> <li>• It is difficult for green business to grow and scale without clear and well-implemented regulations</li> <li>• Green entrepreneurs depend heavily on the overall environment and ecosystem for entrepreneurship</li> </ul>

### Opportunities: What Can Be Done to Reach Scale?

The challenges that impede scaling of green sectors also offer numerous opportunities for green enterprises to improve market penetration in existing areas of operation (scale up), develop products to suit specific customer segments, and expand to other geographic regions (scale out). The study highlighted opportunities ranging from less expensive business model innovations and strategic partnerships to more expensive, but rapid scale solutions such as developing technology platforms, and market building and de-risking mechanisms:

- » **Business model innovations.** Across the seven case studies, business model innovations emerged as a better source of competitive advantage and were comparatively less expensive and time consuming than technology or product design innovations. They also marked a positive tipping point in the growth of green sectors. The pay-as-you-go (PAYG) model is one such business model innovation that has been a game changer for the SHS subsector. Companies such as M-Kopa and Mobisol have been in the forefront, using payment systems such as M-PESA, Airtel and MTN mobile money. This combination of solar and mobile technology is bringing affordable solar technologies to off-grid villages.
- » **Enabling technology platforms.** Almost as important as new business models to the success of green sectors are enabling technology platforms that provide new opportunities and lower the scaling cost for enterprises across an entire green subsector. Safaricom's M-PESA is the leading technology platform behind the mobile money revolution in Kenya. For unbanked Kenyans and many other countries where mobile money has expanded, M-PESA has become far more than a way to send money home. It has revolutionized off-grid markets in East Africa by enabling PAYG customers to make their periodic payments for SHS easily and securely.
- » **Market creation and de-risking mechanisms.** The case studies also highlighted how creating and de-risking markets remains necessary to scale green sectors despite the existing policies and donor initiatives that target green sectors. Certification programs such as Lighting Africa and Lighting Global, by establishing quality standards and best practices, have provided the much needed clarity in the marketplace for consumers and ensured that poor quality products do not spoil the market for green products. Trade and industry associations such as the Global Off Grid Lighting Association (GOGLA), the Alliance for Rural Electrification, the Association of Water Technologies, and the e-Waste Association of South Africa have played an important role in building the nascent green market in developing countries.



- » **Specialty financing instruments for green businesses.** New specialty financial instruments will be equally important to the success of other green sectors. Since green enterprises do not generally follow the growth trajectory needed to attract VC and PE investors, concessional and blended finance will be needed to meet the high initial investments and long payback periods required in many green sectors. Three innovative green financing instruments particularly stood out from the case study research: (i) the World Bank Group's climate venture facilities (CVFs) that specifically target early-stage green enterprises with patient financing and investments below US\$1 million, (ii) growth-stage debt and working capital facilities that are being developed to provide green enterprises with lower-cost operating and expansion capital, and (iii) new instruments that are being developed to provide mitigation of local currency and interest rate risk for green enterprises.
- » **Technology and business model transfer.** New and specific efforts to transfer technology or business models from one country to another represent another emerging approach to enabling scale. While this approach is showing promise, it is too early to judge whether technology or business model transfer will succeed in helping to scale green sectors. The World Bank Group's Climate Technology Program and Factor(E), co-created by the Shell Foundation and Colorado State University's Energy Institute, bring international investors and established technology and business models together with entrepreneurs in developing countries to help the latter access these known approaches.
- » **Strategic partnerships.** While perhaps not novel, one of the most effective ways that green sectors have achieved scale has been through building strategic partnerships. These partnerships were seen across multiple areas in the case studies, ranging from assistance in customer outreach (distribution strategy), improving customer awareness, to customer financing and innovation in product development. Off grid solar enterprise Nova Lumos's partnership with MTN, Nigeria's largest telecommunications provider, has enabled the former to gain access to all MTN customers who can now subscribe to alternative electricity on demand using their mobile phone.



Table ES2. Opportunities and Innovations for Scaling Green Sectors

Opportunity	Examples
<b>Business Model Innovations</b>	<ul style="list-style-type: none"> <li>• Mobile-enabled PAYGO financing mechanism has fostered the development of green subsectors such as SHS</li> <li>• Bundled service combines related product offerings and builds forward and backward integration for products and services to offer packages of solutions.</li> <li>• Credit history facilitation for low-income customers through initial sales and monthly payment history allows customers to upgrade and access credit for other purposes and from other finance providers</li> </ul>
<b>Enabling Technology Platforms</b>	<ul style="list-style-type: none"> <li>• Technology that allows for rapid credit appraisal of potential low-income consumers is being piloted</li> <li>• Technology platforms / MNOs that enable payments and collections ( such as Safaricom's M-PESA for payments)</li> <li>• Convergence and combination of multiple technology-backed services has enabled an overall drop in costs such as smart meters, mobile money and low-cost solar for SHS</li> </ul>
<b>Market Creation and De-Risking Mechanisms</b>	<ul style="list-style-type: none"> <li>• Quality certification programs that establish quality standards and best practices provide clarity in the marketplace for consumers and ensure that poor quality products do not spoil the market for green products</li> <li>• Trade and industry associations can provide services such as policy development and analysis, training, codes of practice, industry promotion, networking, conferences, and industry updates</li> <li>• Development of robust data metrics allow investors interested in green enterprises to measure the economic, social, and environmental performance of their investment are important tools to drive sector development</li> </ul>
<b>Specialty Financing Instruments for Green Businesses</b>	<ul style="list-style-type: none"> <li>• Specialty financing mechanisms that invest in early stage green enterprises such as World Bank Group's climate venture facilities (CVFs), growth stage low-cost debt and working capital facilities, and instruments that provide mitigation of local currency and interest rate risk for green enterprises can drive green subsectors</li> </ul>
<b>Technology and Business Model Transfer</b>	<ul style="list-style-type: none"> <li>• Specific efforts to transfer technology or business models from one country to another can potentially enable scale</li> <li>• Matchmaking of foreign businesses or technology with local businesses is being piloted to help successful green businesses and business models to scale out</li> </ul>
<b>Strategic Partnerships</b>	<ul style="list-style-type: none"> <li>• Choosing the business partner and area of collaboration has enabled many green enterprises to operationally scale their businesses both in their home countries and expand outside to cover a larger customer base.</li> <li>• Partnerships for building customer awareness and for customer financing help green businesses in market building and reaching potential customers.</li> </ul>





Multilateral and bilateral development financing institutions (DFIs) and impact investors should lead the way in creating innovative financing mechanisms for green enterprises. First, risk capital financing has been shown as a missing type of financing necessary for scaling green enterprises. Second, these institutions should test and rollout local currency financing instruments to help enterprises mitigate currency and foreign exchange (FX) rate risk. Green enterprises that need to borrow in hard currency and invoice in local currency are significantly hampered by these challenges.

Entrepreneurial support organizations and foundations are often those most closely connected to the individual green enterprises. As such, one opportunity that stands out for the efforts of these organizations is to experiment with business model and skills transfer programs. This research has highlighted how innovative business models and skilled entrepreneurs are still lacking in most green sectors and can be the critical factor to scale green sectors.

Collectively, these efforts build what can be called the “market infrastructure” that is needed to support the development of green sectors. Green subsectors should be supported by effective regulation, industry organizations, appropriate financing instruments, and enabling technology platforms. Donors, governments, financiers, and other actors must take these long-term, complementary actions to build market infrastructure, while also supporting piloting and experimentation of business models, to scale green sectors.



# Introduction

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Green sectors are some of the most important economic sectors for meeting the targets agreed in the Paris Climate Accord, achieving the Sustainable Development Goals (SDGs), and realizing overall development gains in the coming decades. They can help to accelerate progress towards sustainable development and poverty reduction through more efficient use of natural resources, provision of clean energy and water, and building resilience of households to the impacts of climate change.

Green sectors encompass all economic activity related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy. As such, green sectors include renewable energy, energy efficiency, sustainable agriculture, water management and purification, resource efficiency, and waste management.

By definition, the products and services offered by enterprises in these sectors provide environmental benefits that better manage natural resources or reduce climate-related or other pollution. Green products also positively affect the everyday lives and wellbeing of citizens, including poor and rural consumers. Clean cook stoves reduce the indoor air pollution that is a leading cause of death in the developing world,<sup>1</sup> and clean drinking water kiosks reduce risks of water-borne infectious diseases and improve overall health outcomes. Off-grid solar home systems and mini-grids provide electricity to a growing number of rural homes and small businesses, keep the lights on in hospitals and schools, and power irrigation for farmers.

Recently, increasing attention is being given to the economic opportunity that green sectors offer to developing countries, such as the potential to boost jobs and incomes through increased investment in green, low-carbon technologies.<sup>2</sup> Investment in green sectors in developing countries is estimated to reach over US\$6.4 trillion in the decade leading up to 2023.<sup>3</sup>

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1 According to the World Health Organization (WHO), 4.3 million people a year die prematurely from illness attributable to the household air pollution caused by the inefficient use of solid fuels for cooking. 2012 WHO data, accessed from <http://www.who.int/mediacentre/factsheets/fs292/en/>

2 The Global Commission on the Economy and Climate (2014) Better Growth, Better Climate – The New Climate Economy Report, Global Report. <http://newclimateeconomy.report/2014/>

3 The \$6.4 Trillion Climate and Clean Technology Opportunity, World Bank Group (2014), accessed in April 2017, <http://blogs.worldbank.org/psd/64-trillion-climate-and-clean-technology-opportunity>

This has led governments, donors, and stakeholders interested in economic development to look for market-oriented strategies to boost the growth of green sectors in developing countries. Programs range from support for and investment in individual businesses to sector-wide strategies and initiatives. The World Bank Group (WBG) Climate Technology Program has established seven Climate Innovation Centers (CICs) to support clean technology ventures and green enterprises with technical knowledge, capital, and access to markets.<sup>4</sup> Another WBG initiative, the Global Environment Facility (GEF), has collectively channeled over US\$4.8 billion to support low-carbon and carbon-resilient development in client countries.<sup>5</sup> The Asian Development Bank's (ADB) Climate Change Fund (CCF) was established in 2008 to facilitate greater investment in developing member countries to effectively address the cause and consequences of climate change through capacity building, development of knowledge products and services, and facilitating knowledge management activities. Similarly, several large foundations such as the Lemelson Foundation and the Shell Foundation have focused extensively on promoting green enterprises and markets.

The success of these various initiatives has been modest to date, with only a small number of green subsectors reaching significant scale. For instance, the off-grid energy and lighting subsectors have witnessed impressive growth in the past few years and have begun to attract significant investment.<sup>6</sup> There has been a steady increase in the number of off-grid enterprises in operation that collectively have reached millions of customers who previously lacked energy or had poor energy options.<sup>7</sup> Though these trends are promising, many of these enterprises are nascent and would need to rapidly scale up the delivery of clean energy services to make a significant impact in achieving the ambitious energy access goals in the SDGs. Furthermore, only a few of the enterprises operating in these subsectors have proven long-term sustainability or achieved profitability at scale.<sup>8</sup>

Most other green sectors in developing countries, however, have not achieved scale as defined by multiple sustainable enterprises competing in the same markets and reaching millions of consumers.<sup>9</sup> For example, clean drinking water is potentially an enormous market throughout the developing world, but only a limited number of enterprises have reached scale in selling clean water as a product. Similarly, only a few businesses in climate-smart agriculture have reached millions of consumers and operate sustainably and, as this report finds, they are struggling to find scalable, profitable business models. It is difficult to point to a developing

<sup>4</sup> See [www.infodev.org/climate](http://www.infodev.org/climate)

<sup>5</sup> World Bank Group 2014 data, accessed from <http://www.worldbank.org/en/topic/climatechange/brief/gef>

<sup>6</sup> The off-grid solar sector has attracted more than US\$511 million in investments to date, with sharp increase in recent years. PAYG companies have attracted almost US\$160 million in 2015. GOGLA's Source: [https://www.gogla.org/sites/default/files/recource\\_docs/investment-study-vol-2.pdf](https://www.gogla.org/sites/default/files/recource_docs/investment-study-vol-2.pdf)

<sup>7</sup> 3.77 million off-grid solar products were sold in the second half of 2016, with Sub-Saharan Africa and South Asia accounting for 50 percent and 38 percent of units sold, respectively. To date, 110.9 million people have benefitted from off-grid solar products. For more details, see GOGLA (2017) Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data. [https://www.gogla.org/sites/default/files/recource\\_docs/final\\_sales-and-impact-report\\_h22016\\_full\\_public.pdf](https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf)

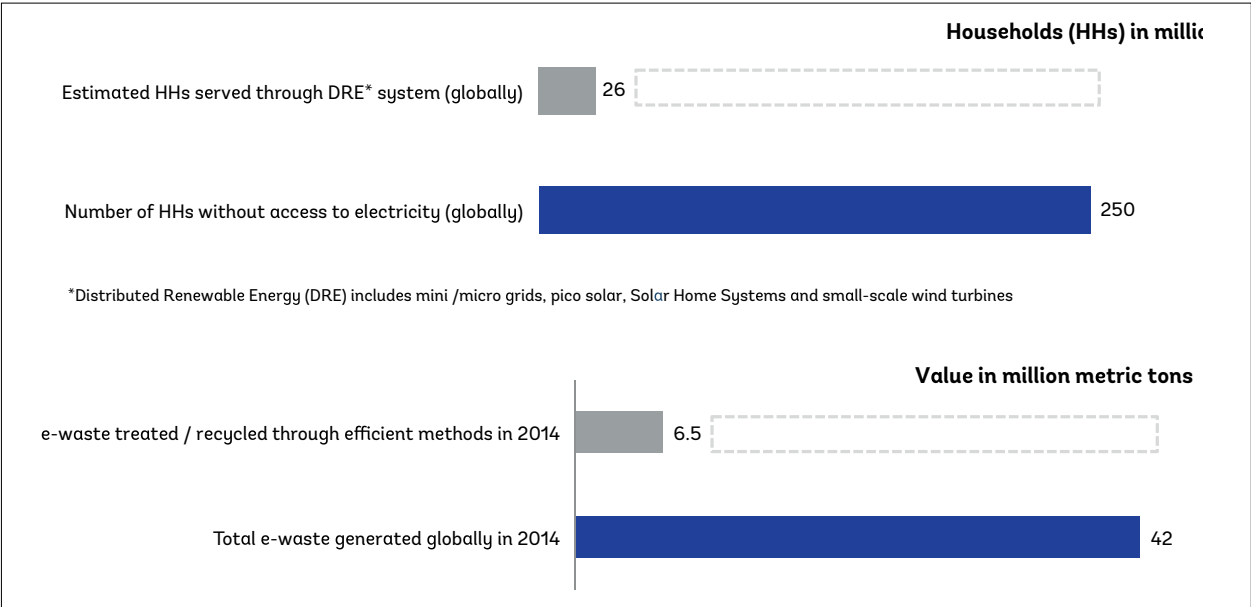
<sup>8</sup> Shell Foundation (2014), "Accelerating Access to Energy: Lessons Learned from Efforts to Build Inclusive Energy Markets in Developing Countries," [http://www.shellfoundation.org/ShellFoundation.org\\_new/media/Shell-Foundation-Reports/Final-A2E-Report-low-res-no-date-on-front.pdf](http://www.shellfoundation.org/ShellFoundation.org_new/media/Shell-Foundation-Reports/Final-A2E-Report-low-res-no-date-on-front.pdf)

<sup>9</sup> Utility-scale renewable energy has been excluded from the analysis in this report as the subsector is organized like infrastructure sectors, with "projects" and project finance, rather enterprises and enterprise finance, dominating activity and investment in the subsector.



country that has a large and competitive climate smart agriculture sector. Figure 1 illustrates the scope of two challenges in the developing world that green enterprises seek to address. Enterprise based solutions, while only one aspect of addressing such challenges, offer the potential to deliver needed solutions to millions of consumers and businesses facing these and similar challenges that green enterprises are well suited to address.

**Figure 1. Green Solutions Delivered at Scale Can be an Important Aspect of Solving Development Challenges**



So, what does it take to scale up the growth of green sectors? This study was initiated to shed light on the common challenges that have limited the scaling of green enterprises and the emergence of competitive green sectors in developing countries. It also aims to uncover and catalog emerging opportunities that show potential for enabling the scale up of these sectors in ways that might not have been possible in the past due to lack of a technology platform, mature business model, or other emerging opportunity. The study uses business models as its unit of analysis because establishing scalable or replicable business models has been demonstrated as an important path to deliver market-oriented solutions at scale in lower income markets.<sup>10</sup>

The challenges to growing green enterprises are complex, and scaling up green sectors requires multi-faceted approaches. The development of newly emerging sectors requires long-term efforts across various dimensions, including policy and regulations, technological and financial innovation, business model experimentation and replication, workforce development, and others. This study identified several opportunities for scaling up green sectors more rapidly. We suggest some key recommendations for how various stakeholders – including donors, governments, development finance institutions (DFIs), and entrepreneurial support organizations—can take new and more effective actions towards scaling green sectors.

10 Michael Kubzansky in Chandy et al., Eds. (2013), “Why Business Models Matter” adapted from “Getting to Scale: How to Bring Development Solutions to Millions of Poor People.”

## Assessing the Green Business Landscape

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This research chose to focus on green enterprises spread across five sectors - climate-smart agriculture, renewable energy, solid waste management, drinking water purification and management, and wastewater management – which are of immediate and long-term importance to the developing world. Subsectors within those, such as solar home systems, mini-grids, drip irrigation kits, community water purification units, and green water automated teller machines (ATMs), offer specific products to address problems ranging from lack of energy access to suboptimal resource usage in agriculture to paucity of clean drinking water, often in remote or poor communities. Other subsectors, such as industrial wastewater management and solid waste management, create infrastructure for safe disposal of the increasing amounts of pollutants that are generated in the developing world.

Within these sectors, this study focused on a set of seven subsectors that provide an interesting mix of business models, some of which are scalable and replicable, offer insights for other subsectors, and highlight innovative response to the common challenges that green sectors face. These subsectors were selected because they offer a good number and range of enterprises for research, indicate evidence or potential for scale, and have attracted interest from either traditional commercial or impact investors. Further, enterprises operating in these subsectors have demonstrated some ability to design, test, and implement radical changes in their mode of operations to improve efficiency or profitability, and the potential to adapt to changing market conditions, regulations, and customer preferences, as frequently encountered in green sectors.

Table 1 describes the seven green subsectors covered in this report and their relevance to developing countries.

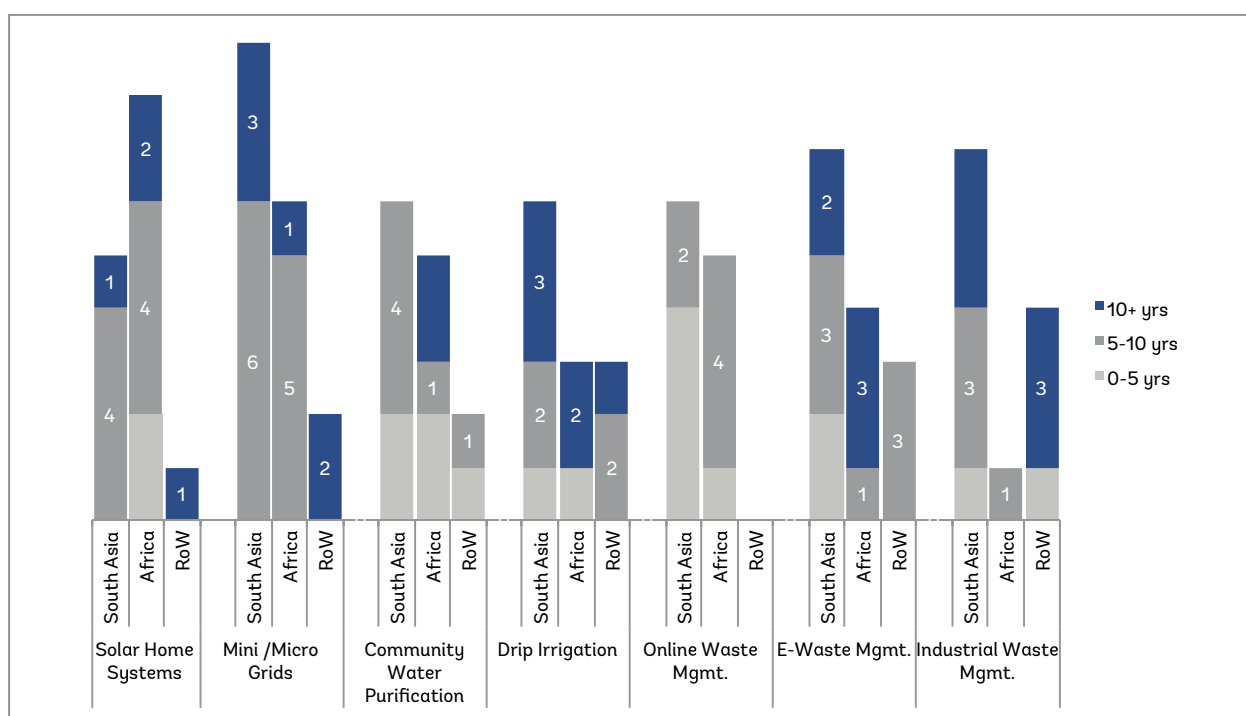


Table 1. Subsectors Covered in This Research

Subsector	Description	Market Size / Potential
<b>Solar Home Systems</b>	<ul style="list-style-type: none"> <li>Meets the energy and lighting needs of off-grid customers and provides a clean alternative to fossil fuel-based solutions such as kerosene</li> <li>Have different wattage to operate products from LED bulbs , mobile chargers to LCD televisions</li> </ul>	<ul style="list-style-type: none"> <li>Global market size in 2015: ~US\$0.7 billion</li> <li>Estimated retail sales in 2020: US\$3.1 billion at a CAGR of 35%</li> <li>Estimated sales of 55 million new systems in Asia and Africa by 2020</li> </ul>
<b>Mini/Micro Grids</b>	<ul style="list-style-type: none"> <li>Well suited to provide energy to remote locations lacking access to the main electricity grid</li> <li>Use solar, biomass, wind or hydro sources to generate electricity. Installed capacity of up to 1 MW</li> </ul>	<ul style="list-style-type: none"> <li>Global market size in 2013: ~ US\$9.8bn</li> <li>Estimated market size in 2020: ~US\$35.1 billion at a CAGR of more than 20%.</li> </ul>
<b>Community Water Purification</b>	<ul style="list-style-type: none"> <li>Involves developing and providing water purification technologies, dispensing units, water cans</li> <li>Serves customers who lack access to improved sources of drinking water.</li> </ul>	<ul style="list-style-type: none"> <li>The bottom of the pyramid (BoP) drinking water market estimated at US\$20 billion in 2008 in Africa, Asia, Eastern Europe and Latin America</li> </ul>
<b>Drip Irrigation</b>	<ul style="list-style-type: none"> <li>Delivers water directly to crop roots through porous or perforated tubing</li> <li>Can be configured for different farm sizes - small kits serve farms ranging from 20 m<sup>2</sup> to 500 m<sup>2</sup>, larger units half acre to over 10 acre farm plots</li> </ul>	<ul style="list-style-type: none"> <li>Global market size in 2015: ~US\$2.1 billion</li> <li>Estimated market size in 2020: ~ US\$3.6 billion at a CAGR of more than 10%</li> </ul>
<b>Online Platforms for Waste Management*</b>	<ul style="list-style-type: none"> <li>Leverage the availability and prevalence of the internet to facilitate the collection of solid waste</li> <li>Encourages behavior change towards waste disposal and recycling</li> </ul>	<ul style="list-style-type: none"> <li>Global solid waste management market size in 2015: ~US\$180 billion</li> <li>Estimated market size in 2023: US\$300 billion at a CAGR of over 8.5%</li> </ul> <p>* Potential market size for online platforms is not available , solid waste management is used as a proxy</p>
<b>E-Waste Management</b>	<ul style="list-style-type: none"> <li>Involves dismantling &amp; recycling or refurbishing and reuse of electronic products</li> <li>Recovers valuable raw materials from discarded devices such as small equipment and IT gadgets</li> </ul>	<ul style="list-style-type: none"> <li>Global volume of e-waste generated in 2014: ~ 42 million metric tons (Mt)</li> <li>Estimated volume of e-waste generated by 2018: ~ 50 million metric tons</li> </ul>
<b>Industrial Wastewater Management</b>	<ul style="list-style-type: none"> <li>Involves assisting industries such as agricultural processing, metalworking and textile manufacturing to treat effluents before discharge, through physical, chemical and biological processes.</li> <li>Increased water-stress in developing countries has increasingly driven industries to treat and re-use wastewater.</li> </ul>	<ul style="list-style-type: none"> <li>Global market size in 2015: ~US\$65 billion</li> <li>Estimated market size in 2020: ~US\$100 billion at a CAGR of more than 8%</li> </ul>

This study draws from interviews with senior managers and founders of 66 enterprises across countries in the developing world, and from secondary research covering an additional 34 enterprises. Most of these enterprises operate in South and Southeast Asia, Africa, and Latin America. While this sample mostly includes early or growth stage enterprises with a vintage of less than eight years, a few mature and established enterprises are included in each subsector to draw insights from their experiences in scaling up and out.<sup>11</sup> *(See Annex 1 for a list of interviewed enterprises)*

**Figure 2. Sectoral, Geographical Distribution, and Vintage of Green Enterprises Included in the Study**



Within each subsector, various business models were identified that enterprises are implementing and innovating upon to address barriers and leverage business opportunities. Only enterprises with similar products and target markets were included to enable “apples to apples” comparisons. The cross-sector analysis allowed us to understand common and differentiated challenges to scaling green sectors. It also enabled us to identify various sector-wide interventions by private, public, and other stakeholders that have had some success in addressing the identified challenges.

<sup>11</sup> The term “scaling out” used in this report refers to a product or business model that has crossed borders into one or more new countries after achieving some success within a first national market.






# What Makes Green Sectors Different?

In many ways, green businesses are like other businesses operating in challenging, developing country markets, serving a highly risk-averse customer base, and attempting to test new business models. They work in difficult macroeconomic and business environments with confusing and often inconsistent sector regulations, fragmented customer bases, limited financing options, and shortages of talented workers.

At the same time, green sectors – from clean energy to climate smart agriculture – share some common features that set them apart from other businesses. These features warrant collective study and, in some cases, collective responses to address their unique challenges.

Figure 3. What Makes Green Sectors Different?

 <b>What Makes Green Sectors Different?</b>	
<b>Need of last mile delivery</b> Green enterprises deliver physical products to market	<b>High dependency on policy support</b> Green enterprises are highly dependent on regulatory regimes and the public sector more generally
<b>Capital intensive</b> Green enterprises have high upfront capital needs	<b>Green enterprises take longer to reach profitability</b> Green enterprises, on average, have longer “gestation” periods before they reach profitability and the steep part of the enterprise growth curve

First, the majority of green enterprises deliver physical products to market, whether they are cook stoves, drip irrigation systems, or water purification products. These products are often sold in rural or peri-urban areas where few distribution and service partners exist. The nature of their business requires these enterprises to develop and manage a full supply chain or build

(and even finance) strategic partners to ensure last-mile reach.<sup>12</sup> As a result, it takes time for these enterprises to expand to new markets and it is difficult to achieve economies of scale. In some cases, negative economies of scale exist if each additional customer segment becomes harder to serve due to remoteness or ability to pay.

Second, green enterprises are highly dependent on regulatory regimes and the public sector more generally. The government is a key customer or an important enabler for almost all green sectors, whose success is highly influenced by the quality of national and local regulatory regimes. Off-grid solar may be one of the early moving green subsectors because its dependence on regulations is lower than, for instance, water enterprises connected to the water grid or green building construction extensively influenced by building codes. Mini/micro-grid enterprises avoid markets with unclear policy on grid extension and scout for locations where the local government supports off-grid electrification.

Third, green enterprises have high upfront capital needs. This relates to the need for prototyping, development, and testing of physical products, purchasing and maintaining inventory, supporting distribution networks, and financing of lower- or middle-income consumers of green products who are particularly sensitive to risk, cost, and value of these new products. The pay-as-you-go (PAYG) business model, for instance, finances consumer purchases of green products that are paid back over time through irregular, small payments from the consumer. With an average repayment period of three to five years from these consumers, PAYG and similar green business models require significant upfront financing to make the model work.<sup>13</sup>

Finally, green enterprises typically take longer to reach profitability and the steep part of the enterprise growth curve. It has been estimated that it can take 6 to 10 years and anywhere between US\$5 million and US\$20 million for a green enterprise to build a sufficiently strong customer base to achieve a net positive cash flow.<sup>14</sup> While a bit more promising, enterprises included in this research, particularly in the solar home systems (SHS), drip irrigation, community water, and mini/micro-grids subsectors, reported average break-even periods of more than three years and significant profitability achieved only in excess of five years. These longer growth trajectories lead to longer investor payback periods and the need for financial support from investors, governments, donors, and other stakeholders, beyond that provided by the conventional support system for entrepreneurship. For many mainstream equity capital providers, investment horizons are within five years, and hence many of the green enterprises may be deemed too slow moving for obtaining the desired returns on investment.

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12 See *Hardware Pioneers* for further discussion on the unique challenges for businesses that design and deliver physical products to emerging markets.

13 Based on information gathered from primary interviews.

14 Shell Foundation (2014), Executive Summary, [https://www.shellfoundation.org/ShellFoundation.org\\_new/media/Shell-Foundation-Reports/Access\\_to\\_Energy\\_Executive\\_Summary.pdf](https://www.shellfoundation.org/ShellFoundation.org_new/media/Shell-Foundation-Reports/Access_to_Energy_Executive_Summary.pdf)



# The Challenge of Scaling Green Sectors

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Scaling up can be understood as making a product accessible to a significant portion of the population in a market, such as the availability of the iPhone in any developed country or the virtual wallet M-PESA in Kenya. M-PESA, the mobile money system developed by Kenya's dominant telecommunications company, Safaricom, offers a useful example of scaling up in a developing country context. It is a market-based solution that reached a broad section of Kenya's population in less than 10 years. While delivered by a single enterprise, the idea was seeded with donor funding and supported by several partner organizations, to be able to develop and thrive in Kenya's context.<sup>15</sup> This outcome represents a pinnacle of development goals – finding a solution that reaches millions, or even billions, of consumers.

However, an individual enterprise's ability to deliver a product such as the iPhone at scale is a rare case: few individual enterprises across any sector have reached this scale, particularly in the more fragmented markets in developing countries. An important lesson from development experience is that scale is most frequently reached when a significant number of businesses with similar product offerings compete in the same market.<sup>16</sup> This competition fosters innovation (product, process, and marketing), cost reductions, and the economies of scale needed to reach the bulk of consumers. As a result, development interventions frequently target the ecosystem of support for businesses and entrepreneurs. This includes everything from the business environment and sector regulations to entrepreneurial support organizations such as business incubators and accelerators, and venture capital and angel investor networks.

A related concept is scaling out, which refers to successfully replicating a business that is working in one country in other countries. This could be done by the same enterprise. However, in many cases, other enterprises take up an idea from one country, adapt it, and take it into another market.

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15 For more on the development of M-PESA see "Getting to Scale: How to Bring Development Solutions to Millions of Poor People," Edited by Laurence Chandy, Akio Hosono, Homi Kharas, and Johannes Linn, Brookings Institution Press, April 15, 2013.

16 Matt Bannick and Paula Goldman (2012), "Sectors, Not Just Firms," Stanford Social Innovation Review ([www.ssireview.org/blog/entry/sectors\\_not\\_just\\_firms](http://www.ssireview.org/blog/entry/sectors_not_just_firms)).

Both scaling up and scaling out highlight the importance of demonstration effects. Replication can happen somewhat naturally in a single country when competing businesses learn from each other. Replication across countries can also happen naturally, but more often requires a targeted effort by a catalytic third party. Such scaling out needs conscious strategy, and even then, failure is more often the norm.<sup>17</sup> The struggles of M-PESA in penetrating the market in South Africa, where the banking infrastructure is well established, illustrates the challenges of scaling out.<sup>18</sup> However, the successful introduction of mobile money by competitors in Tanzania, for example, shows the positive impacts of the demonstration effect.<sup>19</sup>

**Table 2. Common Challenges for Scaling Green Sectors**

Challenge	What Does This Mean?
<b>Green Markets are “Push” Markets: Still Immature and In Need of Nurturing</b>	<ul style="list-style-type: none"> <li>• The customer base in most green sectors is fragmented</li> <li>• There is low customer awareness of both green product markets and specific products in the marketplace</li> <li>• A flood of low quality green products that are being widely distributed in developing countries creates additional market barriers</li> <li>• Green markets are frequently distorted by a myriad of government and donor funded programs</li> </ul>
<b>Green Businesses Launch but Don’t Grow: Few Move Into Commercialization</b>	<ul style="list-style-type: none"> <li>• Green sectors might attract fewer high quality, experienced entrepreneurs, and strong management teams</li> <li>• Green businesses face inadequacies in infrastructure and logistics services</li> <li>• Green technologies and markets are immature, with businesses still struggling to work through business models, master the technologies, and adapt them for sale in those markets</li> </ul>
<b>Green Businesses Are Not Venture Capital-Style Investment Opportunities: Different Types of Financing Suited to the Characteristics of the Sector are Needed</b>	<ul style="list-style-type: none"> <li>• There is a gap in the availability of early stage risk capital in a form that is appropriate for the capital-intensive, slower growth nature of green businesses</li> <li>• There is a gap in availability of non-equity forms of capital -- working capital, debt, and consumer financing -- for green enterprises at the growth stage</li> <li>• Currency and convertibility risk can hamper the roll out and growth of green business in developing countries</li> </ul>
<b>The Private Sector Cannot Go It Alone: Green Sectors Do Not Grow without Proper Regulation (and Subsidies)</b>	<ul style="list-style-type: none"> <li>• It is difficult for green businesses to grow and scale without clear and well-implemented regulations</li> <li>• Green entrepreneurs depend heavily on the overall environment and ecosystem for entrepreneurship</li> </ul>

17 IFC / Intelicap (2015), “Corridors of Shared Prosperity”; Seed UNO, “Replicating Eco-Inclusive Enterprises,” report.

18 Lerato Mbele, “Why M-Pesa failed in South Africa?” BBC News, May 11, 2016. <http://www.bbc.com/news/world-africa-36260348>

19 GSMA (2014), “Enabling Mobile Money Policies in Tanzania: A “Test and Learn” Approach to Enabling Market-Led Digital Financial Services,” <http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/03/Tanzania-Enabling-Mobile-Money-Policies.pdf>



The case studies and other research conducted for this study revealed several common challenges for scaling green sectors as summarized above in Table 2. The most prominent of these challenges are highlighted in the discussion below.

### Green Markets are “Push” Markets: Still Immature and In Need of Nurturing

While green markets overall are large in developing countries,<sup>20</sup> they are still in very early stages of development. Most product offerings are not widely known in the marketplace and the demand for these products is not well articulated. Hence, green markets tend to be “push” markets, meaning that enterprises and other like-minded stakeholders must work actively to build the market, rather than simply addressing an existing market with new offerings.

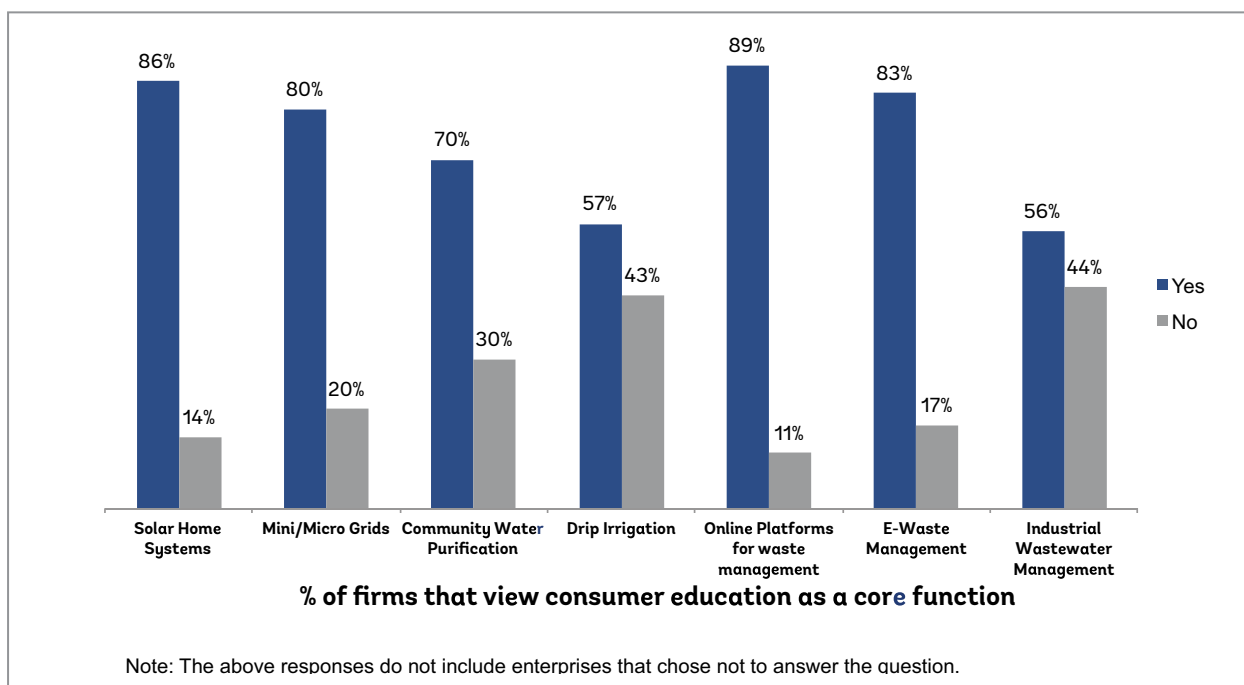
Green businesses face four specific market challenges:

- » The customer base in most green sectors is fragmented, and typically features customers with different needs and varied purchasing power. Customers for drip irrigation products within a single country, for instance, cultivate a variety of crops on farms of different sizes in varied climates and have different purchasing power. Similarly, community water enterprises cater to customers with different water access challenges and varying capacity to pay for clean water. This kind of customer fragmentation creates challenges for businesses in segmenting the market and targeting products to customers appropriately. As a result, businesses must often choose to either sell a single product that may not fulfill the needs of most of their potential customers, or design, distribute, and service a vast range of products that more precisely meet customer needs. Limited existing market intelligence further hinders the ability of these enterprises to understand and consolidate the various market segments. Even where such intelligence is available, enterprises may lack the resources to address the needs of such fragmented markets.
- » There is low customer awareness of both green product markets and specific products in the marketplace. Risk- and price-sensitive customers from low- and middle-income groups in developing countries are often wary of investing in products that are unknown, offered by a company they do not know, and rarely available in local shops. Awareness of green products also requires consumers to understand unfamiliar technology, policy and regulatory issues (e.g., solar panel subsidies or net metering), and consumer financing options. Often, green enterprises contribute to the challenge by poorly articulating the economic value proposition of their products, focusing on the environmental benefits to society, rather than emphasizing the benefit to the customer. The case studies repeatedly revealed that consumer education was viewed as a necessity, and in many cases, a core function of the enterprises’ success. All these factors converge to create consumer hesitation to take up new products and high customer acquisition costs for the business. Figure 4 illustrates the challenge of customer awareness across the subsectors studied.

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20 As mentioned earlier, World Bank Group (2014) estimates an expected investment of US\$6.4 trillion through 2023 in green sectors.

Figure 4. Green Enterprises Often Take On the Role of Market Builders



- » A flood of low-quality green products that are being widely distributed in developing countries creates additional market barriers.<sup>21</sup> Enterprises represented in the case studies repeatedly stated that their products' reputations were being undercut by low-quality competition. For instance, low-quality drip irrigation systems lead to consumers doubting the quality of green products and the effectiveness of the entire subsector. Most subsistence farmers in Africa have struggled with drip line blockages in low-cost, low-quality products.<sup>22</sup>
- » Green markets are frequently distorted by a myriad of government and donor-funded programs in developing countries. For example, many well-intentioned governments and NGOs provide free or heavily subsidized solar lanterns or clean cook stoves to consumers in poor regions. Evidence repeatedly finds that short-term subsidies and giveaways undercut the ability of businesses to compete sustainably in these markets. Investment and marketing plans are constantly in flux to avoid competing with giveaways, and servicing and maintenance plans are affected by these programs.<sup>23</sup> In some cases, these subsidy programs eliminate markets for for-profit businesses. While subsidies are often necessary to build green markets, as we describe later in this report, they must be developed and implemented carefully to avoid harmful distortions.

Given the immaturity of green business markets, enterprises experiment repeatedly with business models that allow them to stay in business while the market is defined and stabilized. As a result, investors and customers act tentatively in comparison to more mature sectors.

21 For instance, off-grid solar lighting market trends report indicates that the Solar Home Systems market is facing challenges to remain profitable due to the easy availability of low quality spurious products that are much lower in price.

22 Refer to report on 'Technical considerations affecting adoption of drip irrigation in Sub-Saharan Africa' by Lonia Friedlander, Alon Tal, Naftali Lazarovitch

23 Many economists and critics have pointed to the economic distortions created by subsidies, especially subsidies that are used to promote specific sectors or industries. Generally, such subsidies tend to divert resources from more productive to less productive uses, thus reducing economic efficiency. See, for example, International Institute of Sustainable Development, accessible at: <https://www.iisd.org/GSI/effects-subsidies>



## Green Enterprises Launch but Do Not Grow: Few Move into Commercialization

Another challenge identified from the research is that green businesses have a particularly difficult and costly path to commercial success. Compared to non-green sectors, relatively few green enterprises in the subsectors studied move beyond the startup phase into successful growth and commercialization stages. Moreover, many enterprises reported growth rates of less than 10 percent after the initial four to five years of operation, a pace not commensurate with achieving wide-scale impact or accessing traditional investment opportunities.

Various factors, including the long gestation periods, high upfront capital costs, and policy dependence eliminate a high percentage of businesses after initial startup. Our research suggested several other factors hindering enterprise growth.

- » Green sectors might attract fewer high quality, experienced entrepreneurs, and strong management teams. The case studies found enterprises lacking the management capabilities needed to execute at scale. This talent gap suggests experienced entrepreneurs may be hesitant to enter green sectors until business models and markets mature. For example, in the development of the utility-scale renewables sector, experienced project developers quickly entered the market in developed countries, but have moved more cautiously into the markets in developing countries, where the operating environment is less conducive to rapid project scale or success. The markets in developing countries have been served by inexperienced project developers, resulting in failure of many projects to go beyond the signed power purchase agreements (PPAs) into full development. In response, programs such as Power Africa, guarantees from governments, and financing from DFIs have been put in place to attract high quality project developers (the entrepreneurs of utility-scale renewable energy) to enter these markets. Similar efforts to attract experienced, high-quality entrepreneurs could benefit other green sectors.
- » Inadequacies in infrastructure and logistics services are also key obstacles to successful growth of green businesses. Green businesses that rely on imported components and distribute and service their products across countries are particularly dependent on efficient infrastructure. Most developing countries fare poorly on the World Bank Group's Logistics Performance Index that takes into consideration aspects such as infrastructure, logistic competence, and timeliness. This suggests slower enterprise growth due to overall inefficiencies and increasing costs for green businesses.
- » Green technologies and markets are immature, with businesses still struggling to work through business models, master the technologies, and adapt them for sale in those markets. For example, in response to addressing the needs of a diverse customer base, enterprises in the solar home system (SHS) market offer customers a multitude of options to make payments, including various types of mobile money, cash, bank transfers, or subsidy credits. Similar fragmentation of customers and solutions across green sectors means that existing green enterprises are still pioneers in their markets with low survival rates.

More research is needed to determine if the failure rate and difficulty in growing is related to particularities of green businesses, the market, the type of entrepreneurs attracted to the sector, or a combination of these factors.



### Green Businesses Are Not Venture Capital-Style Investment Opportunities: Different Types of Financing Suited to the Characteristics of the Sector Are Needed

Many of the existing financing instruments in place for green businesses seek to replicate the angel, venture capital, and private equity models that have been successful in building the software and electronics sectors in developed countries. However, evidence suggests that venture capital, even in developed countries, is the wrong model of financing for green enterprises that are capital intensive, have a longer timeframe of growth, and cannot deliver the outsized returns required by the venture capital model.<sup>24</sup> The case studies illustrate that this is particularly true in developing countries, where the additional challenges of those markets lead to generally slower growth and longer investor payback periods.<sup>25</sup> High initial investment requirements and payback periods of more than five years in many green sectors require patience and treatment that is more similar in many ways to long-term infrastructure projects, whereas investors compare green businesses to other sectors such as information technology, manufacturing, and electronic goods to set return expectations. Moreover, innovative instruments such as receivables financing can be deployed to finance a few subsectors, such as SHS, that work on PAYG models; however, they are not yet available to other green sectors.

Green sectors generally may mostly experience low or steady growth, not Silicon Valley-style high-growth.<sup>26</sup> Many green enterprises may rely on some form of subsidy, whether direct or through facilitation of the market or other means, for a very long time. It is important to consider how the financing instruments affect the development of the sectors, and design programs and policies accordingly.

Some exceptions continue to encourage venture capital-style investors in green businesses. One sector is digital green business, such as software to manage energy use in buildings or wind power and battery storage installations. However, most green sectors are showing limits to the success of such investment theses.<sup>27</sup> A range of impact investors are participating in green sectors and some are now making investments fully aware of the limited potential for venture style returns in the short run. However, others may be contributing to a hype of returns that evidence does not yet support.

The case studies highlighted several financing challenges:

- » There is a gap in the availability of early-stage risk capital in a form that is appropriate for the capital-intensive, slower growth nature of green businesses. With few exceptions, each of the markets studied had higher availability of financing at the growth stage, when strong market traction and revenue streams had been established (i.e. investment of US\$3 million or more). Many markets were

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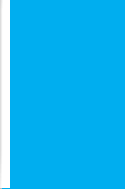
<sup>24</sup> See, for example, Gaddy et al. (2016), *Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation*, MIT Energy Initiative Working Paper.

<sup>25</sup> See Jean-Louis Racine, "To Foster a Climate Technology Revolution, Support Start-Ups That Won't Grow or Be Profitable," (blog; forthcoming).

<sup>26</sup> See Jean-Louis Racine, *ibid.*; also "An Impact Investor Urges Caution on the 'Energy Access Hype Cycle,'" available at <http://nextbillion.net/an-impact-investor-urges-caution-on-the-energy-access-hype-cycle/>

<sup>27</sup> For further discussion, see Ceniath: <http://nextbillion.net/an-impact-investor-urges-caution-on-the-energy-access-hype-cycle/>; Dirk Munch: <http://nextbillion.net/hype-in-the-energy-access-sector-finally/>; and GOGLA: <http://nextbillion.net/an-impact-investor-urges-caution-on-the-energy-access-hype-cycle/>






- » There is a gap in the availability of non-equity forms of capital, such as working capital, debt, and consumer financing, for green enterprises at the growth stage. Green enterprises are increasingly marketing their products to customers with a consumer financing plan such as lease-to-own, PAYG, or fee-for-service. Each of these requires large outlays from the green enterprise or from a partner that provides the financing. Successful experience with solar hot water systems in South Africa demonstrates the catalytic effect that appropriate consumer financing models can have for a green market.<sup>28</sup>
- » Currency and convertibility risk can also hamper the roll out and growth of green business in developing countries. Due to the absence of longer-term fixed-rate local currency financing, green businesses frequently accept U.S. dollar- or euro-denominated loans. Sales are made locally, meaning that customer payments come in local currency. Currency hedging is generally unavailable in these markets or comes at exorbitant expense. The mismatch from financing in one currency and selling in another imposes potential stress on green businesses and their business model. It makes planning more difficult, increases financing costs, and limits their ability to scale out to other countries. Similarly, limits on convertibility of local currency into hard currency, such as U.S. dollars or euros, prevents enterprises from importing additional inventory. In contrast, green enterprises that can export to markets that pay in hard currency gain an advantage, as they are able to service debt without the same currency and convertibility risks.

Every green sector is heavily regulated. Governments play key roles of regulators, enablers, and, at times, customers for these sectors. For capital-intensive subsectors such as drip irrigation and solar home systems, governments have played an enabling role through subsidies and tax breaks to incentivize private sector participation. In others, like e-waste, online platforms for waste management, and community water, governments have played the role of a regulator, mandating compliance with pollution control or safe water norms. In some subsectors, such as community water, the government is also a key customer.

As a result, without clear and well-implemented regulations, it is difficult for green business to grow and scale. For instance, water and energy are often distributed by a state-owned or state-regulated utility. The regulator formally sets the tariff charged to consumers for water or power. It also informally influences the order in which creditors are paid. In agriculture, government agencies regulate input prices, provide services to farmers, and own or manage wholesale and retail markets. Other examples of green regulations include feed-in tariffs, auction mechanisms that set prices for utility-scale renewable energy providers, building codes, which affect the use of green products and techniques in buildings and help create a market for energy efficiency businesses, and wastewater treatment regulations. In all the subsectors studied, regulation was a key factor that either drove or limited the growth of the market.

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Figure 5. Government Role Across Green Business Subsectors Varies Significantly

	Regulator	Distribution Partner	Price Setter / Subsidy Provider	Customer / Offtaker
 <b>Green Sectors Do Not Grow without Proper Regulation and, In Some Cases, Subsidies</b>				
<b>Solar Home Systems</b>	H	L	M	M
Government influences SHS businesses through grid planning and connection rules, rate tariffs, import regulations, and energy access subsidies				
<b>Mini / Micro Grids</b>	M	L	H	M
Government influences mini-grid businesses through policies on grid extension and price setting for grid power. Government owned agencies are also key buyers of power from mini/micro grid utilities				
<b>Community Water Purification</b>	H	M	M	M
Government regulation on pricing seen in a few countries. Government agencies are the buyers and capex providers in many cases				
<b>Drip Irrigation</b>	L	L	H	M
High government activity seen in subsidy provision and making the drip irrigation kit more affordable for farmers				
<b>Online Waste Management</b>	M	M	L	L
Limited role of the government at present, however government agencies can play a key role in enabling access to customers				
<b>E-Waste Management</b>	H	L	L	L
Government has key role in terms of policies and guidelines such as EPR* regulations and buyer buy back regulations				
<b>Industrial Wastewater Management</b>	H	L	L	L
Government plays a significant role and mandates wastewater treatment before discharge				

High Impact

Low Impact

Medium Impact

\*Government mandates wastewater treatment before discharge.



Good regulatory outcomes depend on more than well-designed rules and regulations. They should also be accompanied by well-formulated implementation and enforcement strategy. Regulations that reduce costs for customers and enterprises, such as tax incentives for solar panels, have helped to build the market, while those that increase costs, such as direct mandates for compliance in the industrial wastewater sector, need monitoring to ensure effectiveness. Similarly, access to electric power is a political mandate, and policies and programs for grid extension often change. This creates a lack of long-term visibility for the mini/micro-grid enterprises in many developing countries. Seeming subtleties, such as how subsidies are paid out, can also be critical. A 'buy-one-get-one-free' solar panel subsidy for poor households, for instance, can work effectively if the subsidy can be collected easily by the business on behalf of a consumer, but is ineffective if the consumer must go to a government or utility company office for reimbursement of their purchase. Design and implementation of regulations, therefore, matter greatly.

The reality is that in developing countries regulations in green sectors are generally incomplete, unclear, and applied inconsistently. A recent report estimated that only 4 countries in Africa are at a reasonably advanced stage of developing sustainable energy policy.<sup>29</sup> This will inevitably impede progress of green sectors. However, there are good examples of helpful policy regimes in challenging contexts. For example, Kenya's feed-in-tariff has shown strong results in driving renewable energy development. Bangladesh's SHS market has benefited from strong regulation by the enforcing body, the Infrastructure Development Company Limited (IDCOL).<sup>30</sup> This demonstrates that targeted policies and regulations can still work effectively within countries that struggle with setting an overall positive regulatory regime.

While well-implemented subsidies were utilized in many of the more successful cases studied, it is important to point out that subsidies come at a fiscal cost. Policy makers should always consider the tradeoffs of subsidies for green enterprises and the outcomes likely to be achieved against other uses of public funds. Offsetting green subsidies with reductions in fossil fuel subsidies are one means to consider for creating a revenue-neutral solution.

Finally, green entrepreneurs depend heavily on the overall environment and ecosystem for entrepreneurship. Targeted policies for green entrepreneurs have demonstrated little success in environments that are generally not conducive to entrepreneurship and business. Countries that build a supportive business environment, strong sector regulations, and strong green entrepreneurship ecosystem stand to lead the way on development of green sectors.

29 Banerjee, Sudeshna Ghosh; Moreno, Francisco Alejandro; Sinton, Jonathan Edwards; Primiani, Tanya; Seong, Joonkyung. 2017. Regulatory indicators for sustainable energy : a global scorecard for policy makers. Washington, D.C.: World Bank Group. <http://documents.worldbank.org/curated/en/538181487106403375/Regulatory-indicators-for-sustainable-energy-a-global-scorecard-for-policy-makers>

30 Dipal Chandra Barua, "Bangladesh: Scaling Energy Access and an IDCOL 2.0 Vision for 100% RE," March 2, 2017. <http://www.powerforall.org/blog/2017/3/2/bangladesh-scaling-energy-access-and-an-idcol-20-vision-for-100-re>

## Opportunities: What Can Be Done to Reach Scale?

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The conditions that pose challenges to scale also offer numerous opportunities for green enterprises to improve market penetration in existing areas of operation (scale up), develop products to suit specific customer segments, and expand to other geographic regions (scale out). For example, the case studies highlighted opportunities ranging from less expensive business model innovations and strategic partnerships to more expensive, but rapid scale solutions such as developing technology platforms, and market building and de-risking mechanisms.

Many of these opportunities are unfamiliar to new enterprises, which struggle to define and identify them in a systematic way and instead responding to them opportunistically. Leveraging macro developments such as technology developments and information and communication technology (ICT) ubiquity, for instance, offers significant opportunities to green enterprises to grow their business. At the same time, lack of skills and business acumen within enterprises can be a barrier to tapping the opportunity. Other opportunities require drawing in larger ecosystem stakeholders such as financial institutions and governments, which may be difficult for individual enterprises to achieve. Nonetheless, some of the opportunities discussed below demonstrate the potential to help green businesses and sectors reach scale.



Table 3. Opportunities and Innovations for Scaling Green Sectors

Opportunity	Examples
<b>Business Model Innovations</b>	<ul style="list-style-type: none"> <li>• Mobile-enabled PAYGO financing mechanism has fostered the development of green subsectors such as SHS</li> <li>• Bundled service combines related product offerings and builds forward and backward integration for products and services to offer packages of solutions.</li> <li>• Credit history facilitation for low-income customers through initial sales and monthly payment history allows customers to upgrade and access credit for other purposes and from other finance providers</li> </ul>
<b>Enabling Technology Platforms</b>	<ul style="list-style-type: none"> <li>• Technology that allows for rapid credit appraisal of potential low-income consumers is being piloted</li> <li>• Technology platforms / MNOs that enable payments and collections ( such as Safaricom's M-PESA for payments)</li> <li>• Convergence and combination of multiple technology-backed services has enabled an overall drop in costs such as smart meters, mobile money and low-cost solar for SHS</li> </ul>
<b>Market Creation and De-Risking Mechanisms</b>	<ul style="list-style-type: none"> <li>• Quality certification programs that establish quality standards and best practices provide clarity in the marketplace for consumers and ensure that poor quality products do not spoil the market for green products</li> <li>• Trade and industry associations can provide services such as policy development and analysis, training, codes of practice, industry promotion, networking, conferences, and industry updates</li> <li>• Development of robust data metrics allow investors interested in green enterprises to measure the economic, social, and environmental performance of their investment are important tools to drive sector development</li> </ul>
<b>Specialty Financing Instruments for Green Businesses</b>	<ul style="list-style-type: none"> <li>• Specialty financing mechanisms that invest in early stage green enterprises such as World Bank Group's climate venture facilities (CVFs), growth stage low-cost debt and working capital facilities, and instruments that provide mitigation of local currency and interest rate risk for green enterprises can drive green subsectors</li> </ul>
<b>Technology and Business Model Transfer</b>	<ul style="list-style-type: none"> <li>• Specific efforts to transfer technology or business models from one country to another can potentially enable scale</li> <li>• Matchmaking of foreign businesses or technology with local businesses is being piloted to help successful green businesses and business models to scale out</li> </ul>
<b>Strategic Partnerships</b>	<ul style="list-style-type: none"> <li>• Choosing the business partner and area of collaboration has enabled many green enterprises to operationally scale their businesses both in their home countries and expand outside to cover a larger customer base.</li> <li>• Partnerships for building customer awareness and for customer financing help green businesses in market building and reaching potential customers.</li> </ul>

### Business Model Innovations

The importance of new business models to the success of green sectors in developing countries cannot be overstated. The case studies and literature demonstrate how business model innovations provide a better source of competitive advantage and were comparatively less expensive and time consuming than technology or product design innovations. They also marked a positive tipping point in the growth of green sectors.

The PAYG model in the development of SHS subsector offers a good example of the importance of business model innovation. The rise of the mobile-enabled PAYG financing mechanism has fostered the development of the SHS subsector. A critical enabler for PAYG solar is the uptake of mobile money services to unlock customers' ability to make small payments through their mobile phone. Nearly 80 percent of the SHS enterprises included in this research offered this service. Notably, PAYG is now being tested and adopted in two additional green product markets – drip irrigation and drinking water delivery. For example, SunCulture is testing out PAYG drip irrigation in the Kenyan market. Donors are taking note: United States Agency for International Development (USAID) and IFC are supporting SunCulture and additional PAYG irrigation businesses respectively, and the Kenya Climate Innovation Center is working with a PAYG company, Futurepump, in the solar irrigation pump segment. This demonstrates the importance of such business model innovations to open wide possibilities for scaling across green sectors.

Bundled service is another business model innovation (or at least evolution) offering a strengthened value proposition to the customer. Bundled service combines related product offerings and builds forward and backward integration for products and services to offer packages of solutions. Drip irrigation kits, for example, are being increasingly coupled with solar pumps for irrigation. By bundling offerings, green enterprises widen their appeal to consumers, accommodate fluctuations in demand for their core products, and provide themselves with space to innovate new offerings.

Credit history facilitation for low-income customers in developing countries offers yet another example of business model innovation. Most low-income customers struggle to access credit for any productive activity, since they generally lack existing bank accounts or other means to establish a credit history. Essentially, this model utilizes initial sales and monthly payment history (of a SHS, or mini/micro-grid for example) to establish a pattern of credit history for customers. After a time of paying off the initial purchase, customers have a trail of payments that could be utilized to establish their credit worthiness. This helps them to not only upgrade to higher usage services with SHS enterprises, such as a low wattage television, refrigerator, or fan, but also access credit for other purposes and from other finance providers.<sup>31</sup>

Another business model shift is the evolution of green enterprises from vertical integration to specialization. Vertical integration is a common business strategy for companies working in immature markets, such as most pioneering green businesses find themselves in. It is done to compensate for the lack of quality partners for production, distribution, sales, payments, or

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31 See GOGLA article for more on this credit facilitation model: <http://nextbillion.net/dear-critics-heres-why-the-off-grid-energy-industry-needs-impact-investment/>



servicing. Green enterprises such as M-KOPA and Jain Irrigation have built their success around carefully building and managing nearly all upstream and downstream segments of their value chains. This has enabled them to control quality, cost, and customer experience at all points. However, this model involves high overheads and limits agility, and can bring challenges as companies scale and manage the increasingly complexity of the full value chain.

Green enterprises are increasingly meeting this challenge through specialization in their core business and partnering for non-core activities. For example, some enterprises are working with third party organizations that have emerged to take on specific value chain activities. PEG Ghana has partnered with Tigo to manage customer billing and payments across the wide range of payment platforms used in Ghana. In other cases, green enterprises take it upon themselves to build the capacity of independent distribution and maintenance partners. However, this stretches resources and creates risks due to reliance on these newly formed or weak partners. In response to the need for new partnerships, some donors interested in filling gaps for the green enterprises are actively forming nonprofit or nongovernmental organizations (NGOs) to take on important value chain activities.

Some of the more nascent green sectors could benefit from business model development support to allow businesses to innovate in operations, pricing and building partnerships for distribution. Several approaches are being tested with the intention of allowing green enterprises the time and resources necessary to experiment with new business models. One example of this is the GSMA, the organization representing mobile operators worldwide, fund to support piloting of business models that demonstrate new mobile renewable energy platforms.<sup>32</sup> For instance, GSMA has worked together with ReadyPay Solar to help enable thousands of people in Uganda to pay for small-scale solar electricity in their homes through their mobile phone.

### Enabling Technology Platforms

Almost as important as new business models to the success of green sectors are enabling technology platforms that provide new opportunities and lower the scaling cost for enterprises across an entire green subsector.<sup>33</sup>

The best-known technology platforms are those that enable payment and collections. M-PESA, the mobile money system developed by Kenya's dominant telecommunications company, Safaricom, to collect customer payments, is a good example. M-PESA serves as a virtual wallet on mobile phones into which subscribers deposit cash that they can then use to pay bills. Kenya now has more mobile money accounts than any other country, 31.6 million in a nation with a population of 44 million.<sup>34</sup> M-PESA has become a critical enabler of green business

32 For more on the GSMA fund that supports business model innovations, see: <https://www.gsma.com/mobilefordevelopment/programmes/m4dutilities/innovation-fund-2>

33 Science and technology policy refers to these as "infatechnologies" as they are essential technological infrastructure for entire sectors. Examples of infatechnologies from other sectors include packet switching for telecommunications, automation for advanced manufacturing, and many others. Gregory Tasse, "Underinvestment in Public Good Technologies", U.S. National Institutes of Standards and Technology. <https://www.nist.gov/sites/default/files/documents/2017/05/09/underinvestment-JTT-2005.pdf>

34 Muriithi Mutiga, "The Africans Buying Sunshine with Their Phones," *The Guardian*, July 28, 2016. <https://www.theguardian.com/world/2016/jul/28/the-africans-buying-sunshine-with-their-smartphones>



growth in the region, with enterprises like M-KOPA using this digital finance as a key aspect of the M-KOPA product offering. M-KOPA integrates the M-PESA payment technology into each of its home systems to allow customers to make micro-payments to M-KOPA for their use of a SHS. This PAYG model is emerging as one of the most important enablers of green business and demonstrates how a single technology advance, when widely available, can underpin the growth of a sector.

Other less known technology platforms also exist, such as technology platforms for billing. Billing platforms are critical as green enterprises generally serve many customers with small amounts billed each month. In contrast to payment platforms, which generally utilize forms of prepayment (e.g. scratch cards), billing platforms allow enterprises to offer post-paid payment plans. These billing platforms have largely been created in developing countries by mobile operators. The following box illustrates the power of matching billing platforms to green enterprises.

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### Box 1. Nova Lumos Leverages MTN's Technology Platform to Bring Affordable Electricity to Nigeria

Nova Lumos Netherlands Holding B.V. is a SHS business that markets its products in Nigeria under the name TXTLIGHT. Nova Lumos provides SHS under a pay-as-you-go (PAYG) model, which allows consumers to use mobile payments and transfer cash via text messaging to pay for power in advance. Typically, customers can obtain electricity for less than US\$ 0.50 a day.

Nova Lumos' business model has turned out to be highly scalable due to its partnership with incumbent mobile operators. Early in its development, Nova Lumos entered into a partnership with MTN, Nigeria's largest telecommunications company with over 60 million subscriber base, for sales, marketing, and distribution. TXTLIGHT jingles can now be heard on radio and TV across Nigeria and TXTLIGHT systems are sold at

MTN retail stands. Yet another aspect of the partnership is the use of MTN's billing systems for TXTLIGHT customers. Nova Lumos has integrated a MTN SIM card into its SHS, enabling MTN customers to pay for their SHS on their existing mobile phone bill. By utilizing this billing platform, Nova Lumos has solved what can be an extremely complex task for young businesses to manage.

Nova Lumos' partnership with MTN has helped accelerate the company's growth, enabling it to emerge as one of the largest and fastest growing off-grid solar firms. In 2016, Nova Lumos received US\$ 90 million from a group of private investors to grow its business in Nigeria while also to expand into other countries.

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Another important technology platform is the convergence and combination of multiple technology advances into a single offering to enable green enterprises. In the off-grid energy sector, the combined advances of smart meters, mobile money and low-cost solar have enabled an overall drop in costs for SHS businesses. These are already changing the face of the off-grid sector through new technology enabled business models, and may start changing





the utility scale renewable energy sector as well. Convergence of technologies is likely to be an important factor in scaling climate smart agriculture (e.g. sensors and drones), green buildings (e.g. LEDs, sensors, and building management software), and clean water (e.g. sensors to remotely monitor water quality and pump malfunctions)<sup>35</sup> for agriculture.

Finally, technology that allows for rapid credit appraisal is being piloted by PEG Ghana and others. This technology matches publicly available demographic data with proprietary data acquired from potential customers to rapidly assess their credit worthiness. Such technology can help green businesses to overcome one of the challenges of customer acquisition that is an expensive aspect of many green businesses.

### Market Creation and De-Risking Mechanisms

Several cases studies illustrated how creating and de-risking markets remains necessary to scale green sectors despite the existing policies and donor initiatives that target green sectors. A number of approaches have emerged to both build new markets and to better understand, mitigate, and manage market risks.

Certification programs that establish quality standards and best practices provide clarity in the marketplace for consumers and ensure that poor quality products do not spoil the market for green products. The World Bank Group's Lighting Africa program was put in place precisely to play this role for off-grid lighting, and was later expanded to other off-grid household products and to Asia as Lighting Global.<sup>36</sup> It provides quality assurance and certification for SHS, solar lanterns and other pico-solar products to signal quality in the marketplace. It also provides market intelligence to different businesses, investors, and donors to draw them into the marketplace. Government standard bureaus in countries including Kenya and Ethiopia have adopted national standards that align with the Lighting Global quality standards, and other countries are considering similar measures.<sup>37</sup> The Global Lighting and Energy Access Partnership (Global LEAP) has also been working to increase quality standards by sponsoring research and analysis related to the development of Lighting Global quality assurance program.<sup>38</sup> Global LEAP is also leading efforts to develop a quality assurance framework for mini- and micro-grids.

Trade and industry associations can also play an important role in building the nascent green market in developing countries. Typically, these organizations provide a wide range of services including policy development and analysis, training, codes of practice, industry promotion, networking, conferences, and industry updates. The Global Off Grid Lighting Association (GOGLA), the Alliance for Rural Electrification, the Association of Water Technologies, and the e-Waste Association of South Africa are examples of associations that promote and support the development of their respective industries. GOGLA has played a key role in growing and strengthening the market for clean, quality off-grid lighting products globally.

35 See a short discussion of UKAID's program on sensors for water kiosks in Rwanda at: <http://www.gsma.com/newsroom/press-release/uk-and-gsma-partner-on-mobile-technology-to-fight-global-poverty/>

36 For more information on Lighting Africa, see its website at: <https://www.lightingafrica.org/>

37 The United States White House (2016). Catalyzing global markets for off-grid energy access. [https://obamawhitehouse.archives.gov/sites/default/files/docs/catalyzing\\_global\\_markets\\_for\\_off-grid\\_energy\\_access\\_final\\_cover.pdf](https://obamawhitehouse.archives.gov/sites/default/files/docs/catalyzing_global_markets_for_off-grid_energy_access_final_cover.pdf)

38 For more information on Global LEAP, see its website at: <http://globalleap.org/>

## Box 2. Lighting Africa and Lighting Global Set Global Standard for Quality Off-Grid Lighting<sup>39</sup>

Lighting Global is the World Bank Group's platform to support the development of commercial markets for modern energy services for the more than 1.2 billion people in the world without access to electricity. The Lighting Global product quality assurance program sets the global standard for quality off-grid solar devices and kits. Under the program, Lighting Global presently lists over fifty quality verified solar products from more than 20 manufacturers.

The Lighting Global quality assurance framework was originally developed by Lighting Africa, an IFC/World Bank Group program to counter market spoilage arising from an influx of products of unknown quality that was beginning to undermine consumer and investor confidence. As the

program evolved, it became clear that the need for quality standards for portable, off-grid lighting products extended to other regions, driving Lighting Africa to expand its quality assurance work globally through the Lighting Global Quality Test Methodology.

Lighting Africa and Lighting Global have been key sources to provide independent market intelligence, defining quality standards, leveraging finance and providing important assurances to early consumers. Part of the Lighting Africa work led to the creation of the entity that became the Global Off-Grid Lighting Association (GOGLA), the sector's leading industry body now managed and operated as an independent entity providing a range of support services to its members.

Finally, data and metrics that allow investors, foundations, DFIs, and banks that invest directly into green enterprises to measure the economic, social, and environmental performance of their investment are important tools to drive sector development. Both investors and entrepreneurs are demanding greater rigor in data collection and more evidence of investment outcomes. Investors want to understand what is being done with their capital and to assess which companies will have greater impact at scale. Entrepreneurs, for their part, want to better understand how end users benefit from their products and services to inform marketing and product development.

While the development of robust data and metrics is still in the early stages across green sectors, there are some promising initiatives. The Global Impact Investing Network (GIIN), for instance, has created the Impact Reporting and Investing Standards (IRIS) to assist investors assess financial, social, and environmental performance of investments in green and other impact sectors. IFC, Intelcap, GIZ and others support the PRISM tool, which aligns with IRIS.<sup>40</sup> The World Bank Group and IFC, in partnership with major international banks, are piloting metrics for off-grid solar systems in Nigeria to provide a uniform standard for stakeholders to assess enterprise performance. These stakeholders have developed a key performance indicator (KPI) framework specifically for PAYG enterprises that seeks to increase transparency around operational and business model performance of energy service providers. This

<sup>39</sup> Modified from Shell Foundation's Enterprise Solutions for 2030 (2017).

<sup>40</sup> IRIS information: <https://iris.thegiin.org/metrics> ; PRISM launch: <https://www.giz.de/en/worldwide/25261.html>



framework is expected to assist in obtaining market data, check its reliability, and ultimately enable a more robust understanding of the green business sector that will facilitate investments and sector growth.<sup>41</sup> This draws inspiration from the mobile telecommunications sector for which key metrics including average revenue per user (ARPU) underpinned large-scale investments when the mobile industry was still nascent in developing countries. By standardizing such metrics, stakeholders hope to offer investors a uniform way to assess performance of off-grid enterprises.

## Specialty Financing Instruments for Green Businesses

Specialty financing has driven the growth of some mature green subsectors. Among utility-scale renewables, the project finance approach underpinned by power purchase agreements (PPAs) drove investment in both developed and developing countries. Energy Service Companies (ESCOs) were pioneered to offer efficiency improvements to a range of business customers, but were only successful when specialty financing models and instruments were created. Similarly, consumer financing has been key to driving the sales of household green products to customers with inconsistent incomes, and has been successful with solar hot water systems in South Africa and in the Caribbean.

New specialty financial instruments will be equally important to the success of other green sectors. Since green enterprises do not generally follow the growth trajectory needed to attract VC and PE investors, concessional and blended finance or program related investments<sup>42</sup> will be needed to meet the high initial investments and long payback periods required in many green sectors. Financial innovation is necessary to create new specialty financing instruments to meet the needs of green enterprise.

Three innovative green financing instruments particularly stood out from the case study research.

- » First, the World Bank Group's climate venture facilities (CVFs) are financing facilities that specifically target early-stage green enterprises with appropriate financing. CVF features include investment sizes below US\$1 million, open-ended structures to allow variable investment holding periods, first loss provisions to attract commercially-minded investors to a riskier space, and technical assistance facilities to allow for support directed by the fund management team. Notably, CVFs are managed by local fund management teams to enable deal sourcing and management that is close to the local entrepreneurs. These CVFs are being tested in Kenya and Ghana with backing from donors.<sup>43</sup> A key bottleneck is the availability of local fund management teams with the capacity to assess deals in green sectors and the interest and experience to manage funds that invest at an early stage.<sup>44</sup> To address this, some donors are developing programs to develop first-time fund managers, such as the IFC SME Ventures program. However, building the ecosystem of experienced fund managers in developing countries will take years or decades. New approaches to matching internationally experienced fund managers with local teams could be considered to address this challenge.

41 Source: Internal report on Key Performance Indicator (KPI) Framework for Off-Grid Solar Impact Lab. February 2017

42 Program-related investments (PRIs) are investments made by foundations to support charitable activities that involve the potential return of capital within an established time frame.

43 Reference to KCVF and GCVF literature.

44 Interview with staff of the World Bank Group climate technology program

- » Second, growth-stage debt and working capital facilities are being developed to provide green enterprises with lower-cost operating and expansion capital that enterprises need as they transition from product development and early sales into growth stage. The facilities are meant to provide an alternative to high-cost debt from banks or high amounts of equity that is dilutive and only accessible to a limited number of globally connected founding teams. These facilities are filling a critical gap for growth stage financing.

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### Box 3. Growth-Stage Lending Programs from DFIs are Filling Critical Gaps in Financing for Green Enterprises

Development financial institutions (DFIs) have started playing a critical role in promoting change towards a low-carbon development by providing financing to green business with little access to traditional financing.

- » The Green Climate Fund (GCF) and Acumen Fund signed an agreement in 2016 that allows Acumen to receive GCF financial resources to invest in companies along the off-grid energy value chain to drive access to off-grid solar power in East Africa for low-income consumers. The project will initially provide solar technologies to rural, off-grid communities in Rwanda and Kenya, with possible expansion to Uganda at a later stage. The GCF Board has committed USD 25 million of the Fund's resources to this program.
- » The Overseas Private Investment Corporation (OPIC) provides support for the creation of privately-owned and managed investment funds, in response to the critical shortfall of private equity capital in developing countries. OPIC-supported funds help emerging economies to access long-term growth capital, management skills, and financial expertise through equity and equity-

related investments. OPIC has committed \$4.1 billion to 62 private equity funds in emerging markets since 1987. These funds in turn have invested \$5.6 billion in more than 570 companies across 65 countries.

- » PROPARCO's Investment and Support Fund for Businesses in Africa (FISEA) makes equity investments in businesses, banks, microfinance institutions, and investment funds operating in Sub-Saharan Africa. FISEA targets vulnerable population groups and regions that are more unstable or emerging from crisis situations, as well as sectors traditionally bypassed by investors. Special attention is paid to the growth of small- and medium-sized businesses.
- » FMO, the Dutch Development Bank, has invested in the private sector in developing countries and emerging markets in sectors such as infrastructure, manufacturing and services. For instance, FMO and Swedfund of Sweden have provided a line of credit to NMB Bank for lending to SMEs in Zimbabwe.

Such facilities offer examples that can be modified and adapted for the growth stage needs of green businesses in different contexts.



- ## Technology and Business Model Transfer

Another approach being piloted is matchmaking of foreign businesses or technology with local businesses. The World Bank Group's climate technology program is piloting this approach in South Africa and Kenya.<sup>45</sup> Factor(E)Ventures is another effort underway, supported by the Shell Foundation. These approaches bring international investors and established technology and business models together with local teams to setup a local business utilizing these known approaches. Again, the results of these efforts remain to be seen.

While perhaps not novel, one of the most effective ways that green sectors have achieved scale has been through building strategic partnerships. When successful, these partnerships are often replicated by other green enterprises. Choosing the right business partner and area of collaboration has enabled many green enterprises to scale their businesses both in their home countries and expand outside to cover a larger customer base. These partnerships were seen across multiple areas in the case studies, ranging from assistance in customer outreach (distribution strategy), improving customer awareness, to customer financing and innovation in product development. Given the weakness of traditional distribution partners in the locations where most green enterprises operate, novel partnerships can fill this role. Partners may be mobile operators, microfinance institutions, or other institutions that have wide reach. As discussed previously, such a nontraditional partnership has been working for Nova Lumos in Nigeria through its partnership with MTN. Such partnerships can be replicated and innovated upon.

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Many of the green sectors have limited value chain development and little flexibility to invest in core operations as well as support structures. In response, they develop strategic partnerships with complementing enterprises and organizations to help scale up and out to new markets and countries. Such partnerships were seen across a whole range of activities, from customer outreach and customer engagement to other important integrated activities such as technology development and service bundling for improved product uptake.

Enterprises operating in subsectors where access to consumer financing is low and product cost is high, such as drip irrigation, have set up in-house or outsourced consumer financing divisions to improve uptake of their products. For instance, in India, Netafim established its own financial institution, Netafim Agricultural Financing Agency (NAFA), to offer customized financial solutions to farmers and other stakeholders in the micro irrigation value chain. Similarly, Jain Irrigation has also set up a financing company to enable access to finance to its smallholder farmer customers. Enterprises are also able to hedge risks pertaining to subsidy receivables and customer payments by transferring them to the books of the financial institution, enabling them to focus on their core operations.

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### Box 4. PEG Ghana's Partnership with Tigo Cash Promotes Financial Inclusion and Solar Energy

PEG Ghana sells solar energy products to off-grid customers on PAYG payment plans, currently operating in Ghana and Cote d'Ivoire. They plan to reach 500,000 households in West Africa by 2018 and 1 million households by 2020. As a business that relies on digital payments, PEG Ghana has been working with mobile operators like Tigo Ghana to innovate in the area of mobile money.

PEG Ghana provides consumer financing solutions to its low-income customers to make the transition to cleaner energy more affordable. All payments are made through mobile money. PEG Ghana uses Tigo Cash,

Tigo Ghana's mobile wallet offering with over 3.5 million registered subscribers, to facilitate the digital payments. Such partnerships serve the dual goal of promoting access to energy and providing financial inclusion. By linking digital payments to useful everyday products or services such as reliable energy, customers have more attractive reasons to adopt and use digital payments. The partnership has promoted the demand and usage of mobile money, and thus increased the revenue for Tigo Cash. As per CGAP's research, PEG customers have generated 122 percent more revenue per active user for Tigo Cash than non-PEG customers.

*Source: CGAP*

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Other important partnerships have emerged for awareness building of green products. The mobile industry association GSMA, with UKAID support, has served this role for the off-grid solar sector, for example. GSMA promotional work has included publication of white papers and market research,<sup>46</sup> social media campaigns, pitch events and other entrepreneur showcase

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<sup>46</sup> GSMA Mobile for Development program publishes research reports for the off-grid solar energy sector.





events, small grants to demonstrate business models, and partnership grants for utilities to partner with entrepreneurs.<sup>47</sup> The GSMA is self-interested in the success of the sector, as it can increase demand for the mobile operators' services. However, this is a mutually beneficial partnership that has contributed to the success of various off-grid solar enterprises and the growth of the sector overall.

Another area of strategic partnership was observed in customer finance wherein green enterprises collaborated with financial institutions to enable access to finance to the low-income population segment. This was seen largely in product markets such as SHS and drip irrigation, where the low-income population is the direct consumer. Moreover, regulatory and policy guidelines such as priority sector lending for renewable energy sector observed in countries such as India enable and encourage such strategic tie-ups.

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#### **Box 5. Going "All In" on Solar Finance – IDCOL's Partnerships with 'Partner Organizations' Drives Solar Home System Installation in Bangladesh**

Bangladesh is home to one of the largest off-grid solar energy programs in the world, with nearly 4 million solar home systems (SHS) installed. Bangladesh ranks among the lowest in the world for population with access to electricity, with close to 75 percent of people in rural areas having no electricity in their homes. SHSs have enabled this population to have access to electric lighting and has become a key pillar of the nation's energy infrastructure.

Bangladesh's success story has been largely driven by the efforts of the Infrastructure Development Company Limited (IDCOL), a state-owned infrastructure financing company, with technical and financial support from various development partners. IDCOL initially received credit and grant support from the World Bank Group and GEF to start the program. Later, other agencies such as GIZ, KfW, ADB and USAID came forward with additional financial support for expansion of the SHS Program. Since 2003, IDCOL's SHS program has connected more

than 3.5 million households in off-grid areas to electricity.

A key element of IDCOL's success is its innovative, partially subsidized SHS delivery and financing mechanism. IDCOL wanted to develop the capacity of the local enterprises within Bangladesh to deliver and maintain SHS in rural households and was able to attract a number of such enterprises. IDCOL now works with 56 such partner organizations (PO) that sell, install, and maintain the SHSs. These POs have an extensive presence in rural areas and provide the full range of after-sales service, including guaranteeing the performance of the SHSs. IDCOL ensures quality of the SHSs, with its staff conducting random checks across the covered households to ascertain product quality and after-sales service provided by the POs. IDCOL also provides direct subsidies that reduces the SHS cost for customers and support for microcredit financing. Finally, IDCOL provides one channel for dispersing financial support from international donors

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47 See GSMA's <http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/01/Lessons-from-the-use-of-mobile-in-utility-pay-as-you-go-models.pdf>

and multilateral development banks, thus unifying an otherwise fragmented market.

Though IDCOL has faced numerous challenges such as low-quality products, shortages of technical staff, and high turnover at POs, it has been able to sustain

its growth momentum. Building on its success with the SHS program, IDCOL is expanding its effort to promote solar pumps for agricultural irrigation across rural Bangladesh and helping companies to diversify and offer integrated solar solutions.

*Source: IDCOL Website and annual reports*

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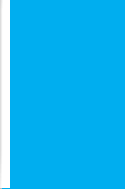
Interestingly, few strategic partnerships were seen in product development or technology innovation. Most green enterprises are in the early growth stage and view in-house product development or service innovation as a source of competitive advantage. For the slightly more mature markets, such as drip irrigation, technology partnerships were observed in a few cases to reduce the cost of irrigation kits and pipe systems. These took the form of horizontal integration, wherein the technology partner supported the enterprise to smooth the process or improve customer convenience. SHS and mini/micro-grid enterprises partnerships with multinational organizations such as mobile network operators provide a good case in point of such strategic partnerships.

Some development actors such as USAID have launched initiatives to support and facilitate such partnerships. Given their potential to help grow green sectors, more can be done by the development community to catalyze such collaboration.<sup>48</sup>

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<sup>48</sup> USAID provided important grants to setup the Safaricom partnership in the M-PESA initiative. See Vaughan and others in Chandy et. al (2013) for more on the USAID role in M-PESA's development.





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Bilateral and multilateral donors specifically can consider two actions. First, donors should lead the way in making the case that green markets need supportive public policy and funding to grow. The case studies demonstrate that markets that enable the scale of green businesses do not simply materialize once a new green technology or innovative business model comes about. Nearly all green sectors that have successfully scaled have done so in a market that was encouraged by smart policy, clear and consistent regulations (often at the subsector level), and, in many cases, subsidies. Apart from governments, donors are the best placed to make the case that green sectors represent a partial public good and put funding behind that notion. This comes with the challenge of staying the course in the face of unintended market distortions and low enterprise success rates that repeatedly challenge the benefits of “pushing” such markets. Such pitfalls are unfortunate but to be expected, and the proper response is course correction and improvement rather than a pullback from public support for building markets for green products. Market creation and development is the means to attract strong entrepreneurs and management teams that find the market attractive and stable enough to undertake the fundamental business model innovation needed for deployment of green solutions in frontier markets.

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technology and partnerships. Donors are better placed than most actors to finance such long-term experimentation. It is a challenge even for donors to make such long-term efforts with uncertain results when the investment goes beyond the usual three to five-year donor program and funding cycles. However, the payoffs, such as those achieved by M-PESA, can be key to achieving scale. M-PESA, which since its launch has transformed economic interaction in Kenya, would not have been possible without funding from the UK's Department for International Development (DFID) challenge fund.

Governments should prioritize the development and consistent implementation of sector-specific regulations for green sectors. Case studies and research demonstrate that favorable sector regulations, such as a clear plan for energy grid development and whether such extension can be complemented by off-grid solutions, establishing rural electrification plans or programs that incorporate off-grid energy, and establishing technical regulations ensuring quality standards, are critical to scaling green sectors. Off-grid enterprises cannot compete directly with cheaper, subsidized grid power and may face substantial losses if the grid were to be extended to areas where they operate. In India, Prime Minister Narendra Modi has said he wants electricity available in every home by 2022. A total of 125,000 Indian villages lack access to reliable power and the government has designated 18,000 of these villages as economically impossible to reach via conventional grid extension means. As a result, India has witnessed significant activity in the off-grid energy sector.

Governments must also remove unfavorable regulations, such as high import duties and tariffs on green products and components. In a number of African countries, including Kenya, Tanzania, and Zambia, governments have exempted drip irrigation equipment from VAT in a bid to encourage imports and lower the cost of technology for smallholder farmers. However, despite this exemption, confusing and inconsistently enforced policies for importing and selling drip irrigation equipment has sometimes stalled the market.<sup>49</sup> In some cases, subsidies can be crucial to the survival of green enterprises during the pioneering phase of a business model, though it is important to avoid distorting or even destroying markets through green product giveaways or other programs harmful to markets.

Multilateral and bilateral DFIs and impact investors should lead the way in creating innovative financing mechanisms for green businesses. The research suggests that these institutions are best placed to provide two specific types of financial innovations. First, risk capital financing has been shown as a missing type of financing necessary for scaling green businesses. Blended financing is needed to attract private investors to a space with challenging risk-return profiles. DFIs, and, in some cases, impact investors, are best placed to take on that risk, potentially accept lower returns, and therefore crowd-in additional private financing to these sectors. DFIs and impact investors can adopt a wide variety of strategies to help the private sector gain confidence and to lower capital costs via co-investment in emerging markets: demonstrate successful models in new areas and high-risk projects through co-investing; provide guarantees and risk insurance to the private sector; create new instruments that allows that aggregation of smaller green projects in order to attract large institutional investors; and

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49 Partnering for Innovation, 2016. The Market for Small-Scale Drip Irrigation in East and Southern Africa: Opportunities and Challenges to Commercialization. [http://www.partneringforinnovation.org/docs/Resources\\_The\\_Market\\_for\\_Small\\_Scale\\_Drip\\_Irrigation.pdf](http://www.partneringforinnovation.org/docs/Resources_The_Market_for_Small_Scale_Drip_Irrigation.pdf)



Second, these institutions should test and rollout local currency financing instruments to help enterprises mitigate currency and foreign exchange (FX) rate risk. Green businesses that need to borrow in hard currency and invoice in local currency are significantly hampered by these challenges. In the last few years, some promising solutions have emerged but have not yet achieved scale. In this regard, DFIs can explore several options for FX risk reduction in developing countries. They can work with national authorities (e.g., central banks) in developing countries to improve domestic financial and capital markets and provide technical assistance to fund reforms to deepen and broaden domestic financial intermediation in local currency. DFIs can provide currency risk hedging instruments to improve the management and allocation of FX risk. TCX, which was created in 2007 by European and African DFIs, has underwritten around USD 5 billion of currency risk in more than 50 developing countries over the past decade, allowing around 3-5 million SMEs to access local currency financing at viable rates. Finally, DFIs should explore financing and guarantee instruments that bear FX risks. The European Investment Bank's Investment Facility is the best known sizable program within the DFIs where the lender takes open currency risk and charges a premium to cover FX losses. After 10 years of financing around EUR 600 million in loans, the cumulative FX premium has been around five times greater than FX losses, demonstrating that a DFI can tolerate currency risk, price the risk, and earn a positive return.

Piloting and experimentation is therefore warranted and entrepreneurial support organizations and foundations are well placed to do this. The World Bank Group's CTP is following this recommendation by piloting a business model transfer program in Kenya and South Africa in collaboration with local organizations including the Green Cape South Africa. This "Market Connect" program effort links international companies with successful green business models with local small, green and growing businesses in South Africa and Kenya that locally implement the business models developed abroad.<sup>50</sup> In a similar fashion, the Shell Foundation, in partnership with the U.S. Global Development Lab of the USAID, is working to scale up three complementary business acceleration models: Factor(E), Sangam, and Shell Foundation's in-house Incubator. These models support entrepreneurs that are seeking to provide access to

50 See <http://www.green-cape.co.za/content/focusarea/world-bank> for more details on the business model transfer effort between the World Bank Group and Green Cape South Africa.

energy services for low-income communities in developing countries, with focus on Africa and Asia. Similar efforts around business model and skills transfer programs should be considered for support by the entrepreneurial support organizations and foundations that work directly with green enterprises.

Collectively, these efforts build what can be called the “market infrastructure” that is needed to support the development of green sectors. Green subsectors should be supported by effective regulation, industry organizations, appropriate financing instruments, and enabling technology platforms. With this support, and the long-term backing of donors and other development actors, business model experimentation can take place and offer a promising opportunity to scale.

Donors, governments, financiers, and other actors must take these long-term, complementary actions to scale green sectors. Green sectors are complex and green enterprises are still pioneering viable business models. Markets will require a significant push to grow and financing and other market infrastructure will take time to evolve. Reaching scale in green sectors is not assured, and will require both financial resources and commitment to long-term engagement by the full range of actors in the ecosystem.

**Table 4. Priority Actions for Donors, Governments, Financiers, and Entrepreneurial Support Organizations for Scaling Green Sectors**

Group	Priority Actions
<b>Donor (Multilaterals, bilaterals)</b>	<ol style="list-style-type: none"> <li>1. Make the case that green markets need creation, including through subsidies that crowd-in private financing without distorting the market</li> <li>2. Fund programs that allow for long-term efforts to pioneer new business models, financing instruments, and enabling technologies</li> </ol>
<b>Governments</b>	<ol style="list-style-type: none"> <li>1. Develop — and implement consistently — sector-specific regulations for green sectors</li> </ol>
<b>Development Financing Institutions and Impact Investors</b>	<ol style="list-style-type: none"> <li>1. Increase focus on risk capital financing for early stage enterprises</li> <li>2. Test and rollout local currency financing instruments to help enterprises mitigate currency and exchange rate risk</li> </ol>
<b>Entrepreneurial Support Organizations and Foundations</b>	<ol style="list-style-type: none"> <li>1. Pilot business model transfer and skills matching programs</li> </ol>



# Green Business Model

## Case Studies



# Case Studies Introduction

This research analyzed innovative green business models across five sectors: Renewable energy, climate-smart agriculture, drinking water purification and management, wastewater management, and solid waste management. The research took a product market approach by segmenting the sectors into products and services used by consumers. Eighteen subsectors were thus identified within the five broad green sectors. Finally, the research team chose seven subsectors—solar home systems, mini / micro grids, community water purification, drip irrigation, online platforms for waste management, e-waste management, and industrial waste water management—for in-depth case studies of business models operating in those subsectors. These seven subsectors were chosen based on the following criteria: presence of reasonable to good density of enterprises, demonstration of investor interest, and the evidence and/or potential of the subsector to scale up and out.

**Table 5. Sectors and Subsectors Covered in the Research**

Renewable Energy	Drinking Water Purification	Sustainable Agriculture	Solid Waste Management	Waste-water Management
<b>Solar Home Systems</b>	<b>Community level water purification units</b>	<b>Drip irrigation</b>	<b>E-Waste management</b>	<b>Industrial Wastewater management</b>
<b>Mini/micro Grids</b>		Solar pumps	<b>Online-platforms for waste management</b>	Municipal wastewater management
Solar Kiosks	Household level water purification	Solar cold - storage		Wastewater treatment products
ESCOs	Packaged water	Bio - fertilizers	Waste to building materials	
			Landfill management	

Note: The highlighted sub sectors have been covered in depth in this report



## Business Model Identification Across the Seven Subsectors

These dimensions were broken down into smaller components.

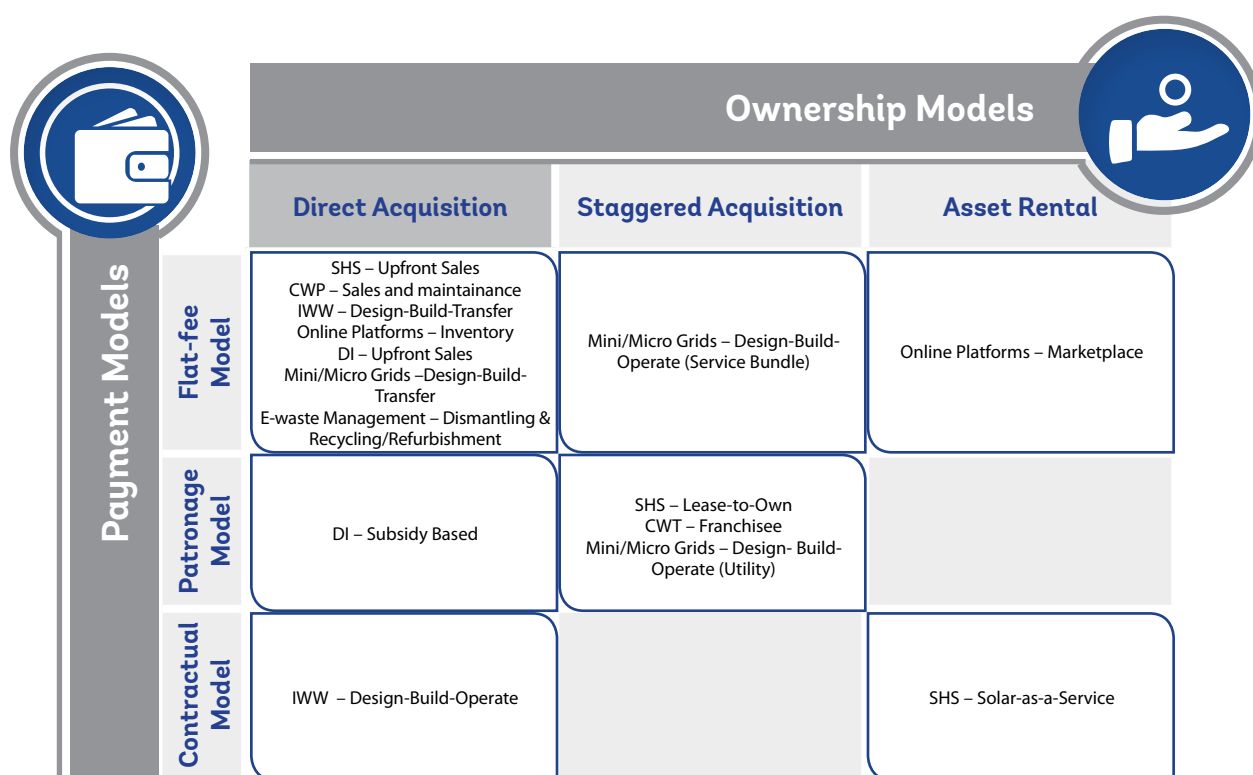
- Flat-fee model: The customer pays the entire upfront cost for the product or service as a flat fee. In some cases, the payment could be facilitated by a financial intermediary, who pays the enterprise a lump-sum, flat fee and recovers in installments from the end-customer
- Patronage model: The customer pays for the product or service in periodic installments to the enterprise
- Contractual model: The customer pays only for the service availed from the enterprise

- Direct acquisition: The enterprise transfers the ownership of the product immediately to the customer
- Staggered acquisition: The customer owns the product but the transfer of ownership is phased and is most often linked to realization of the price in installments over time
- Asset rental: The ownership of the product or service remains with the enterprise (only service is availed and paid for by the customer)

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Figure 6. Business Model Grid Across the Seven Subsectors



Most of the business models took the direct-acquisition and flat-fee approach, as it is easier to design and execute. It, however, also caters to customers that can pay upfront – a challenge in low-income developing countries, particularly for products operating in markets which are more ‘push’ than ‘pull’. Product markets are slowly evolving to include patronage and contractual models that unbundle payments and allow customers to enjoy the benefits of the product even as they pay for it.

### Framework to analyze internal and external factors affecting scale

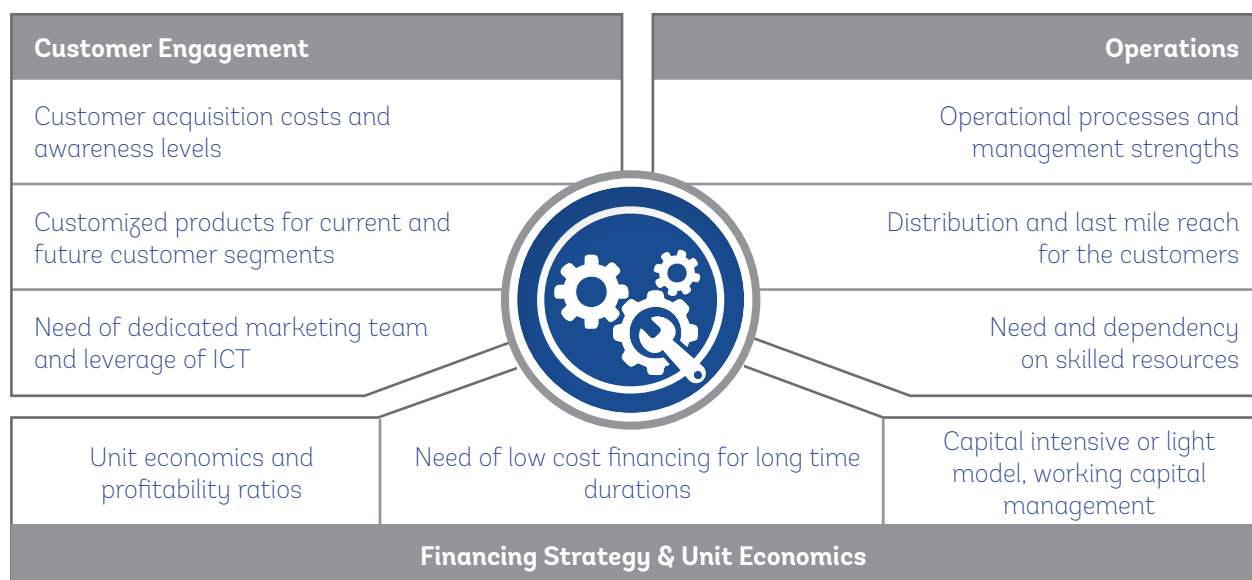
Finally, the research team adopted a framework examining various internal and external factors that impact the ability of green enterprises to scale up and scale out. These internal and external factors not only helped understand the business models but also highlighted the various conditions that the green enterprises attempted to modify or change in order to improve their operations and profitability. These six parameters (see Figure 8) constituted the scalability analysis of the green business models studied in this research.



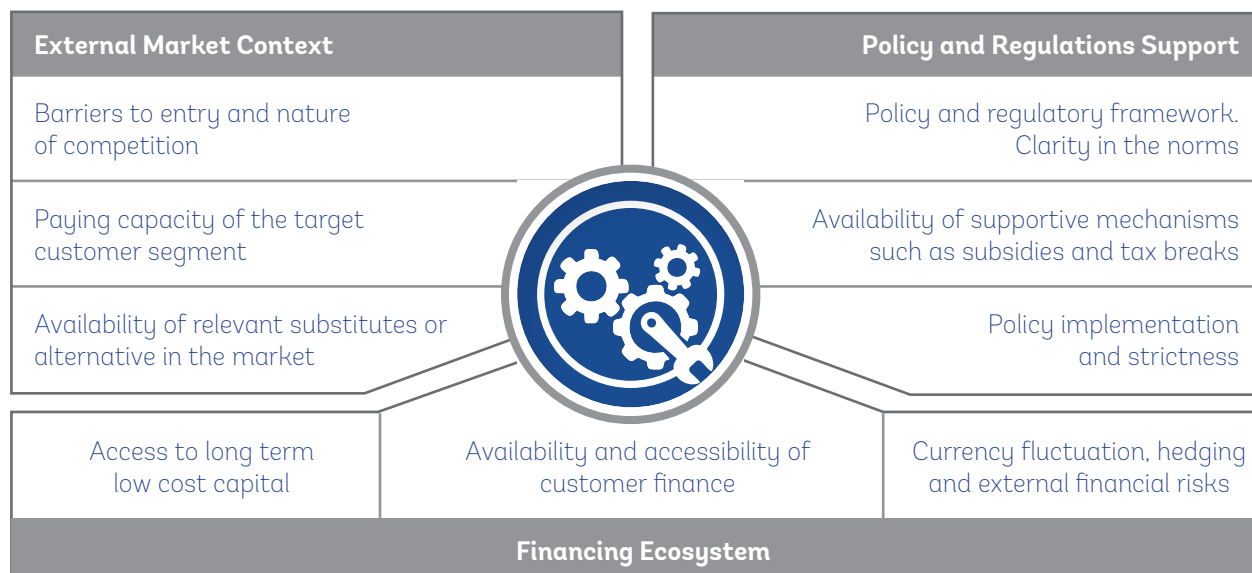


Figure 7. Framework to Analyze Internal and External Factors Affecting Scale

#### Internal factors driving scale



#### External factors driving scale




# Case Study: Solar Home Systems

## 1. Solar Home Systems Market Description

Globally, 1.2 billion people, or 16 percent of the world's population, lack access to electricity and collectively spent US\$27 billion in 2016 on alternative fossil fuel-based solutions such as kerosene and candles.<sup>51,52</sup> Small-scale, distributed solar home systems (SHS) offer a viable and effective alternative to meeting the energy and lighting needs of homes, businesses, communities, and small captive load centers such as street lights, especially in poor, remote communities. SHS have different wattage options to operate products ranging from light bulbs and mobile chargers to liquid crystal display (LCD) televisions and refrigerators. A basic SHS consists of a small solar panel, a battery, a charger controller, light-emitting diode (LED) lights, and a universal outlet for charging cell-phones or other small appliances.

Figure 8. Key Product Categories in the SHS market

	0-10 W Pico PV SHS	10-100 W Mid-sized SHS	100 W+ Large-sized SHS
 <b>Product Capacity (Typical)</b>	2 Lights 1 Mobile / Radio Charger	4-6 Lights 1 Mobile / Radio Charger 1-2 Fans	4-6 Lights 1-2 Mobile / Radio Charger 2-4 Fans 1 TV or Refrigerator
<b>Price Points (Avg. total cost)</b>	8W SHS Asia: US\$75-150 Africa: US\$75-200	40W SHS Asia: US\$150-250 Africa: US\$200-300	100W SHS Asia: US\$250-400 Africa: US\$300-500
<b>Enterprise Examples</b>	M-Kopa, Kenya PEG Ghana, Ghana Aguri, Kenya	Off-Grid Electric, Tanzania Selco, India Simpa Networks, India	Mobisol, Kenya BBOX, Kenya SolarNow, Kenya

51 "Energy Access Database," World Energy Outlook, accessed on February 10, 2017, <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/>

52 Off-Grid Solar Market Trends Report 2016, Bloomberg New Energy Finance and Lightning Global, accessed on February 10, 2017, [https://data.bloomberglp.com/bnef/sites/4/2016/03/20160303\\_BNEF\\_WorldBankIFC\\_Off-GridSolarReport\\_.pdf](https://data.bloomberglp.com/bnef/sites/4/2016/03/20160303_BNEF_WorldBankIFC_Off-GridSolarReport_.pdf)



The SHS subsector has witnessed several innovations in the last decade focusing on efficiency improvements and related price reductions to facilitate access and compete with traditional fossil fuels on price and performance. Recent innovations that improve the ability of solar cells to harvest more than 30 percent of the sun's energy,<sup>53</sup> for instance, are likely to further reduce the per wattage cost of solar power. The development of energy-efficient lifestyle electronic products such as fans, radios, and televisions is also likely to boost SHS sales in the near term. In addition, business model innovations in consumer financing such as the expanding use of pay-as-you-go (PAYG) financing, have supported the growth of the SHS market. PAYG financing reduces the upfront cost burden for customers by allowing them to pay only for usage. Consumers use basic mobile phones or other electronic means to make payments on a daily, weekly, or monthly basis. Through this model, companies can minimize the cost of collections by automating the receipt of payments, while customers get immediate access to basic electricity without having to take out a loan. However, the PAYG model is relatively new and its long-term effectiveness and sustainability in terms of portfolio health could be impacted by high customer default rates or other unforeseen issues.

This study focuses on SHS marketed primarily to off-grid and underserved grid connected customers. The product capacity of SHS units for these customers typically ranges from 8 watts (W) to 100 W. High capacity captive solar energy solutions (such as solar PV for telecom towers) and small capacity products (such as solar lanterns) have not been included as they face different challenges and opportunities. The study analyzed 14 SHS enterprises representing a cross-section of the global SHS market, including the key markets of India and Bangladesh in Asia, and Kenya, Tanzania, Nigeria, and Ghana in Africa.<sup>54</sup> Most of these enterprises are engaged in distribution, installation, operations, and maintenance of SHS units, while a few enterprises utilize external partners for distribution and maintenance support.

## 2. Global Market for Solar Home Systems

An estimated 6.5 million SHS were in operation worldwide in 2014.<sup>55</sup> Market development has been asymmetric, with the Asian countries of Bangladesh, India, China, and Nepal (in that order) accounting for nearly 90 percent of the SHS units installed in 2014. Nearly 60 percent of the total off-grid population lives in rural, semi-urban, or remote rural areas of South Asia in densely populated regions.<sup>56</sup> The South Asian region, has been an early adopter of SHS, largely driven by favorable government policies, donor support, and early participation of the private sector.

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53 Efficiency of Solar cells has been claimed to have improved to more than 30% as per a recent research paper. Solar cell efficiency was estimated to be around 15-20% in 2016 Source: Fiona Macdonald, "Engineers Just Created the Most Efficient Solar Cells Ever," Science Alert (2016), accessed on February 10, 2017, <http://www.sciencealert.com/engineers-just-created-the-most-efficient-solar-cells-ever>

54 The research team interviewed Aspiration Energy (India), Azuri (Kenya), Barefoot Power (India), Kenya Green Supply (Kenya), Lumos (Nigeria), Off Grid Electric (Tanzania), Onergy (India), PEG (Ghana), Selco Power (India), and Simpa Networks. Information from secondary sources was obtained on FRES (Mali, Uganda), M-Kopa (Kenya), Mobisol (Kenya), and Solaric (Bangladesh).

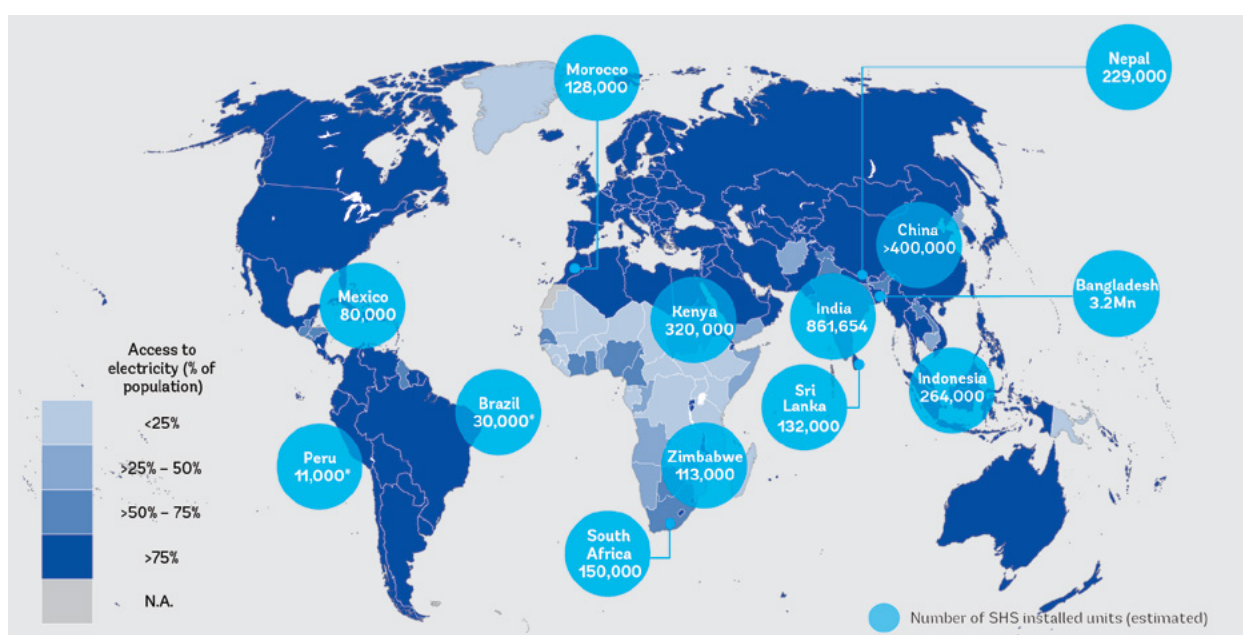
55 "Renewables 2016: Global Status report," REN21, accessed on February 10, 2017, [http://www.ren21.net/wp-content/uploads/2016/05/GSR\\_2016\\_Full\\_Report\\_lowres.pdf](http://www.ren21.net/wp-content/uploads/2016/05/GSR_2016_Full_Report_lowres.pdf)

56 "Access to Electricity (% of Population)", The World Bank Group, accessed on February 10, 2017, <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>

The SHS market is expected to grow at a compounded annual rate of nearly 35 percent, with estimated retail sales reaching US\$3.1 billion by 2020.<sup>57</sup> Much of this growth is expected in the Asian countries of India, Pakistan, and Indonesia; African countries of Kenya, Tanzania, and Nigeria; and in Latin American countries such as Brazil and Bolivia. Rooftop SHS is particularly suitable as off-grid households are remote and dispersed in these countries, making it difficult for central grid power to reach them. It is estimated that 55 million new SHS units will be sold in the developing markets of Asia and Africa by 2020.

Many enterprises participate in the global SHS market, with significant enterprise activity in India and Bangladesh.<sup>58</sup> The market is also served by unbranded and counterfeit products that are difficult to monitor and regulate. While most enterprises operate in a single country or region, a growing number of enterprises, such as Azuri, SolarNow, Selco, and Mobisol, have expanded to multiple countries.

**Figure 9. Access to Electricity and Installed SHS<sup>59</sup>**



Note: \*Figures for SHS installations in Latin America are low due to high grid electricity penetration. SHS installations in Peru have been estimated based on two SHS programs. Figures for SHS installations in Brazil are not directly available and suitable approximations have been made based on CBEM reports available at <http://cbem.com.br/wp-content/uploads/2011/12/PV-COMES-TO-THE-MAINSTREAM-30000-SHS-INSTALLED-BY-UTILITY-IN-BRAZIL-UNDER-A-NEW.pdf>

57 Estimated sales in 2015 were at US\$0.7 billion for Pico PV and large SHS. Source: "Off-Grid Solar Lighting Market Trends," Bloomberg New Energy Finance (2015), accessed on February 10, 2017, <http://conference2015.gogla.org/wp-content/uploads/2015/10/Off-Grid-Solar-Lighting-Market-Trends.pdf>

58 It is estimated that nearly 200 suppliers of SHS are active in India. IDCOL lists over 60 SHS enterprises active in Bangladesh.

59 "Number of Units: Off-Grid Renewable Energy Systems: International Renewable Energy Agency, 2015," accessed in 2017, [https://www.irena.org/DocumentDownloads/Publications/IRENA\\_Off-grid\\_Renewable\\_Systems\\_WP\\_2015.pdf](https://www.irena.org/DocumentDownloads/Publications/IRENA_Off-grid_Renewable_Systems_WP_2015.pdf). Access to Electricity: <http://en.actualitix.com/doc/maps/wld/world-map-access-to-electricity-by-country.jpg>. Source for Peru-related information: <http://www.worldbank.org/en/results/2014/09/24/peru-brings-electricity-to-rural-communities> and <http://www.energia16.com/peru-installs-pv-solar-systems-in-168-rural-communities-in-cusco/?lang=en>



### 3. Key Drivers and Challenges for the Solar Home Systems Market

Between cost reductions, latent consumer demand, and a marketing push for higher-margin products, SHS is likely to capture an increasing share of the energy market in the next few years. There is already an established market and economic need to reduce the use of traditional and inefficient sources of lighting, such as kerosene, with efficient solutions like SHS. SHS also offer customers indirect benefits, such as reduced health risks associated with incomplete combustion of kerosene. However, these indirect benefits are not easily converted into demand since customers often do not factor long-term health benefits into their purchase decisions.

Despite the global viability and growth in SHS products, the market faces significant barriers. For example, low barriers to market entry and less stringent quality regulations have led to a crowded market with numerous SHS enterprises essentially competing on price. Poor quality products at low prices with no or limited warranties result in low levels of customer satisfaction. Many enterprises interviewed for this study said that earning customer trust and convincing them of the benefits of buying high quality, albeit more expensive, SHS, has been a key challenge.

Figure 10. Key Drivers and Challenges for the SHS Market

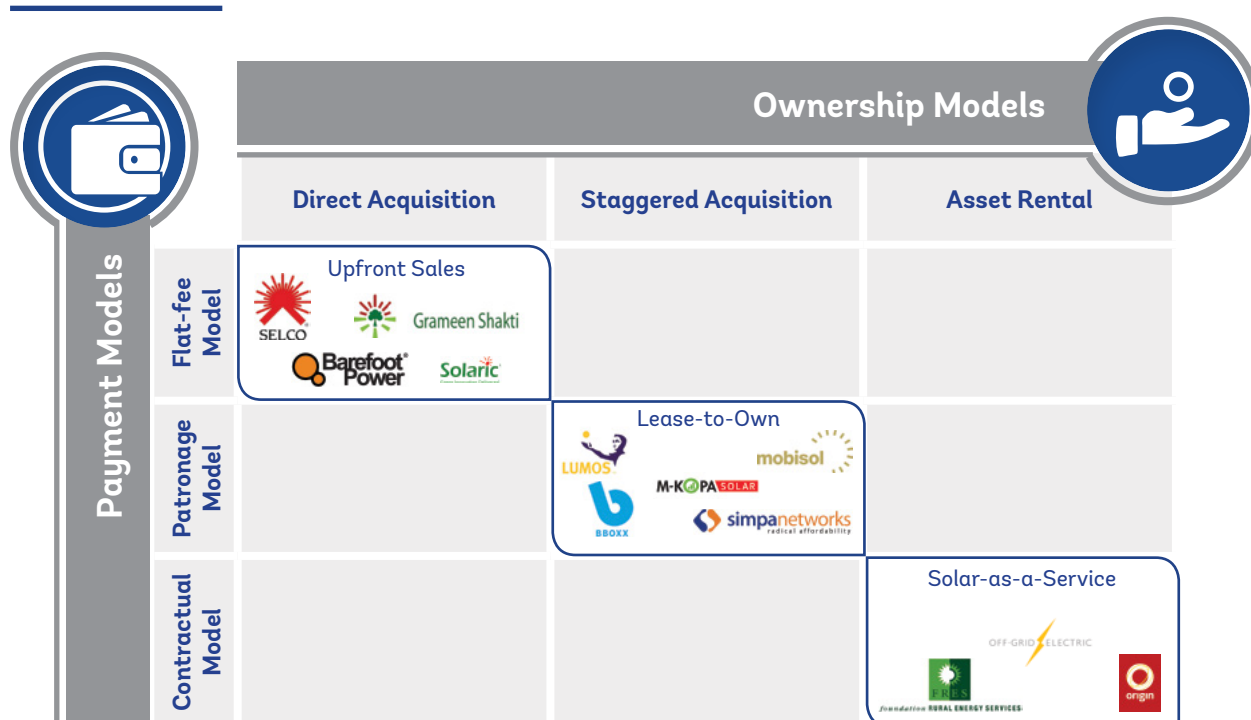




#### 4. Mapping of Solar Home Systems Enterprises into Business Models

Globally, low-income customers have different preferences for SHS asset ownership, but most seek flexible access and affordability with convenient payment terms. In response, enterprises in the SHS market structure their payment terms and revenue strategy around the customer's ability to pay.

Figure 11. Mapping Enterprises Across Business Models in SHS Market



To cater to different customer payment abilities and preferences, SHS enterprises typically follow one of three business models:

1. **Upfront sales model:** The customer pays the entire SHS cost upfront to the enterprise, either directly or by obtaining a loan with the help of the SHS enterprise, which facilitates access to credit through partner banks, credit cooperatives, microfinance institutions (MFIs), or financial non-government organizations (FINGOs).
2. **Lease-to-own pay-as-you-go (PAYG) model:** This model is tailored to match customers' ability to pay. The customer pays a small down payment followed by prepaid or usage payments on a daily, weekly, or monthly basis. The enterprise transfers SHS ownership once the customer completes full payment. The enterprise effectively finances the sale of SHS through deferred payments and recovers its cost over the lease period.



3. **Solar-as-a-service pay-as-you-go (PAYG) model:** This model is tailored to meet the needs of customers who do not seek to own the SHS. Customers can control the amount of electricity they consume and pay only for the energy they use. Payments can be tailored to capacity and made in small amounts. The enterprise enters into a power purchase agreement with the customer that could run for 10 years.

The PAYG model has evolved in the last few years as a modern and innovative way to reduce the upfront costs of SHS for low-income customers. However, the PAYG model faces the risk of customer payment defaults, and to date there is limited information on the performance of these underlying assets. In contrast, the upfront sales model is a more traditional model and requires less sophistication for business operations. Enterprises also customize and create hybrid models to meet customer requirements. For example, PAYG enterprises such as M-KOPA in Kenya tie up with finance providers such as microfinance institutions (MFIs) and savings and credit societies (SACCOs) for last mile delivery and customer engagement.

### 5. Scalability Analysis of the 'Upfront Sales' Business Model

The upfront sales model has the highest concentration of enterprises in the SHS market since it is simple, can be adopted by sellers of unbranded SHS, requires low capital investment in monitoring and payment collection technology, and attracts limited policy or regulatory restrictions.<sup>60</sup> The upfront sales model appeals to customers who can pay the entire price of the SHS in one lump sum either from own funds or through an individual or group loan sourced from a local bank, MFI, or local cooperative. The SHS enterprises may play a role in connecting customers to financial institutions based on their credit history and household incomes. They also provide operational and maintenance support to customers at minimal or no cost. Enterprises leverage the existing customer base of partner financial institutions to target potential customers for the SHS product.

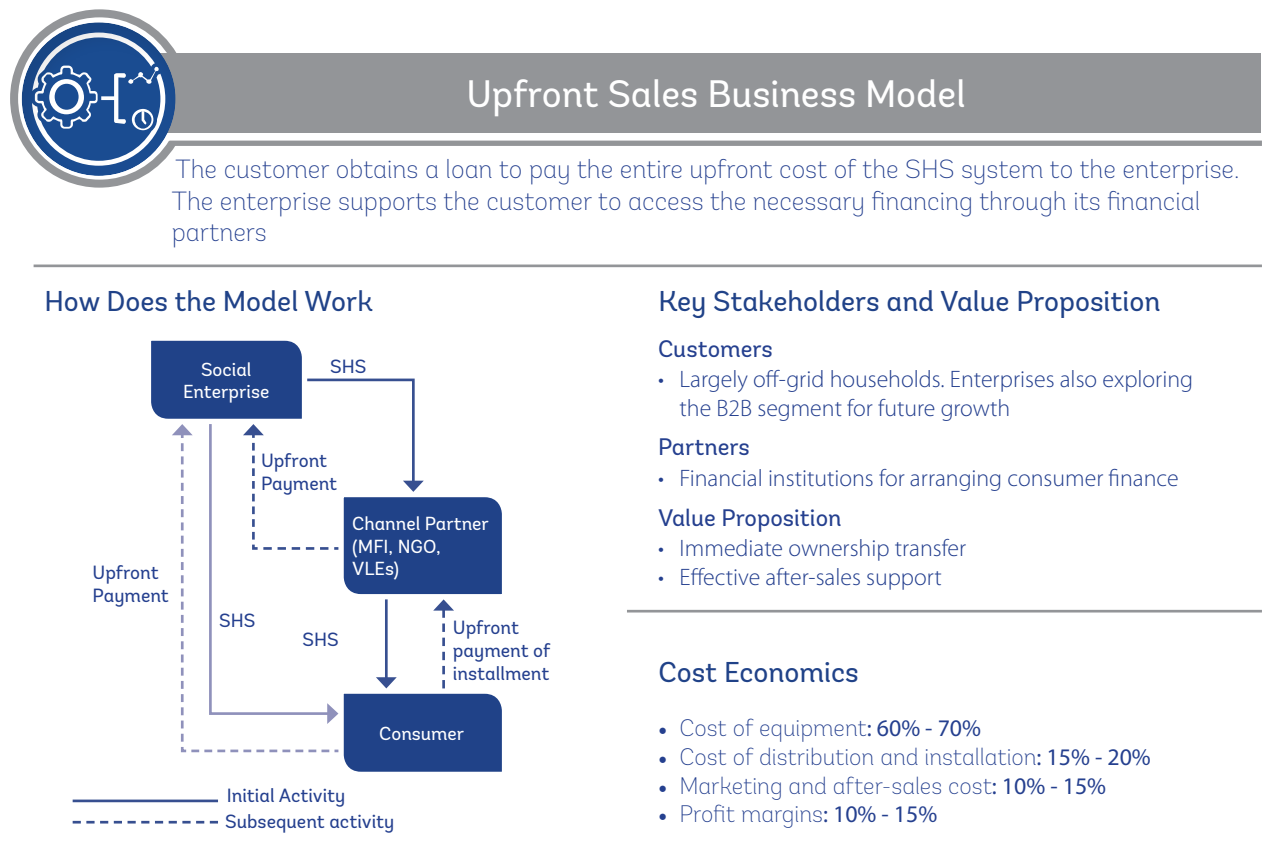
The upfront sales model is very popular in South Asia due to the availability of consumer financing channels through banks, MFIs, and other nonbanking financial companies (NBFCs). Therefore, most SHS enterprises in the region, such as Barefoot Power, Selco, Solaric, Grameen Shakti; and a few in Africa, such as Solar Now, Power Point, and Sunlar, use the upfront sales model.

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<sup>60</sup> For instance, more than 300 SHS enterprises are estimated to use the upfront sales model, whereas the PAYG model enterprises are expected to be around 35 to 40 enterprises in South Asia and East Africa as per different sources and reports



Figure 12. Upfront Sales Business Model in SHS Market



## 5.1 Internal Factors

### Customer Engagement

Since the market has several low-cost options, enterprises deploying the upfront sales model need to offer value added products and services to gain competitive advantage and justify their higher price. Several enterprises have enhanced their product portfolio to include electronic products to reduce their dependency on traditional SHS products, and diversify revenue streams. For example, Solaric, a leading SHS enterprise in Bangladesh, has expanded its product portfolio to develop electronic products such as low wattage fans and televisions. The enterprise also plans to launch a low energy consumption computer that can run on a 60W SHS.<sup>61</sup> It expects a high portion of its revenues to come from such lifestyle electronic products in the next three years. Most customers for these electronic products are existing low-income households that already use SHS and are ready to move up the energy ladder with lifestyle products and services.

### Operations

Upfront sales enterprises need strategic tie-ups with financial institutions to ensure access to finance for their customers, who may otherwise find it difficult to pay the entire upfront

61 Solaric Bangladesh website, innovations in appliances available at <http://solar-ic.com/solaricdev/sample-page/>

cost of the SHS. Enterprises that build partnerships with a diverse set of financial institutions that have different processes for credit risk assessment and offer different interest rates and payment recovery mechanisms are likely to scale better. For example, Barefoot Power in India has established three channels for financing its customers: (i) commercial and rural banks (under the priority sector lending norms<sup>62</sup>), (ii) MFIs, and (iii) corporate social responsibility (CSR) programs.<sup>63</sup> The enterprise can offer its customers different financing options, convenience in making payments, and different interest rates based on eligibility. This not only reduces the risk of credit default for the banks but also ensures customer satisfaction due to favorable payment terms and credit options. Similarly, India's Selco Solar ensures that its customers have access to credit through its partnerships with local commercial banks, regional rural banks, and credit cooperatives. The interest rates are competitive and range from 5 percent to 14 percent based on the source of credit.<sup>64</sup>

### Unit Economics

Upfront sales enterprises spend about 60 percent to 70 percent of incurred costs on equipment and goods. Distribution and installation costs account for another 15 to 20 percent. These enterprises earn margins that are 10 percent to 15 percent lower than enterprises using the other SHS business models. Many enterprises interviewed in this segment are targeting economies of scale with aggressive outreach and growth targets ranging from 40 percent to 80 percent in the next four to five years. They are seeking rapid customer acquisition to reduce the risks and cost of holding inventory. Unit economics could be improved through expansion of operations in under-penetrated areas and leveraging alternative delivery channels such as village level entrepreneurs (VLE) to reach rural customers.

### Financial Strategy

Local banks and other financial institutions often find it difficult to finance off-grid low-income households due to the absence of credit history or a guarantee mechanism. Moreover, the SHS unit itself cannot be offered as collateral to the financial institution as there are few secondary markets where used SHS units can be sold.

To overcome this challenge and to scale operations, enterprises support financial institutions in managing the credit default risk. Selco Power, for instance, provides margin money guarantee<sup>65</sup> and has created a revolving fund mechanism to provide credit support to its financial partners. The Selco team also helps customers analyze their household cash flows and assets to maximize their chances of obtaining a solar loan. Barefoot Power similarly supports financial institutions with preliminary credit assessments of customers based on household cash flows to hasten the loan approval process.

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62 Priority Sector in India refers to those sectors of the economy which may not get adequate credit in the absence of this special dispensation. Priority Sector Lending is a mandate by the Central Bank for providing a specified portion of total bank lending to few specific sectors

63 The CSR channel is less utilized as the lead times for approval of grant money is much higher with delays in payment releases from the related corporate entity.

64 "Finance," SELCO, accessed on February 10, 2017, <http://www.selco-india.com/finance.html>

65 A type of bank guarantee when the bank asks the borrower to deposit some money as a counter security



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### Box 6 Building the solar ecosystem in India: Selco Power India

Selco is one of the leading SHS enterprises in India. Over 60 percent of its business in India comes from bank-financed SHS for individual households. To build its Indian market, Selco has had to provide an entire range of services including quality products at competitive rates, on-ground after-sale service, and customer financing options.

When Selco started its operations in India, the supporting financial ecosystem for promotion of solar products was absent. The company had to invest significantly in building awareness among financial

institutions and policymakers. Consequently, the break-even period for Selco was nearly seven years. Access to affordable finance was a key barrier for customers as the local banks and other financial institutions would not lend credit to them due to absence of credit history and a guarantee mechanism. To address this challenge, Selco started providing margin money guarantee and has created a revolving fund mechanism. Selco has also established an incubator center to promote rural entrepreneurs that can replicate Selco's model in different parts of India.

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## 5.2 External Factors

### Market Context

To scale their operations, many upfront sales enterprises are targeting business-to-business (B2B) customers that have higher power needs and seek reliability and quality in supply. For example, in India, Selco has seen business growth in the B2B segment as rural entrepreneurs, small shopkeepers, home institutes, and home-based industries demand solar lighting products with much higher capacity and price points. Selco estimates that the B2B customer segment will overtake households as the largest contributor to its revenues in next few years.<sup>66</sup>

### Financing Ecosystem

Most of the upfront sales enterprises included in this research are active in South Asian countries where the solar financial ecosystem in terms of customer debt financing is relatively well developed. Several financial institutions have partnered with enterprises to offer solar specific loan products to customers. For financing enterprise expansion and operations, most upfront sales enterprises indicated their preference for debt or subordinate debt products, and shared that funding is available if they can demonstrate business model stability and sales volume.

### Policy and Regulations

Several relevant government policies in developing nations of Asia focus on reducing the upfront investment burden of off-grid customers by offering subsidies through financial institutions. This ensures additional support from financial institutions, and upfront sales enterprises are likely to benefit the most from such initiatives. They can receive full payment for the SHS within a shorter span of time, thereby reducing their financial risk and freeing

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<sup>66</sup> Intelcap primary interviews with stakeholders

up capital that they could utilize to scale up. For example, Barefoot Power has entered into an agreement with the government of Vanuatu to offer subsidies of approximately 30 percent for its SHS products through financial channels. However, a delay in subsidy payment from the government to customers or the enterprises can be a major barrier to scale. In India, subsidy payments to SHS enterprises were delayed by over a year, severely impacting the working capital and cash flows of enterprises.<sup>67</sup> Hence, many enterprises have moved away from subsidies and adopted the upfront sales model. The market has continued to grow, driven by customer demand, even after the enterprises reduced their dependence on subsidies in the last few years.

### 5.3 Scaling Out

The upfront sales model is likely to scale better in geographic regions that have higher penetration of banks and MFIs, and where government subsidies are available for installing off-grid SHS. Bangladesh and Nepal, for instance, have offered direct and indirect subsidies ranging from 30 percent to 75 percent of the SHS installation costs for off-grid households. This model will also thrive in countries where a significant proportion of the low-income population has disposable income to pay upfront or obtain loans. In countries where microfinance and government subsidies are available, such as Bangladesh, India and Nepal and some Latin American countries, upfront sales enterprises have significant opportunities to scale operations.

Upfront sales enterprises prefer trade partnerships or setting up wholly owned subsidiaries to expand in geographic areas far from their home operations. This may stem from their preference to have better control over operations and leverage their brand name. For instance, Barefoot Power has established its own subsidiaries across several Asian countries and sells SHS under its brand name, Barefoot Connect.

Upfront sales enterprises may find it difficult to scale out to countries where the financial ecosystem supporting solar financing is not well developed. For instance, in many Central and Western African countries, banks and financial institutions treat SHS as they would any other product and SHS is not highly valued as collateral.

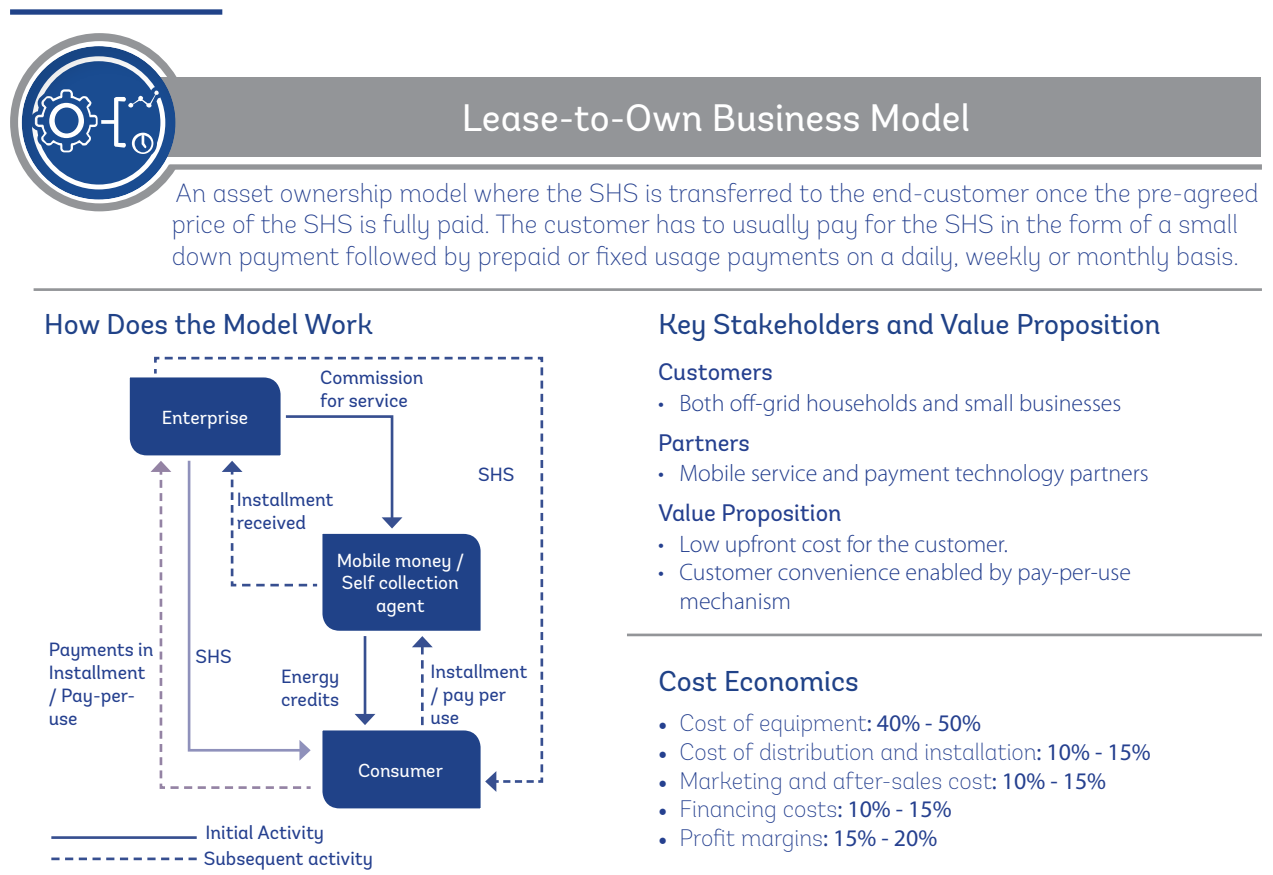
## 6. Scalability Analysis of 'Lease-to-Own' PAYG Business Model

The lease-to-own model emerged from the need for asset ownership by low-income customers who may not have the financial capacity to pay for the SHS upfront. By accepting staggered payments, the enterprise finances the SHS and recovers the full cost over a typical period of 18 to 36 months from the customer. Enterprises deploying this business model often utilize digital channels where customers use mobile money or SMS codes for payments. Proprietary hardware and software is used to tie the usage of services to the payments, and machine-to-machine learning helps manage communication with the SHS and customers. M-KOPA, Mobisol, PEG Ghana, Azuri, and BBOXX in Africa; Simpa Networks in South Asia; and Quetsol in Guatemala follow this business model. There are significant differences in key operational aspects in this model, such as length of the payment period, size of initial deposit, interest rates, and flexibility in payments depending on the SHS wattage capacity and area of operations of the enterprise.

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<sup>67</sup> Intellecap primary interviews with stakeholders

Figure 13. The 'Lease-to-Own' Business Model in SHS Market



## 6.1 Internal Factors

### Customer Engagement

The lease-to-own model is attractive to customers who view SHS as a household asset with intrinsic value. However, first time customers may find it difficult to understand concepts such as lease period and installment payment terms, and therefore hesitate to sign up for the SHS purchase. Lease-to-own enterprises need to deploy marketing strategies, such as coopting some in the local community to act as its brand ambassadors and bundling products to improve SHS uptake. For instance, in addition to leveraging its sales and marketing team, which is usually from the local community, Azuri bundles its products with other popular brands to make them attractive and familiar to potential customers. The enterprise shared that this strategy was particularly successful in Rwanda.<sup>68</sup>

Lease-to-own enterprises can leverage customer data and payment track record to identify new opportunities to scale. They can capture demographic, consumption, and payment behavior data about their customers that could be examined through advanced analytics to design value added services. For example, customers that begin with the basic product (8W or 10W SHS) can be migrated to higher wattage SHS to support lifestyle products. M-KOPA monitors customers' lease period and reaches out to them towards the end of their tenure to

<sup>68</sup> "Rwanda's First PayGo Solar Power Heads towards Success," August 2014, Azuri corporate publications

offer higher value lifestyle products such as televisions based on their credit history.<sup>69</sup> Customer and payment data can also be used to validate credit decisions, appraisal checks, and customer segmentation.

### Operations

Given that lease-to-own enterprises engage with customers over a long period of time and tailor their products to ensure flexible access and payment avenues, they need to ensure seamless customer experience, effective monitoring, and payment collection mechanisms. Many enterprises enter strategic tie-ups with mobile network operators (MNOs) to facilitate digital top up or mobile money payment mechanisms that unlock energy credit in the SHS unit. Lumos, for instance, partnered with MTN to pilot the first mobile-enabled energy service in Nigeria in 2014. MTN's brand name was well recognized in the country and Lumos build a relationship with its customers while drawing on MTN's support for distribution, sales, and after-sales customer services. MTN benefited through increased income per user and loyalty through regular payments that led to lower churn as existing customers were less inclined to change over to another mobile network in Nigeria's highly competitive mobile services market.<sup>70</sup>

The success of these payment mechanisms depends on customer awareness and comfort with digital finance and mobile money. This is a challenge in many developing countries where low-income customers are more comfortable with cash transactions. PEG Ghana, for instance, initially faced challenges in replicating M-KOPA's mobile money model in communities where cash-based transactions were common. PEG Ghana refined its product and invested significant resources in building localized operations and tie-ups with MNOs to increase awareness about the benefits of digital finance and mobile money.<sup>71</sup> Simpa Networks in India deploys its own field staff 'Urja Mitras' to collect cash payments from rural customers and process energy credit, since many of its customers are not comfortable using mobile money and prefer cash transactions. Cashless transactions are slowly gaining traction in India.

### Unit Economics

Lease-to-own enterprises typically incur costs on equipment, consumer financing and operations, which include technology and collection process costs. They currently earn gross profit margins in the range of 15 to 25 percent, and expect margins to improve with increasing scale of operations, as cost per incremental sale will fall. Many enterprises interviewed for this research are in the growth stage with aggressive outreach and growth targets ranging from 75 percent to 150 percent for the next three or four years. To achieve this level of growth, they will need to provide low-cost capital financing, strong payment technology and robust credit appraisal processes. However, while financing facilitates purchases, the customer may have to pay higher 'lifecycle ownership' costs (sum of payments over the lease period to own the SHS)

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69 "Pay-As-You-Go Solar Power Takes Off in Africa," Feb 2015, CNBC report available at <http://www.cnbc.com/2015/02/25/pay-as-you-go-solar-power-takes-off-in-africa.html>

70 Caroline Sheldon, "Lessons Learned from Our Grantees: Lumos," GSMA (2016), accessed on February 10, 2017, <http://www.gsma.com/mobilefordevelopment/programme/m4dutilities/lessons-learned-from-our-grantees-lumos>

71 Mobile for Development Utilities, PEG Ghana, Licensing Solar-as-a-Service in a New Market, GSMA (2016), accessed on February 10, 2017, [http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/03/GSMA\\_Report\\_PEG\\_Ghana\\_Licensing\\_Solar\\_As\\_A\\_Service.pdf](http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/03/GSMA_Report_PEG_Ghana_Licensing_Solar_As_A_Service.pdf)





when compared to the upfront sales model due to a high effective interest rate and a longer duration of lease period compared to loan tenure.

### Financial Strategy

The payment terms of lease-to-own SHS customers are spread over a period of three to five years, whereas the enterprises have to pay their suppliers upfront while keeping the financing cost for the customer affordable. Lease-to-own enterprises, therefore, seek long-term, patient capital such as soft loans, grants, and impact capital to support their upfront purchases. Lumos, for instance, raised a US\$15 million long-term loan from the Overseas Private Investment Corporation (OPIC) to fund the deployment of over 75,000 SHS units across Nigeria in 2016.<sup>72</sup> At an average price of around US\$800 per SHS unit (of 80W capacity) spread across a period of five years, this translates to sales to debt coverage ratio of 4:1. Similarly, PEG Ghana raised US\$1.5 million in debt from Oikocredit, responsAbility and SunFunder that will help it provide SHS for 75,000 residents or 15,000 households in Ghana.<sup>73</sup> At an average price of US\$200 per SHS unit of 8W capacity, this translates to sales to debt coverage ratio of 2:1. Such financing support helps SHS enterprises deploy resources for rapid scale up. Kenya-based Azuri also prefers debt financing to support sales and business expansion. The company created a first loss fund using equity and retained earnings to cover customer payment default risks. These examples indicate that lease-to-own SHS enterprises need to attract long-term debt and grant funding to expand their customer base and scale.

Moreover, enterprises with a large customer base and historical customer payments data are likely to have better access to long-term capital in the lease-to-own segment. Examples include M-KOPA and Mobisol, which have been in operations for more than five years. M-KOPA raised a US\$10 million loan from the Commercial Bank of Africa in 2014-2015, and US\$10 million in a combination of equity and grants from the United Kingdom's (U.K.) Department for International Development (DFID), Bill and Melinda Gates Foundation (BMGF) and other investors,<sup>74</sup> and increased its sales of SHS units by over 100 percent in 2015-16.

72 "International Solar Initiative to Drive Affordable Power Access in Nigeria," ESI Africa (2016), accessed on February 10, 2017, <https://www.esi-africa.com/news/international-solar-initiative-to-drive-affordable-power-access-in-nigeria/>

73 Danielle Ola, "PEG Africa Raises US\$1.5 million Debt, Nets USAID Grant for Residential Solar," PV Tech (2016), accessed on February 10, 2017, <http://www.pv-tech.org/news/peg-africa-raises-us1.5-million-debt-nets-usaid-grant-for-residential-solar>

74 Katie Fehrenbacher, "How M-KOPA Unlocked Pay-As-You-Go Solar in Rural Kenya," GIGAOM (2014), accessed on February 10, 2017, <https://gigaom.com/2014/04/10/how-m-kopa-unlocked-pay-as-you-go-solar-in-rural-kenya/>

## 6.2 External Factors

### Market Context

A few enterprises interviewed for this research identified payment fatigue and customer drop-offs (prolonged payment defaults), especially in long-term lease periods, as a major growth barrier. A well-diversified customer base across low-income households, business customers, and community service centers may allow enterprises to spread the risk and build financial flexibility. For example, when Mobisol expanded its operations from Tanzania to Rwanda, it diversified its target customer mix to include small businesses such as tailoring and stitching units and small scale food processing units that need good lighting to be more efficient. SHS could potentially enhance incomes of these small businesses and contribute to more stable and higher monthly payments and lower defaults.<sup>75</sup> In Nigeria, Lumos is similarly looking to serve community service centers such as hospitals, churches, and mosques to build its customer base.<sup>76</sup>

### Financing Ecosystem

Most lease-to-own enterprises have been established in the last five years, and many enterprises covered in this research are seeking to raise funds for business growth. Some face challenges in attracting investors since the business model is relatively new and is dependent on clients with little or no credit history. Innovative financial mechanisms such as receivables being transferred to a special purpose vehicle (SPV) and securitized for raising long-term capital, and energy impact bonds can help enterprises to access capital for scale. BBOX, for instance, set up an SPV in 2016 that issues notes and sells them to a funding agency, Oikocredit. The value of the notes is based on future receivables from customers' contracts. The sale of these contracts provided BBOX with capital to supply approximately 1,200 new solar home systems in Kenya in 2016.<sup>77</sup>

Lease-to-own enterprises may also face hedging risks in countries with higher currency fluctuations. They usually must pay for the upfront cost and installation of the SHS units to their suppliers (typically in U.S. dollars), while customer payments are received in local currency as part payments over a long period of time. A high currency fluctuation can seriously impact their profitability and plans for scale. For instance, many SHS enterprises in Nigeria are facing higher costs challenges since Nigeria's currency lost nearly 40 percent against the U.S. dollar over the last couple of years.<sup>78</sup> Appropriate hedging strategies with the additional cost being transferred to the end customer and sourcing of capital from local finance providers and channels could be possible solutions to safeguard against such currency shocks.

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75 Mobile for Development Utilities, Mobisol Pay-as-you-go Solar for Entrepreneurs in Rwanda, GSMA (2016), accessed on February 10, 2017, <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/Mobisol-Pay-as-you-go-Solar-for-Entrepreneurs-in-Rwanda.pdf>

76 Lumos: Pay-As-You-Go Solar in Nigeria with MTN, Mobile for Development Utilities, GSMA October 2016

77 "First Securitization Deal for Off-Grid Solar in Africa," Oiko Credit (2016), accessed on February 10, 2017, <https://www.oikocredit.coop/k/n171/news/view/138533/462/first-securitization-deal-for-off-grid-solar-in-africa.html#WJ2stvlnl0h>

78 Intelcap primary interviews with stakeholders



## Policy and Regulations

Lease-to-own enterprises often provide in-house financing and many countries therefore consider them to be nonbanking financial companies (NBFC) for regulatory purposes. The NBFC segment usually comes under the purview of the central bank, and enterprises offering SHS financing may be subject to capital adequacy norms and interest rates caps. For example, M-KOPA evaluated the option of entering India with a lease-to-own model.<sup>79</sup> In India, any enterprise that seeks to accept lease payments must register as a finance company under the jurisdiction of the Reserve Bank of India. As the minimum paid up capital requirement for an NBFC in India is US\$0.3 million, this was a very expensive option compared to the US\$4,000 required to register as a company. Potential solutions could be to partner with an NBFC or bank to process the lease payments, but putting these systems in place takes time.

## 6.3 Scaling Out

The market need for the lease-to-own model hinges on customers' convenience to pay in small installments to eventually own the product. The model needs the support of digital finance channels and mobile money operators for convenient customer payments. It is likely to scale better in East and West African countries such as Rwanda, Kenya, Tanzania, and Nigeria, and in Latin American countries such as Brazil, where mobile money payment options are widely used. Moreover, the model seems to be more popular with the slightly mature age group of customers of more than 30 years who prefer to own the SHS and can correlate the monthly expenditure on the SHS with other household expenses.<sup>80</sup> It has the potential to serve diverse customer groups and deepen engagement with higher wattage units for lifestyle products.

Lease-to-own enterprises prefer licensing agreements or trade partnerships to expand outside their home country, while they set up their own subsidiary to scale out to nearby geographies. This is possibly because the model requires the enterprises to build financing and mobile payment partnerships in these markets, which take time and could have legal implications. Also, the cultural context could be very different and might be better managed by licensees or trade partners. For instance, M-KOPA, Kenya has entered into a licensing agreement with PEG Africa to offer its products in Ghana, whereas Azuri has established its own subsidiaries across various countries of East Africa.

Lease-to-own enterprises may find it difficult to scale out to countries where digital payment transactions such as mobile money penetration and usage are low and where the solar financing ecosystem for clean energy adoption is active. In contrast, upfront sales models will thrive in this context. Therefore, South Asian countries such as India and Bangladesh, which have an established financing ecosystem for SHS adoption, may not be suitable for market expansion for these enterprises.

Lease-to-own enterprises in Africa have attracted significant attention from donor and development finance institutions, and funding is available for some enterprises for expansion of product portfolios and geographic footprint. Some enterprises prefer mainstream capital

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<sup>79</sup> Intelcap primary interviews with stakeholders

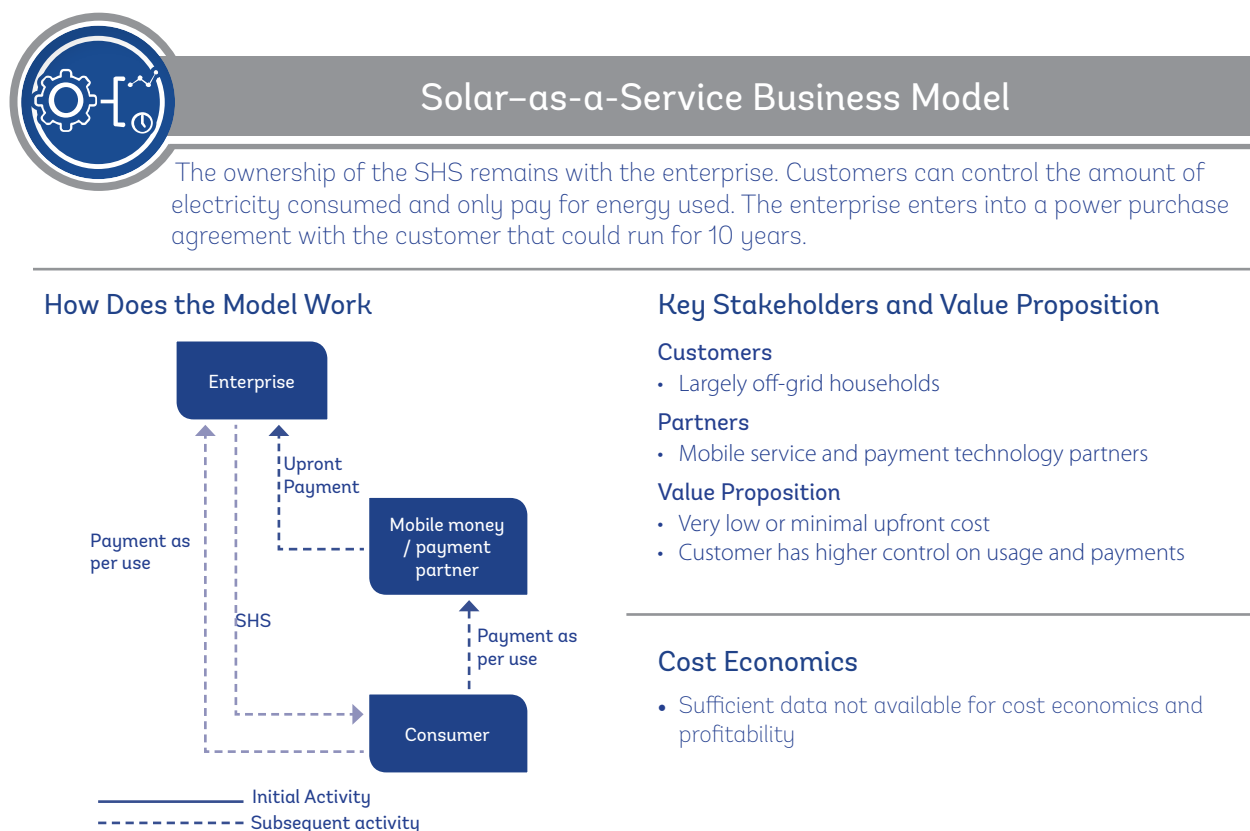
<sup>80</sup> Intelcap primary interviews with stakeholders

for expansion to ensure long-term financial sustainability. For instance, SolarNow in Uganda has utilized grant funding to set up operations, but then shifted its focus to raise funds from mainstream capital providers based on the strength of its balance sheet and financial statements.<sup>81</sup>

## 7. Scalability Analysis of 'Solar-as-a-Service' (SAS) PAYG Business Model

The solar-as-a-service (SAS) model taps into typical low-income customer behavior of seeking the most affordable source of electricity. It mimics the grid model, where the customer only seeks access to electricity and does not view the SHS as an asset or wish to own it. The enterprise incurs the cost of the SHS installation and recoups these costs from usage fees chargeable to the customer. This business model has only evolved in the last few years and relatively few enterprises such as Off-Grid Electric and FRES in Africa have adopted it so far. This model is more popular with urban and peri-urban customers in developed countries, with enterprises such as Origin Energy, Solarcity, and Sunnova offering solar energy services to an environmentally-conscious middle- to high-income customer segment. Enterprises retain ownership of the SHS in this model, but face challenges in maintaining the units especially in remote, rural areas.

Figure 14. The 'Solar-as-a-Service' Business Model in the SHS Market



Note: Only one enterprise shared the cost economics, so cost economics are not available for this business model.

81 Intellec primary interviews with stakeholders



## 7.1 Internal Factors

### Customer Engagement

Off-grid customers need to be educated about the concept of solar-as-a-service and its potential benefits such as convenience and flexibility in payments and control over costs, particularly when customers need to shift from other affordable solutions such as diesel, kerosene, and candles. Solar-as-a-service enterprises must therefore invest in customer outreach and customize marketing initiatives, since standardized promotion and pricing methods may not work for all communities. For example, Off Grid Electric Tanzania deployed door-to-door sales in central and northern zones of the country, but realized that this plan did not work for coastal communities, which tend to value their privacy more highly and prefer community channels to learn about a product or service. By developing a strategy that focused on the community, such as road shows and skits, the enterprise significantly improved its expansion in coastal Tanzania.<sup>82</sup>

Customer stickiness is a challenge in contractual models. To offer convenience and on-demand support to its customers, Off Grid Electric has set up 24/7 customer service centers, the first of its kind in the country, to ensure that customer's queries and problems are quickly resolved.<sup>83</sup>

### Operations

Solar-as-a-service enterprises may find it difficult to employ field level employees who can effectively communicate the benefits of the model to rural customers. Faced with this challenge in East Africa, Off Grid Electric is setting up a training academy to fulfill its need for hundreds of field executives each year that may be otherwise difficult to obtain from the open market.<sup>84</sup>

The operational model of solar-as-a-service enterprises needs to be flexible enough to dismantle and reinstall SHS units at different locations in case of consistent payment default by the customer during the contract period. This could mean loss of inventory and payment delays that in turn require considerable working capital and impact the enterprises' ability to scale. As a result, these enterprises risk spending an inordinate amount of time on securing lines of credit and viewing themselves as solar finance companies, rather than focusing on product quality, customer acquisition and engagement.

### Unit Economics

Solar-as-a-service enterprises typically incur major costs on equipment and operations, which include technology costs and marketing costs. A few of these enterprises have comparatively higher gross profit margins in the range of 30 percent to 40 percent, since their cost of financing has been relatively low. The solar-as-a-service enterprises interviewed for this research shared that they aim to achieve aggressive outreach and growth targets ranging from 100 percent to 150 percent in the next three or four years. To achieve this growth, they will need to tie up with local capital financing providers to support initial investment and robust credit appraisal processes to ensure they identify and target paying customers.

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82 Intelcap primary interviews with stakeholders

83 Adva Saldinger, "Off-Grid Solar Power is Gathering Steam in Africa, What's Next?," Devex Impact, Oct. 26, 2015, <https://www.devex.com/news/off-grid-solar-power-is-gathering-steam-in-africa-what-s-next-87149>

84 Off-Grid Electric, Impact, accessed on February 10, 2017, Off-Grid Electric (blog), <http://offgrid-electric.com/ourimpact/#impact>

### Financial Strategy

Solar-as-a-service enterprises usually charge a small amount for the installation of the SHS, and the customer enters a service contract with the enterprise for usage or rental payments. The enterprise bears the entire upfront cost of the SHS and loads the usage charge in small increments retrospectively. Payback periods typically stretch over seven to 10 years.<sup>85</sup> Enterprises with long-term contracts face the risk of payment fatigue among customers and increased costs to mitigate nonpayment and default. In developed countries, solar-as-a-service enterprises, such as U.S.-based Origin Energy, address this challenge by only serving households with good credit histories and cash flows to manage the payments.

Like their 'lease-to-own' counterparts, enterprises in the solar-as-a-service business model can also leverage their receivables for securitization and investments in scale.

## 7.2 External Factors

### Market Context

In some countries, low-income customers' cultural and social preferences to own the SHS unit as a social status asset rather than perpetually lease it could be a major deterrent for solar-as-a-service enterprises. Many SHS enterprises that began with the solar-as-a-service model have shifted to the lease-to-own model in response to customer preferences. Simpa Networks in India started its operations as a service company but shifted to the lease-to-own model in 2014. Similarly, Off Grid Electric is also exploring the possibility of offering SHS units on a lease-to-own basis in Tanzania.<sup>86</sup>

### Financing Ecosystem

There are few solar-as-a-service enterprises in the developing world and most have been established in the last four or five years. These enterprises focus on maximizing the concentration of customers in targeted geographies with less focus on assessing payment default risk as they retain asset ownership. These enterprises can achieve scale in a shorter time frame, but run the risk of higher customer drop-offs or payment defaults. Since solar-as-a-service enterprises have fast growing customer bases and good margins, albeit with comparatively higher risks of payment default, they are likely to be more suitable for risk capital investors. Off Grid Electric recently raised US\$70 million in its Series C funding led by DBL Partners and a host of other marquee investors, such as Omidyar Network, and Vulcan Capital.<sup>87</sup>

### Policy and Regulations

The growth of solar-as-a-service enterprises is driven by their ability to offer the lowest upfront costs and the flexibility and control of usage to customers. However, its success is impacted by growing electrification and grid extension in many countries because the central grid is better equipped to meet customer requirements of affordable and manageable payments. Solar-as-a-service enterprises are particularly vulnerable to grid extension since they are direct

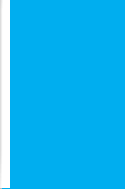
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<sup>85</sup> Intellectap primary interviews with enterprises

<sup>86</sup> Intellectap primary interviews with stakeholders

<sup>87</sup> Jonathan Moules, "Off Grid Electric Lights a Safer Path for Tanzanians," Financial Times (2016), accessed on February 10, 2017, <https://www.ft.com/content/569bf166-c455-11e5-808f-8231cd71622e>





## 7.3 Scaling Out

The solar-as-a-service model focuses on increasing market penetration within a geographic area as the business model has customer relationships that could run for five to 10 years. As a result, there are very few examples of enterprises moving from their home country of operations and scaling out to other geographies.

Simpa Networks is one of the earliest PAYG enterprises in India and currently serves more than 120,000 households. Simpa originally adopted the solar-as-a-service model to provide electricity for a service charge. In 2014, it shifted to the lease-to-own model. Its customers in India preferred to own the SHS as they viewed it as an asset and a lifestyle statement in the local community. Simpa also found it difficult to manage cash flows and predict revenues in the service model as SHS usage varied considerably across customers.

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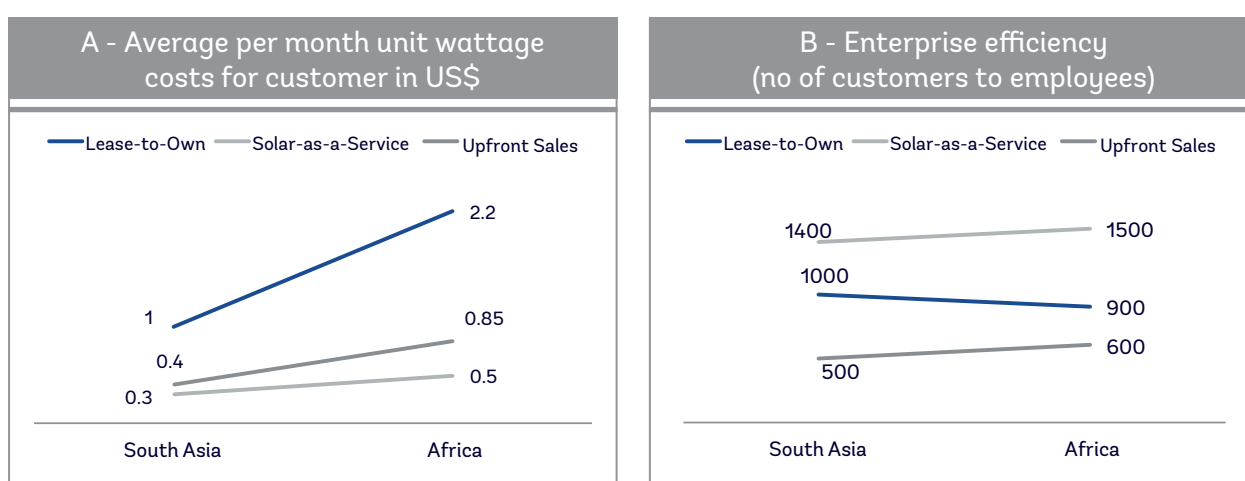


## 8. Comparison of Business Models in Solar Home Systems

Since the SHS subsector caters to off-grid customers, many of whom are in low-income groups, patronage and contractual models are likely to be more effective in scaling in terms of number of customers served. The lease-to-own model is likely to scale better in East Africa and Latin America where digital finance is popular and customers prefer to own the SHS. Countries such as Bangladesh and India in South Asia, and a few Latin American countries are likely to offer higher scaling opportunities for enterprises in the upfront sales model due to adequate presence of financial channels for solar products in these countries. Moreover, market consolidation opportunities are seen in the upfront sales model where a number of smaller players are active and business integration is more feasible.

A comparison of the average costs per unit of power shows a sharp contrast in the pricing of the SHS units in South Asian and African countries. Overall, the lease-to-own model has much higher asset acquisition costs than the upfront sales model in both regions. Enterprises in Africa have a larger field staff to customer ratio compared to their counterparts in South Asia, indicating better efficiency in South Asian enterprises. There are several reasons for highly different price points in South Asia and East Africa. High population density in South Asian countries allows enterprises to target a large set of customers at lower costs, particularly in rural, off-grid areas. SHS distribution and finding cost-effective solutions is the biggest challenge for solar enterprises in Kenya and Uganda, and an essential element in the commercial viability of the business model. Higher margins in the supply chain add to the operational costs in East Africa. In South Asia, the costs are lowered by affordable financing and indirect government subsidies available in many countries in the region.



Figure 15. Cost and Efficiency Ratios Across Business Models in SHS





SHS enterprises often directly offer consumer finance to address customers’ inability to pay. Lease-to-own and solar-as-a-service enterprises view themselves as solar finance providers and focus on lowering the cost of financing, whereas upfront sales enterprises focus on partnerships with financial institutions for consumer finance. Many of these PAYG enterprises also collect customer power consumption and payment history data and use advanced analytics to offer customized products and services. Customer behavior data on power usage and payment history has huge value and could be investigated for predictive behavior analysis and as an alternate mechanism for credit assessment of low-income borrowers.

Table 6. Comparison of Business Models in Solar Home Systems

	Upfront Sales	Lease-to-Own	Solar-as-a-Service
 <b>Internal Factors</b>			
<b>Customer Engagement</b>	Partnerships with local players to improve out-reach	Ownership transferred through part payments	Lower upfront payment and usage fees
<b>Operations</b>	Need of good distribution network	Complex operations for payment technology	Model in nascent stage of development
<b>Unit Economics</b>	Higher upfront costs and monthly installments	Low upfront costs, convenient payments	Minimal upfront costs. Higher contract periods
<b>Financial Strategy</b>	Enterprise facilitates access to finance with financial institutions	Enterprise allows staggered payment by consumer as per use and recovers part of the price of the product	Enterprise allows part payment to consumer as per use
 <b>External Factors</b>			
<b>Infrastructure – ICT</b>	Limited need of ICT	Higher need of metering, payment technology	Higher need of metering, payment technology
<b>Access to Capital - Customer</b>	Enterprise arranged or facilitated using tie-ups	Provided by the enterprise	Provided by the enterprise

### 9. Looking Ahead

The SHS market is likely to grow rapidly in countries where market building activities have already taken place and the technology to support payments and product innovation is available. East African SHS enterprises analyzed in this study are targeting growth rates of more than 50 percent in the next few years. There is a shift in the market too, as customers with access to power lifestyle electronic products graduate to higher wattage systems and seek reliability. Enterprises with enhanced product portfolios that work on low power are likely to find better avenues to scale going forward. This includes coupling solar panels for water pumping, solar drying and husking, and other uses in the agricultural value chain, as well as solar for SMEs and kiosks.

While access to finance is an overarching need, SHS enterprises need support to address specific challenges. Enterprises need affordable debt financing options in local currency to offset the foreign exchange risk, which is a key barrier to scale. Alternative debt instruments such as Merchant Cash Advance and Accounts Receivable Factoring could be investigated to facilitate collateral free loans to SHS enterprises. Partnerships with MFIs and similar low-income credit facility organizations would enable enterprises not only to facilitate last mile distribution and suitable consumer finance, but also to tap into the existing customer base of partner organizations and reduce the investment required to identify potential customers.




# Case Study: Mini / Micro-Grids

## 1. Mini/Micro-Grid Market Description

Nearly 1.2 billion people across the world rely on inefficient alternatives such as kerosene based lighting solutions, diesel pumps, and firewood for meeting their energy needs. Most of this population (over 95 percent) is located in Sub-Saharan Africa and developing Asia, with 80 percent residing in rural and remote locations that are unlikely to be connected to the main grid in the near future.<sup>89</sup> Mini/micro-grids, which involve small-scale electricity generation (10 kilowatt (kW) to 1 megawatt (MW)) serving a limited number of consumers via a distribution grid that can operate in isolation from national electricity transmission networks, offer access to electricity in such locations. These are an alternative to a single customer system, such as in the case of a SHS discussed in the previous section.

Figure 16. Key Product Categories in the Mini/Micro-Grids Market

 Product Capacity	Pico (Up to 5KW)	Micro (5-50KW)	Mini (50KW-1MW)
	1-2 lights 1 mobile charger each for 100 households	3-4 lights 1 mobile charger 1-2 fans each for 150-250 households	4-5 lights 2 mobile chargers 1-2 fans 1 refrigerator/ television each for ~350 households
Installation Cost	US\$7-9 per W	US\$4-6 per W	US\$2-4 per W
Enterprise Examples	PowerGen, Kenya	Avani Kumaon, India Powerhive, Kenya	Ankur Scientific, India Husk Power, India

89 Energy Access Database, World Energy Outlook, International Energy Agency, accessed on March 9, 2017, <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/>

Mini-grid systems, typically sized up to 1MW in installed capacity, usually serve customers with slightly higher power needs, including small-scale industries and anchor loads, such as telecom towers. Micro-grid systems are usually less than 50kW in installed capacity and largely serve household customers and communities. A few enterprises operate pico-grids (smaller generation units of less than 5kW) to serve communities with limited power needs. All these grid systems support lighting, fans, and other appliances for households, as well as irrigation equipment and pumps for farming. They also serve as a reliable fallback and extended source of electricity and lighting for small and medium businesses such as sawmills and tailoring and stitching units.

Mini/micro-grid systems usually run on solar, biomass, wind, hydro or hybrid (solar-wind or biomass-solar) energy sources. Hydropower is a preferred option in hilly and mountainous countries such as Nepal, whereas solar power is prevalent in regions with higher solar irradiance, such as India and Kenya. In a few island regions, such as Maldives, diesel and fossil fuels are also used to fuel the mini/micro-grid systems.

This research includes 16 enterprises from Asia and Africa that serve different customer segments. Of these enterprises, 13 leverage solar technology or solar hybrid plants, two use biomass, and one uses hydro energy.<sup>90</sup> Most of the enterprises included in this research set up mini/micro-grid systems and sell electricity as a service to rural households, farmers, and small businesses. Some enterprises set up mini/micro-grid systems for village communities with grant support, where households enter tariff agreements and collectively pay for operating the mini/micro-grid. Others develop, and transfer either the equipment for mini/micro-grid installations such as biomass gasifiers or the entire establishment to village communities. Since most enterprises included in this research operate micro-grids, they do not primarily focus on institutional customers such as businesses, government departments, and utilities. However, they are exploring this segment to improve viability.

## 2. Global Market for Mini/Micro-Grids

The global micro-grid market is expected to grow from US\$9.8 billion in 2013 to US\$35.1 billion by 2020 at a compound annual growth rate (CAGR) of more than 20 percent.<sup>91</sup> In developed countries, mini/micro-grids are widely accepted as a solution to serve customers in remote islands or hilly terrains. Enterprises in developing countries in Sub-Saharan Africa, South and East Asia are trying to build viable and scalable mini/micro-grids to meet their energy demand, as it may not be feasible to extend central grids to provide universal access to electricity.<sup>92</sup> Mini/micro-grids allow customers to move up the energy ladder, from using electricity to light

90 The research team interviewed Avani Kumaon (India), DESI Power (India), Devergy (Tanzania), Gram Oorja (India), Powerhive (Kenya), Mera Gaon Power (India), OMC Power (India), PowerGen (Kenya), Rift Valley Energy (Tanzania), and Akur Scientific (India). Information from secondary sources was obtained on SharedSolar (Mali, Uganda), INSTASAVE Energy (Kenya), Power Source (Philippines), GHEL (Bangladesh), Husk Power Systems (India), and FRES (Mali).

91 "Global Micro-grid Market: Growing Demand for Eco-Friendly and Cost-Efficient Energy Systems Augmenting Deployment," Transparency Market Research, 2016, accessed on March 14, 2017

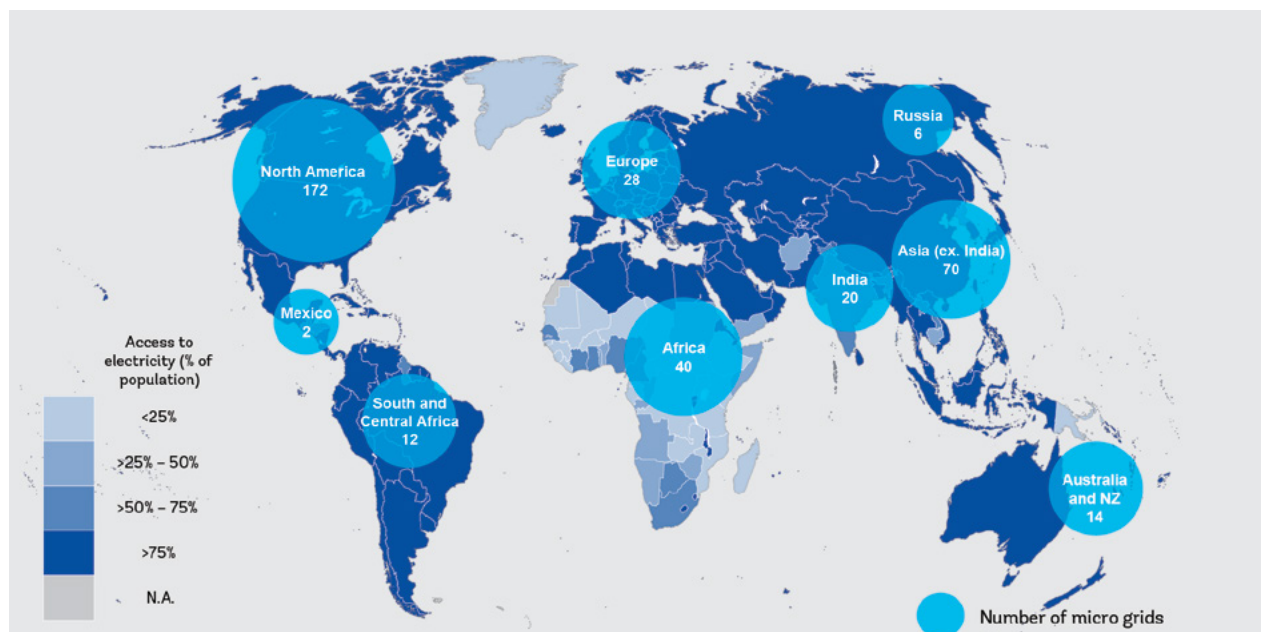
92 Global Facility On Mini-Grids: Accelerating Electricity Access for the Rural Poor, Micro-grid Knowledge, Kevin Normandeau, May 2016, accessed on March 14, 2017, <https://micro-gridknowledge.com/mini-grids/>



homes to operating small machines and running business operations that can support income generation and economic development.

Over the past few years, China has been developing renewable energy-based mini-grids years that integrate into a centralized grid. Bangladesh, Cambodia, India, Morocco, and Mali<sup>93</sup> are among countries with significant activity in mini/micro-grids. India has innovative mini-grids based on rice husk gasification systems.<sup>94</sup> Several other countries, such as Peru, Nigeria, Pakistan, and Yemen as well as island nations such as the Dominican Republic, Samoa, Fiji and Indonesia, have set up mini/micro-grids as part of their rural electrification programs. Private sector enterprises have benefitted from government and/or direct foreign investment-driven rural electrification programs involving financing, tax benefits, or subsidy provision. For instance, the governments in India and Bangladesh provide tax benefits and subsidies on the purchase of equipment to private sector enterprises that build and operate mini/micro-grids. Similarly, the Malian Agency for Development of Household Energy and Rural Electrification (AMADER), with support from the World Bank Group, provides financial support for setting up micro-grid infrastructure in Mali.

Figure 17. Number of Projects in Indicative Geographies and Access to Electricity<sup>95</sup>



Note: Mini / Micro-grids are utilized in both developed and developing countries to meet the power requirements of the remotely located community

93 Mali is often cited as the one success stories for growth in mini/micro-grids in a country where only 17% of the rural population was grid connected in 2016. Several factors including role of AMADER, policy support and demand from customers have provided impetus for mini/micro growth in Mali

94 "Off-Grid Renewable Energy Systems: Status and Methodology Issues," International Renewable Energy Agency, 2015, accessed on March 14, 2017, [https://www.irena.org/DocumentDownloads/Publications/IRENA\\_Off-grid\\_Renewable\\_Systems\\_WP\\_2015.pdf](https://www.irena.org/DocumentDownloads/Publications/IRENA_Off-grid_Renewable_Systems_WP_2015.pdf)

95 Global Micro-Grid Market Website, accessed in 2017: [https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Jon%20Exel\\_GFMG%20BP%20and%20Planning%20FY17\\_optimized.pdf](https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Jon%20Exel_GFMG%20BP%20and%20Planning%20FY17_optimized.pdf) Number of Mini/ Micro Grids Installed: <http://micro-gridprojects.com>

### 3. Key Drivers and Challenges for the Mini/Micro-Grid Market

The mini/micro-grids market has attracted the attention of governments, regulatory bodies, and development financial institutions for its ability to serve remotely located unserved populations, while simultaneously promoting the global transition to low-carbon energy systems. There has been a gradual shift in thinking among key stakeholders from supporting 'grid extension' to 'energy extension', and acceptance that mini/micro-grids are a part of the solution to energy access. Most of the enterprises interviewed for this research have established their operations in areas where there is little possibility of central grid extension in the near future.

Even though mini/micro-grid enterprises have emerged in response to market drivers, government and grant support is critical for their viability until they achieve scale in terms of the number of connections and average returns per connection. Enterprises need to strike a balance between recovering operational costs and making electricity affordable for the customers they serve. Site selection, demand forecasting, and anchor tenants are critical success factors. Enterprises engage with customers over time and need strong governance frameworks and agreements to operate effectively.

Despite the growth potential, mini/micro-grid enterprises face several challenges in scaling operations. They lack access to long-term capital due to the longer pay back periods, have minimum customer density requirements for financial viability, and have relatively lower returns on investment compared to commercial investor expectations. Inadequate availability of skilled human resources also constrains scale, particularly in remote locations.

Finally, lack of transparency, ambiguity in energy policies, and plans for grid extension are major challenges to scaling for mini/micro-grid enterprises. The findings of the multi-donor program - 'The Africa-EU Renewable Energy Cooperation Program (RECP)<sup>96</sup> that supports the development of clean energy markets in Africa - underscore the need for clear definition of the role and the framework for engagement of mini/micro-grids in government policies. RECP stresses the importance of a clear and consistent policy environment to reduce the pre-investment costs in renewable energy projects. A stable policy environment helps investors to understand the risks, predict the return on investment (ROI), invest accordingly in human resources and optimize pre-investment costs.

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<sup>96</sup> Africa-EU Renewable Energy Cooperation Program, accessed on April 7, <https://www.africa-eu-renewables.org/>





Figure 18. Key Drivers and Challenges for the Mini/Micro-Grid Market

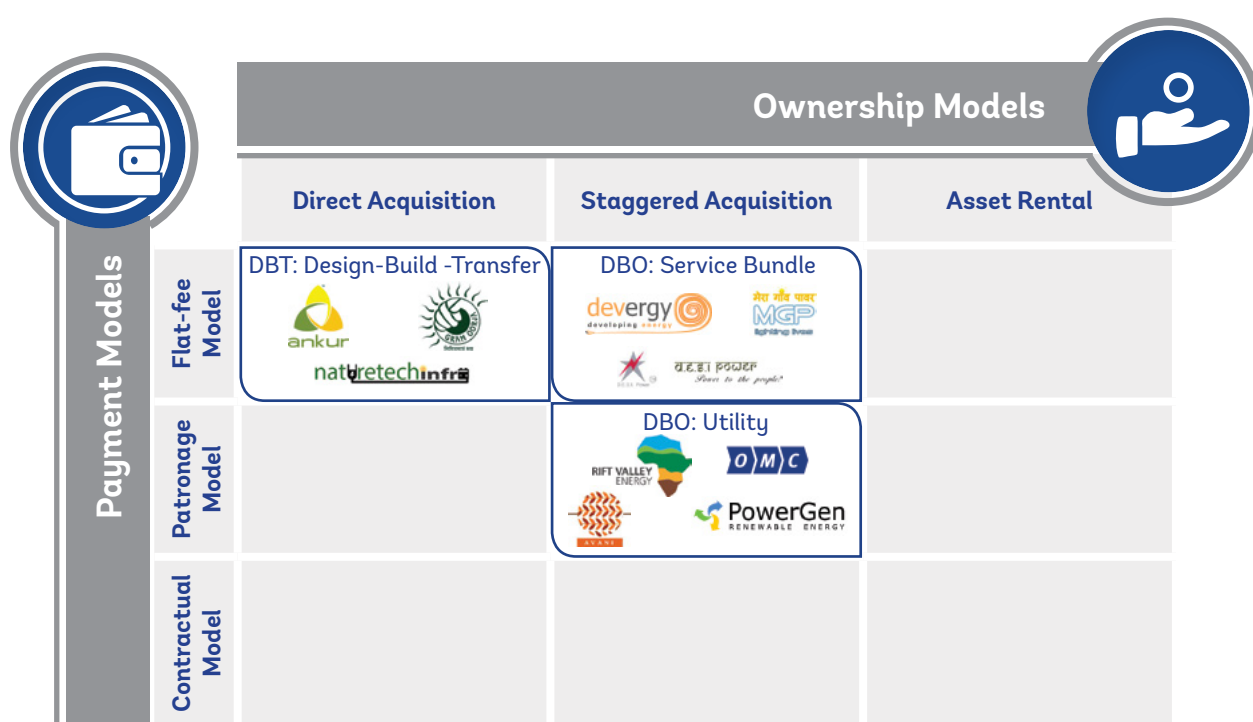


#### 4. Mapping of Mini/Micro-Grid Enterprises into Business Models

Generally mini/micro-grid enterprises either build and operate plants (design-build-operate or DBO model) or transfer the operations and maintenance of the plant to another organization, community, or to an individual entrepreneur (design-build-transfer or DBT model). In turn, the DBO enterprises, in response to customer preferences, offer two different business models: the 'utility model' where customers pay for energy usage and the 'service bundle model' where customers pay a predetermined fee for fixed units of electricity supply. In both cases, there is a well-defined frequency of payment that is part of a power purchase agreement. The payments are usually determined by installation costs, potential customers' ability to pay, and type of capital utilized to install the power plant. While many enterprises have fixed payments, a few

such as Powerhive use smart meters and mobile money payments to charge their customers on a pay-as-you-go basis.

Figure 19. Enterprises Across Business Models in Mini/Micro-Grid Market



1. **Design-Build-Operate (DBO) model:** Enterprises design, build, and operate mini/micro-grids, and distribute electricity to their customers. The model can be sub-categorized as:
  - a. **Utility model:** Customers pay for units of electricity consumed as per the meter, on a prepaid or post-paid basis. This model is more prevalent among customers that prefer to track and moderate their consumption and pay accordingly.
  - b. **Service bundle model:** Customers purchase fixed units of electricity on a bundled or package basis. These package/bundled offerings group common uses of electricity, such as a certain number of hours of light, mobile charging, or another appliance usage per month. This model is more appealing to customers who are unfamiliar with utility services and pricing schemes and seek predictability of cash outflows each month.
2. **Design-Build-Transfer (DBT) model:** Enterprises design and build mini/micro-grids for off-grid communities and transfer the ownership to stakeholders, who operate the plants. DBT enterprises are usually funded by CSR departments of large companies or communities that collectively pay for access to electricity. Local village level entrepreneurs usually operate and maintain these mini/micro-grid plants.

Most of the enterprises included in this research follow the DBO model and continue to operate the mini-grid plants, while a few build and transfer the plants to others. The DBO model has inherent advantages of a long-term engagement with customers with better revenue and cash flow potential. However, operational efficiency is critical to its success and scale. The DBT model, on the other hand, can be scaled rapidly; however, revenue predictability

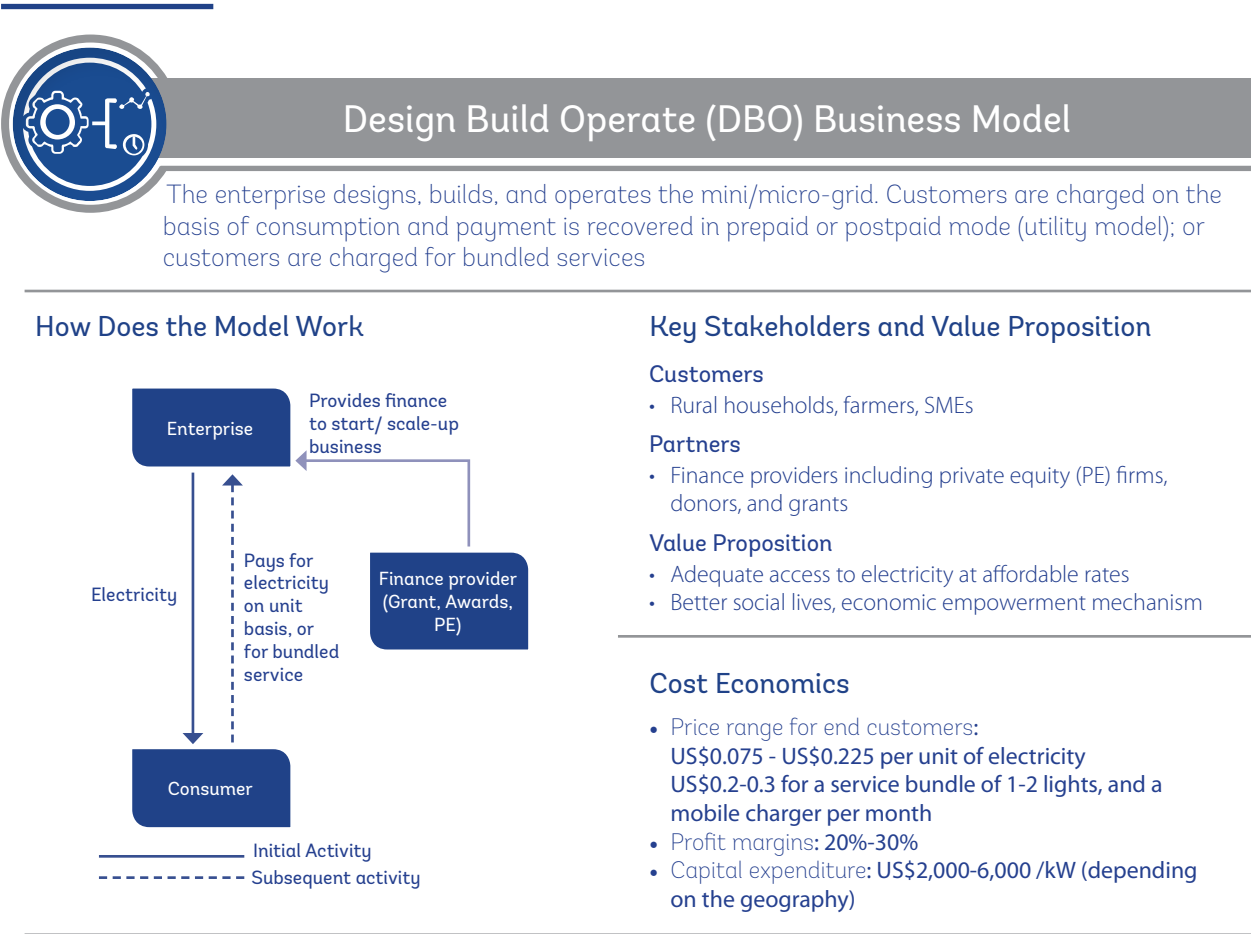


and cash flow projections are often difficult to estimate. It is also difficult to identify a buyer who can buy out the plant and manage operations, unless a village community, nongovernmental organization (NGO), or the government has engaged the enterprise to build and transfer ownership.

### 5. Scalability Analysis of the Mini/Micro-Grids Market

Nearly 90 percent of the enterprises included in this research follow the DBO model. There are low barriers to entry and enterprises adopt either the DBO or the DBT model in response to customers and the market context. In remote locations, where it is difficult to ensure efficient operations and maintenance support, enterprises may prefer to adopt the DBT model and transfer ownership. The DBO model may be more suitable in locations where customers have the ability to pay for electricity. Nonetheless, both models face key challenges for scalability such as customer preferences, customer drop-off and fatigue rates, government policy, and grid extension. This section expounds key differences between the DBO and DBT models in sections such as customer engagement, the minimum need of customers for commercial viability, and the need for a skilled workforce that impact the scale of enterprises.

Figure 20. Business Models Deployed in the Mini/Micro-Grid Market

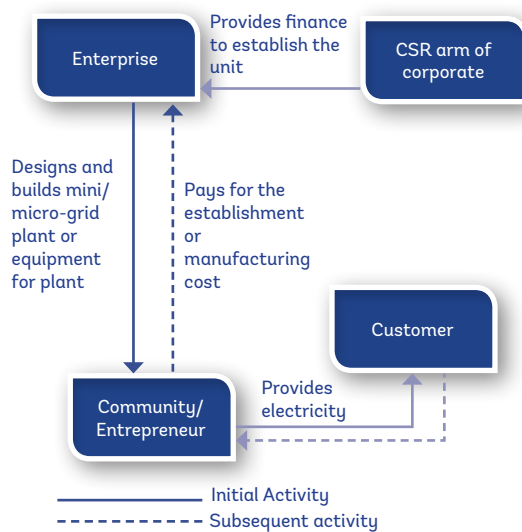




## Design Build Transfer (DBT) Business Model

The enterprise designs and builds the equipment for mini/micro-grids, or the entire mini/micro-grid establishment on specific requests from entrepreneurs or communities. The payment is done either through CSR funds of corporations (for community establishments) or by community after the mini/micro-grid is handed over by the enterprise.

### How Does the Model Work



### Key Stakeholders and Value Proposition

#### Customers

- Rural communities, local entrepreneurs

#### Partners

- CSR arms of corporates, NGOs, local administrations (village panchayats)

#### Value Proposition

- Access to customized mini/ micro-grids components
- Access to affordable electricity

### Cost Economics

- Price range: ~US\$0.225 per unit of electricity
- Profit margins: 15%-20%
- Capital expenditure: US\$3,000-8,000 /kW (depending on the geography)

## 5.1 Internal Factors

### Customer Engagement

Mini/micro-grid enterprises need an assured minimum number of households or customers that will purchase electricity to ensure the viability of the plant. DBO enterprises' operational revenues are tied to the usage fees paid by customers over a period of time. DESI Power, for instance, prefers to setup up a mini/micro-grid plant in locations where it has assured demand from at least 30 households for 1.5kW systems.<sup>97</sup>

97 Intellect primary interviews with stakeholders



A few enterprises operating in other energy subsectors found that demand for electricity went beyond lighting and entered the mini/micro-grid market to serve their customer base. In Haiti, Eneji Pwop, in partnership with EarthSpark, was initially involved in selling solar lights, SHS, and clean cook-stoves. Recognizing the potential for mini/micro-grid development, it installed a solar-diesel hybrid grid that supports over 400 homes and businesses. Eneji Pwop aims to build and operate 80 mini/micro-grids in Haiti by 2020.<sup>98</sup>

DBT enterprises need strategic partners such as donor agencies, CSR programs, and village communities that can finance the construction of the mini/micro-grid and take over operations. Gram Oorja in India focuses entirely on building partnerships with CSR programs to finance mini/micro-grid installations.<sup>99</sup> However, DBT enterprises find it challenging to identify the right partner for financing and subsequently operating the mini/micro-grid plants. They invest in technical training sessions for operators and awareness building programs for customers, many of whom are first time users of electricity.

Both DBO and DBT enterprises included in this research utilize local channels, train local volunteers, and leverage existing local resources to serve remote rural customers and improve customer retention. Kenya-based PowerGen has a local customer engagement team that establishes last mile connect with customers to understand their power requirements and set up mini/micro-grid systems based on current and future needs.<sup>100</sup>

## Operations

Operational efficiency is critical and particularly challenging for DBO enterprises since each project site is unique; standardized processes to reduce project development and installation time or operate the plant may not always work. While local onsite support for setting up and operating the mini/micro-grid plant effectively is critical, skilled manpower is a challenge, particularly in remote locations. Enterprises have devised different strategies to overcome this challenge. Kenya-based INTASAVE Energy trains community volunteers in solar panel operation and maintenance. Similarly, DESI Power provides technical and financial support to its partners in operations. India-based Husk Power Systems has established Husk Power University, through which it recruits and trains local people to create awareness and help scale the enterprise.<sup>101</sup> These initiatives add to costs but build the base for strong customer service, benefiting the enterprise and the sector in the long run.

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98 "First Micro-grid in Haiti: The Road to Feminist Electrification," June 2016, available at <https://microgridknowledge.com/first-microgrid-in-haiti/>

99 Intellec primary interviews with key stakeholders

100 Intellec primary interviews with key stakeholders

101 Husk Power Systems, [http://www.cseindia.org/userfiles/Gaurav%20Kumar\\_Design%20to%20Scale.pdf](http://www.cseindia.org/userfiles/Gaurav%20Kumar_Design%20to%20Scale.pdf)

### Box 8 Leveraging Technology for Operational Efficiency: Powerhive, Kenya

Powerhive builds and operates solar-based mobile connected micro grids in rural communities in Kenya. The enterprise has developed several technology-driven processes to simplify microgrid deployment and operations. These include the Honeycomb cloud-based remote monitoring and control platform, the 'Asali' smart meter, and the 'Site Wizard for Analysis, Reconnaissance, and Mapping' (SWARM) project development tool.

Powerhive has the technology for microgrids covered from end to end. SWARM performs economic and opportunity assessment of new markets based on data inputs from public sources (such as population, income level, economic activity, consumption

patterns, as well as satellite imagery) and from specialized surveys. Once a site is selected, the community gets Asali installed as the central hardware for the system. Powerhive's cloud-based software application and proprietary smart meters, which communicate wirelessly to Honeycomb, automate account management tasks, support remote monitoring, control microgrid operations and run real-time data analytics. Powerhive's cloud based solution allows customers to prepay for electricity through mobile money networks, and sends them SMS alerts about top-ups. Such systems could work in un-electrified or under-electrified markets with high mobile penetration such as Philippines and India.

DBO enterprises have developed innovative strategies to meet customer needs and improve revenue per connection. Husk Power has utilized a hybrid model to expand its operations across India and runs more than 70 mini/micro-grid plants. The enterprise sold power to villages for six hours per day with overall charges at US\$3 per month in 2015 for each customer. It later installed solar power plants to double its capacity and offered fulltime power supply to each household.<sup>102</sup> This allowed the enterprise to significantly improve its revenues. In Bangladesh, GHEL allows participating households the option to sell excess electricity to other households. GHEL supports this secondary distribution as it can increase efficiency, deliver socioeconomic benefits, and provide participating households with an additional source of income.<sup>103</sup> Similarly, Sharedsolar, with operations in Uganda and Mali, has borrowed some best practices from PAYG SHS enterprises on smart metering. Its meters monitor usage until the customer's credit is exhausted, at which point the circuit is switched off until more funds are added. This allows customers the choice to purchase electricity when they need it and can afford to pay for it, in contrast to a flat monthly fee.

DBT enterprises work closely with the local community for site identification, demand assessment, operational design, and construction to ensure they optimize pre-investment expenses. Cost overruns due to challenges such as poor road access and higher transportation and logistics costs, especially in remote locations are, however, difficult to pass on to the project financier. DBT enterprises may also have to invest significant operational time in training the community to manage the mini/micro-grid plant post installation and commission. Gram

102 Policy Gap Stops Investors from Expanding Power Grids in Rural India, Financial Express 2015

103 Accessed from GHEL Website, [https://www.ghel.org/index.php?option=com\\_content&view=article&id=14&Itemid=68](https://www.ghel.org/index.php?option=com_content&view=article&id=14&Itemid=68)





Oorja trains members of the community through videos, and arranges for field visits to its corporate training center.

### Unit Economics

The cost economics for mini/micro-grid systems consist of fixed costs for establishing the plant, purchasing machinery and setting up distribution infrastructure, and variable costs for generation and other operations and maintenance (O&M). Fixed costs vary significantly based on plant location, the source of fuel, and capacity of the mini/micro-grid systems, with a lower cost per kW as capacity increases. Both DBO and DBT enterprises spend from 50 percent to 80 percent of the total fixed costs for purchasing equipment and establishing the power plant. For instance, India-based OMC Power spends nearly US\$150,000 to establish a 60kW solar mini/micro-grid system, of which 70 percent goes toward equipment purchases and plant installation, while 30 percent is spent on setting up distribution infrastructure.<sup>104</sup> Similarly, SteamaCo in Kenya spends nearly US\$75,000 in setting up a 5.6kW solar-based micro-grid system in rural Kenyan villages.<sup>105</sup>

Variable costs include salaries of staff, logistics, and maintenance expenses that vary by plant location and the availability of human resources. According to Tanzania-based Devergy, a limited pool of skilled local employees forces it to rely also on expatriate employees who demand high salaries.<sup>106</sup>

Operational profit margins for the DBO mini/micro-grid enterprises are in the range of 20 to 30 percent, while DBT enterprises can earn profit margins of 15 to 20 percent. Longer project periods and higher margins in the operational phase of the mini/micro-grid plant enable DBO enterprises to earn overall better margins. While grants and subsidies cover fixed costs, most of the operating profits are generated from the sale of electricity to customers.

Choosing the right balance between the available fuel source and per unit cost of construction (including machinery cost) is one of the key factors affecting the profitability of mini/micro-grid systems. DESI Power, for instance, is planning to move to biofuel and biomass from solar power in a few villages to reduce project cost and break even more quickly.<sup>107</sup>

Enterprises also try to identify strong anchor tenants and increase revenue per connection quickly to improve capacity utilization early in the project. Gram Oorja notes that it is difficult for early-stage enterprises to prove their viability to capital providers because capacity utilization of the plant is usually low (30 percent) in the initial years for un-electrified remote villages hamlets that have limited commercial activity to start with.<sup>108</sup> This is because enterprises factor in future demand from new and existing customers, and build plants with higher installed capacity. Hence, mainstream capital providers that expect an internal rate of return (IRR) of at least 12 to 15 percent may not be immediately convinced of the attractiveness of this subsector.

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104 Intellec primary interviews with stakeholders

105 Fred Pearce, "African Lights: Solar Micro-grids Bring Power to Kenyan Villages," Yale Environment 360 (blog), October 27, 2015, available at [http://e360.yale.edu/features/african\\_lights\\_microgrids\\_are\\_bringing\\_power\\_to\\_rural\\_kenya](http://e360.yale.edu/features/african_lights_microgrids_are_bringing_power_to_rural_kenya)

106 Intellec primary interviews with stakeholders

107 Intellec primary interviews with stakeholders

108 Intellec primary interviews with stakeholders



### Financial Strategy

In developing countries, mini/micro grid markets have been largely driven by grants from development finance institutions (DFIs), multilateral agencies, and CSR programs. Small project sizes for pico- and micro-grids, limited understanding of off-grid financing, long payback periods, and uncertainty surrounding policies on grid extension make it difficult for early-stage DBT and DBO enterprises to attract mainstream capital providers. Moreover, the supply of fuel in a few cases such as biomass or hydropower may not be reliable throughout the year, making it difficult to predict cash flows and assess the credit worthiness of the enterprises.

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#### Box 9 Leveraging CSR Partnerships to Overcome Financial Challenges in Scaling: Gram Oorja, India

Gram Oorja sets up solar micro-grids in India's off-grid villages with the support of CSR departments of large companies, local NGOs, and village communities. The CSR grants are mostly used to cover capital costs whereas the fees and charges paid by the user are utilized for operational costs.

The enterprise establishes these micro-grids in difficult terrain where grid connectivity is difficult to achieve. The remoteness of the target region makes it difficult for the enterprise to procure commercial

loan unless scalability and viability is demonstrated. Easy access corporate loans in such cases helps the enterprise overcome these challenges and sustain its focus on providing access to energy in remote and hilly regions in India. Gram Oorja has designed and installed 14 micro grid projects, providing light and electricity to more than 350 households since 2012. The enterprise is now expanding its projects throughout the country with more micro-grid projects in the pipeline.

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Larger mini/micro-grid projects have longer gestation and break-even periods of over five years, and usually seek a mix of debt and equity capital. Most enterprises included in this research have received significant grant and aid funding, especially during their early years. Kenya-based PowerGen received grant funding of US\$47,000 for establishing two solar micro-grids of 1.2kW.<sup>109</sup> FRES, with operations in Mali, plans to raise US\$1.5 million in donor and grant funding to develop 10 to 15 mini grid systems.<sup>110</sup>

Some enterprises in East Africa, including Powerhive and Devergy, have been able to raise both equity and debt capital and consequently reduce their dependency on grants.<sup>111</sup> Equity investors typically have supported enterprises with proven track records of developing large projects in countries where mini/micro-grids are likely to be important sources of electricity for large off-grid populations. For instance, Devergy has received equity and quasi-equity from marquee impact investors such as Vulcan Impact Investing and Acumen. Similarly, Powerhive

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109 KIVA Loan Facilitates Growth of PowerGen Micro-Grids in Off-Grid Communities across Kenya, 2014 <http://www.energy4impact.org/news/kiva-loan-facilitates-growth-powergen-micro-grids-grid-communities-across-kenya>

110 Foundation Rural Energy Services (FRES), Energy Access Practitioner Network, 2016

111 East Africa has a more developed financial infrastructure in addition to large market and policy support, eliciting more interest from investors as compared to the rest of the continent.



raised US\$20 million in 2016 for expansion into new markets in Africa and Asia, and continued growth in Kenya. PowerGen raised US\$4.5 million in early 2017 from DOB Equity and others to expand its portfolio of off-grid solar and wind power systems in Zambia, Tanzania, and Kenya targeting 7,500 new consumers.<sup>112</sup>

A few enterprises are able to leverage lower debt-to-equity ratios to attract long-term commercial debt. Gautam Solar, for instance, utilized its low gearing ratio (long-term debt to equity) of 0.6<sup>113</sup> and strong interest coverage ratio of 7.7 times to raise long- and short-term debt of more than US\$6 million in 2015 from commercial banks. The enterprise was considered creditworthy as its exposure to interest rate changes and loan repayment burden was low.

## 5.2 External Factors

### Market Context

Mini/micro-grid enterprises face challenges such as difficulty in predicting cash flows, irregular tariff collection, and risk of customer defaults in rural areas. In developing countries, rural household income flows are irregular and dependent on rain-fed agriculture. Mini-grid developers must consider these external factors when projecting tariff collections and cash flows.

Mini/micro-grid enterprises look to expand to markets where they can be assured of a minimum customer base. In the absence of such a market, enterprises face competition not only from suboptimal lighting products such as kerosene lamps and battery-powered torches but also from other lighting solutions such as SHS. While mini/micro-grids provide convenience and flexibility in payments through mobile payments and smart metering, and better control over costs with no initial down payments, SHS enterprises offer asset ownership to customers. This threat is more acute for DBO enterprises since customer drop-offs directly impact their cash flows and profitability. Enterprises often spread the risk by diversifying their customer base to include micro and small enterprises that seek reliable and continuous electricity supply, and are willing to pay a higher price than households. DESI Power, for instance, focuses on commercial customers and farmers (for irrigation) who pay a higher rate for reliable supply of electricity. Many enterprises included in this research shared that they were increasingly looking at the B2B segment to improve their revenues.<sup>114</sup>

DBT enterprises are more suited for markets where community networks are strong or where partner financing entities have wider presence and influence. As DBT enterprises have a relatively limited role in operations and payment recovery after installation, they are effectively shielded from any changes in customer behavior and threat from competition from substitutes.

112 PowerGen raises US\$4.5 million to expand portfolio in East Africa, Jan 2017, available at <https://constructionreviewonline.com/2017/01/powergen-raises-us4-5-million-to-expand-portfolio-in-east-africa/>

113 For a capital intensive business such as mini/micro-grid development any gearing ratio of less than 1 indicates that sufficient leverage is available for accessing long term loans.

114 Intellec primary interviews with stakeholders

### Financing Ecosystem

Commercial banks and investors are often reluctant to support the mini/micro-grid market due to several challenges and the insufficient returns in the short term. The need for market development and customers' limited ability to pay puts a cap on tariffs that enterprises can charge. While governments have prioritized the renewable energy sector, this sector is still relatively new for lending institutions, which need to be educated about non-fossil technologies and opportunities in rural electrification.<sup>115</sup> Equity investors compare the mini/micro-grid market (which mimics infrastructure projects) to other renewable energy markets like SHS (which is similar to mainstream sectors), and find it slow to scale while facing significant risks in terms of policy ambiguity and customer uptake. In short, while commercial capital has supported some established enterprises, a large number of early stage enterprises need to seek alternate sources of funds.

The donor and grant space, therefore, is critical to provide initial support for the growth of this market. Mini/micro-grid enterprises have received soft loans or targeted grants from donors, DFIs, and government programs to develop the market. For instance, Instasave's solar nano-grid model was initially supported by the UK Engineering and Physical Science Research Council and DFID for developing research and development (R&D) facilities. The enterprise raised money for subsequent installations through crowdfunding – another source of finance that, along with CSR programs, is being increasingly leveraged. Mini/micro-grid enterprises can also take advantage of specific financing mechanisms such as blended finance programs for addressing working capital needs, supporting market building activities, and as credit guarantee. For instance, the United States Agency for International Development's (USAID) Development Credit Authority (DCA) provided a US\$75 million pan-African "Beyond the Grid" facility for loans to off-grid producers, manufacturers, and distributors across sub-Saharan Africa in 2015-2016.

However, when the mini/micro-grid projects are funded by government investment, grants from donor agencies or CSR programs, transfer of ownership and responsibility to the local community or NGO is critical for long-term project success, especially for DBT enterprises.

### Policy and Regulations

Governments support mini/micro-grid enterprises in most developing countries through subsidies for customers and tax incentives for enterprises. For example, in Tanzania, the government offers US\$1.3 million as connection subsidy (World Bank Group TEDAP facility through Tz REA) for hydro mini-grids.<sup>116</sup> In India, enterprises such as Devergy are exempt from excise duty for importing machinery and components for mini/micro-grid installation, while Gram Oorja benefits from sales tax exemption in some states. Power Source Philippines Inc. receives government subsidies and holds a special license to operate end-to-end (generation and distribution) power supply solutions in remote areas in the Philippines.<sup>117</sup> However,

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115 "Hybrid Mini-Grids for Rural Electrification: Lessons Learned," USAID, Alliance for Rural Electrification. Source: [https://ruralelec.org/sites/default/files/hybrid\\_mini-grids\\_for\\_rural\\_electrification\\_2014.pdf](https://ruralelec.org/sites/default/files/hybrid_mini-grids_for_rural_electrification_2014.pdf)

116 "Financing Mini-Grids in East Africa, GIZ PDP Workshop," GVEP International, March 19, 2014, <https://www.giz.de/fachexpertise/downloads/2014-en-george-pep-fachworkshop-mini-grids.pdf>

117 "About Us," PowerSource Group, accessed on March 10, 2017, <http://www.powersourcecellc.com/pages/about-us.html>



such programs tend to focus on certain technologies such as solar and wind energy. Other technologies such as biomass and hydropower were seen to receive lesser support.

Policy support where the government allows mini/micro-grid providers to act as independent distributors of power can assist enterprises to scale faster. For example, the Kenya Energy Regulatory Commission has licensed Powerhive to generate, distribute, and sell electricity to the Kenyan public. Governments have also encouraged scale through long-term public-private-partnerships (PPPs) with enterprises. For example, the Indian government financially supports 'rural energy service providers'<sup>118</sup> to meet its targets of installing around 10,000 mini/micro-grids across the country over five years.<sup>119</sup>

Providing universal electricity is a political mandate in developing countries and government departments often do not share their plans of extending the grid to off-grid areas in advance. This poses a risk for mini/micro-grid enterprises since customers prefer subsidized grid electricity even if it is unreliable. Enterprises in China and Tanzania often partner with utilities through PPAs to avoid such customer drop-offs and duplication of distribution infrastructure. Many enterprises included in this research scout for locations where the local government supports off-grid electrification. OMC Power, for instance, has scaled extensively in the Indian state of Uttar Pradesh where the local state government has drafted a policy for mini/micro-grids and provides clarity on plans for central grid extension.

Given the risk of external factors such as unclear policy on grid extension, many enterprises are looking to install and run smaller micro and pico power units that have lower capital costs and are easy to dismantle and relocate as required. PowerGen, for instance, is focusing on scaling operations through pico-grids (less than 3kW installed capacity plants) that supply electricity to small communities of around 30 to 50 households to meet their basic lighting and cooling needs, and that can be easily relocated in case of adverse market conditions.<sup>120</sup> However, scaling of operations may be a challenge since operational and maintenance control can become difficult as the number of pico power units increases.

### 5.3 Scaling Out

Many mini/micro-grid enterprises have scaled within and outside their home countries. DBT enterprises, specifically those that supply components and carry out construction work for mini/micro-grids, have been able to scale out rapidly. Factors such as coping with the infrastructure and development challenges, policy measures and support from the local government, customers' ability to pay, and availability of local partners, play a key role in defining the scaling out strategies in this subsector. Ankur Scientific prioritizes countries based on favorable policy landscape and availability of financial security either through credit guarantee mechanisms or through government tax and import duty benefits. The enterprise

118 The Indian government in order to promote the development of mini grids has proposed to empanel entities (Companies/ NGOs) to promote the National Solar Mission in large scale. A five point criterion is used to shortlist the entities. Details at <http://mnre.gov.in/file-manager/UserFiles/Empanelment-of-companies-for-minigrid-NSM.pdf>

119 "Powerhive Subsidiary Becomes First Private Utility in Kenya's History To Be Licensed to Sell Electricity to the Public," May 7, 2015, <http://www.powerhive.com/powerhive-subsidiary-becomes-first-private-utility-in-kenyas-history-to-be-licensed-to-sell-electricity-to-the-public/>

120 Intelcap primary interviews with key stakeholders

has expanded its operations to countries such as Cambodia, Sri Lanka, Namibia, Thailand, Malaysia, Vietnam, Laos, Philippines, and Indonesia.

Enterprises also survey and identify countries where potential customers are financially able to pay for the service. According to PowerGen, the lack of credit history of potential customers is a major challenge for scaling out. The enterprise conducts economic surveys to develop this intelligence. Similarly, Powerhive, based in Berkeley, California, which plans to expand to Rwanda, Uganda, and Nigeria, has conducted market surveys to understand the viability of the model in these countries. Some enterprises have devised solutions to address infrastructural challenges and work exclusively in difficult geographic terrains to expand operations. Avani Kumaon, which operates in the hilly terrain of Uttarakhand, plans to scale out to similar geographies in the states of Himachal Pradesh, and Jammu and Kashmir in India; and to other mountainous countries such as Nepal and Bhutan.

While enterprises did not mention a preferred format for replication and scaling out, many of them opt for strategic partnerships with local entrepreneurs and enterprises for scaling out. These entrepreneurs generate demand for mini/micro-grids in their respective countries. Some successful enterprises receive requests to establish mini/micro-grids in other countries, and prefer to opt for the knowledge transfer route, in which they share the technology and train local entrepreneurs to operate the mini/micro-grids. Ankur Scientific has successfully used this format to scale considerably in the last decade to over 40 international locations.<sup>121</sup>

### 6. Comparison of Business Models in Mini/Micro-grid Market

Initial setup costs, customer segments, and policy implications are similar for DBO and DBT enterprises. However, there are significant differences in the way DBT and DBO enterprises develop the market and engage with their customers. DBT enterprises typically use partnerships to engage with customers and are less invested in the operations and maintenance process than DBO enterprises. They are also relatively protected from changes in customer behavior as they typically earn revenues upfront. In contrast, the revenues and profitability of DBO enterprises are inextricably linked to the strength of their customer service, robustness of collection mechanisms, and changing customer preferences and behavior.



DBO utility enterprises can devise better customer engagement plans and offer value addition such as lifestyle electronic products depending on customers' energy usage patterns than DBT enterprises. Within the DBO model, the utility model requires metering and monitoring mechanisms to track customer usage. It also requires a robust payment collection mechanism. Technology allows enterprises to obtain customer data that can be utilized for designing value added products and expand business operations. The service bundle model is comparatively simpler than DBT enterprises to establish and operate once customer requirements have been identified. However, these enterprises also need to continually interact with customers to know about their changing power needs.

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<sup>121</sup> Intellectap primary interviews with stakeholders



Table 7. Comparison of Business Models in the Mini/Micro-Grid Market

	Design, Build, Operate (DBO)	Design, Build, Transfer (DBT)	
 <b>Internal Factors</b>			
	<b>Customer Engagement</b>	Sustained engagement and data collection to ensure payment recovery and offer value-added products	Short-term engagement during design / commissioning phase, typically through partners
	<b>Operations</b>	Needs capacity building and on-the-ground presence for metering, monitoring, and payment collection mechanisms	Relatively simpler system to deploy, with implementing partner managing operations
	<b>Unit Economics</b>	High initial capital expenditure and customer acquisition costs result in operational profit margins of 15%-25%	
 <b>External Factors</b>	<b>Financial Strategy</b>	Project finance is typically through self or impact capital	Financing typically secured through partnerships with donors/CSR programs/communities/government
	<b>Market Context</b>	Market driven by large aspirational and un-electrified population in the developing world	
	<b>Financing Ecosystem</b>	Progressively lower interest from equity investors due to low returns. Financing ecosystem comprises of impact investors, DFIs, donors and government programs	
	<b>Policy and Regulations</b>	Supporting policy in terms of financial assistance, tax breaks exist in most developing countries; however, uncertain grid expansion plans is a threat	

### 7. Looking Ahead

Due to limited access to mainstream capital providers, mini/micro-grid enterprises are highly dependent on donor or grant funding in near future. Investors are reluctant to invest in this market due to internal risks such as the capital-intensive nature of the business models along with lower gross margins and longer payback periods, and external factors such as poor clarity on grid extension policies. The mini/micro-grid market mimics the infrastructure sector and there is a case to examine the feasibility of alternative financing mechanisms such as blended capital finance, viability gap funding, and social impact bonds to support it. These forms of capital could be utilized for both the low-income end-customers and first generation early stage energy entrepreneurs and enterprises.

The market can demonstrate viability by exploring opportunities to offer additional services to customers such as water purification using solar reverse osmosis systems and providing access to solar pump systems for irrigation. The concept of 'smart villages' (where access to energy catalyzes development) that could have solar powered grid system integrated with irrigation and heating applications controlled by intelligent sensors and smart metering solutions can be explored in the near three to five years.<sup>122</sup>

Governments are aware of the challenges that policy ambiguity poses for this market and are attempting to address it through supportive policies such as National Policy for Renewable Energy based Micro Grids and Mini Grids introduced in India in 2016. Clear lines of communication between key stakeholders at the institutional and policy levels and private sector enterprises at the regional and local levels will accelerate deployment of mini/micro-grid projects going forward.


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<sup>122</sup> Gerro J. Prinsloo et al, "Smart Rural Villages," Conference Paper, EPA Solar Power International (SPI) 2016





Figure 21. Key Product Categories for CWP Enterprises

	Small-Scale Community Water Plants	Large-Scale Community Water Plants
	Enterprises set up small scale CWP plants and may offer O&M services for a fee or through franchisees	Enterprises set up large scale CWP plants and offer O&M services or set up franchisees
Description		
Plant Capacity (typical)	Micro units (less than 5000 lpd), small units (5000 to 12,000 lpd)	Plant capacity is usually more than 12,000 units and up to 150,000 lpd
Average Installation Costs	US\$15,000-30,000 (depending on the geography and capacity)	US\$30,000-40,000 (depending on the geography and capacity ) US\$-20,000 for franchise
Price per 20 Liters of Water	US\$0.1 -\$1 (depending on the geography)	US\$0.01 -\$0.1 (depending on the geography)
Enterprise Examples	Sarvajal, India Jibu, Kenya dloHaiti, Haiti	WaterHealth, India Waterlife India

Customers for CWP systems can generally be classified into two categories: institutional customers such as governments and micro-entrepreneurs that serve end-consumers (rural and semi-urban populations that either face water scarcity or only have access to poor quality or contaminated water). Institutional customers also include other entities such as integrators and financiers of capital expenditure (capex) who bid for government projects, donors, multilateral agencies and NGOs. Large corporations such as Apollo Tyres, BASF, General Electric, Maruti Suzuki, and Saint Gobain, have also addressed the need for access to safe water through CSR programs.

This research analyzed 13 CWP enterprises operating across Asia and Africa, and includes enterprises that have footprint in multiple countries, such as WaterHealth and Grundfos Lifelink, as well as regional players like Sarvajal that have operations in one country.<sup>126</sup> The study also includes a few very early-stage enterprises such as Maji Milele that have recently entered the CWP market.

The cost of installation per CWP unit varies significantly based on capacity and geographic location. The price of improved water differs across countries due to various factors including government price ceilings, access to grants that subsidize the cost of water treatment, treatment technology, and quality of water.

<sup>126</sup> The research team interviewed dloHaiti (Haiti), Drinkwell Systems (India), Grundfos Lifelink (Denmark), Jibu (Kenya), Maji Melele (Kenya), Sarvajal (India), Synergy Solar (India), Water Health (India), Waterlife (India), and Waterpoint (India). Information from secondary sources was obtained on Safe Water Enterprises (Kenya), Punjab Saaf Paani Company (Pakistan), and Rand Water (South Africa).



## 2. Global Market for Community Water Purification

According to the World Resources Institute (WRI), the bottom of the pyramid (BoP) water market is estimated to be US\$20 billion across the low-income countries of Africa, Asia, Eastern Europe, and Latin America. It is predominantly urban, with rapid growth observed in peri-urban areas that do not receive municipal water supply and have limited options to obtain affordable, clean drinking water.<sup>127</sup> In contrast, people in rural areas with relatively higher access to water are less motivated to pay for improved drinking water. CWP enterprises are present in South Asia, Africa, and Latin America, with significant enterprise activity in India, Pakistan, Kenya, and Peru.<sup>128</sup>

CWP enterprises work with multiple stakeholders in the safe water space, including private sector microenterprises, governments, water utilities, donors, and NGOs. Some of these enterprises plan to scale up in their home country and a few also plan to expand to nearby countries where it is relatively easier for them to find retailers or build franchise networks. East Africa-based Jibu, which sells clean drinking water in urban and semi urban communities in Kenya, Rwanda and Uganda, for instance, is developing plans to scale-out to nearby Zimbabwe, Zambia and Tanzania.<sup>129</sup> India-based Sarvajal also plans to expand to other countries through the knowledge transfer route, where it will not directly set up operations in other countries but transfer technology to local franchisees.<sup>130</sup>

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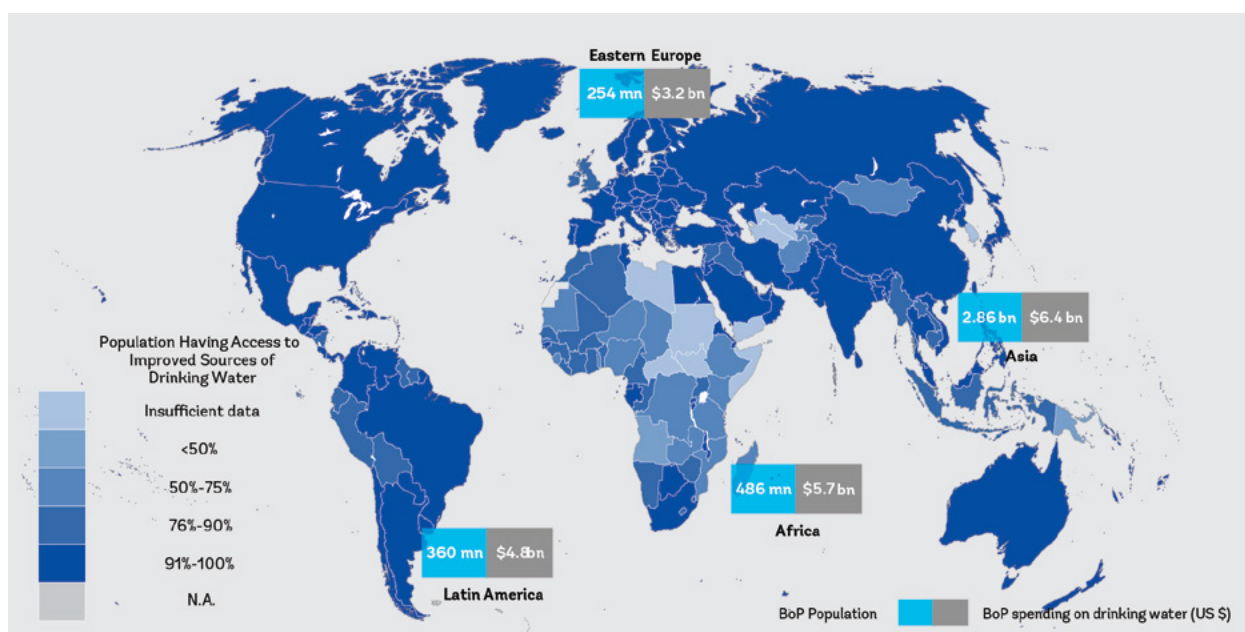
127 "The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid," WRI and IFC (2007), Chapter 4, The Water Market, accessed on February 14, 2017, [http://www.wri.org/sites/default/files/pdf/n4b\\_full\\_text\\_lowrez.pdf](http://www.wri.org/sites/default/files/pdf/n4b_full_text_lowrez.pdf)

128 James Laughlin, "Water Market Continues Growth Despite Global Recession," Water and Wastewater International, accessed on February 14, 2017, <http://www.waterworld.com/articles/wwi/print/volume-24/issue-6/regulars/perspective/water-market-continues.html>

129 Intellec primary interviews with stakeholders

130 Intellec primary interviews with stakeholders

Figure 22. BoP Population and Spending on Drinking Water<sup>131</sup>



Note: BoP spending on clean drinking water has been taken as an indicator for community water purification market as the two metrics are closely related. The market size indicates the relative size of CWP markets across geographies.

### 3. Key Drivers and Challenges for the Community Water Purification Market

Growing awareness of the need for safe water and the gradual acceptance and willingness to pay for clean drinking water will be the primary drivers expanding the CWP market. Private sector enterprises have a significant opportunity to serve the base of the pyramid for whom access to safe drinking water is out of reach and who could increasingly rely on service provision through the domestic private sector.

At the same time, these enterprises face several challenges, including high initial investment, significant operational and distribution costs, and pressure to keep prices of water low enough to ensure uptake. Furthermore, as governments continue to focus on improving piped water distribution, CWP enterprises could struggle to scale up their operations. Supply of water is widely perceived as a public responsibility and governments in most developing countries provide water at little or no cost to low-income consumers. CWP enterprises, therefore, face the challenge of competing in a market where water prices are either regulated or very low. This impacts the operational profitability of water kiosks and dispensing units, and increases their pay-back period.

131 Intelicap analysis based on primary interviews; "Water and a Green Economy in Latin America and the Caribbean (LAC)," UN Water, 2012; "10 Places Most in Need of Clean Water," Ecorazzi, 2012; "Water: The Next Four Billion," WRI



External factors such as availability of land, water and electricity can also impact the ability of CWP enterprises to grow their business. Challenges in access to adequate power supply has encouraged some enterprises to opt for alternative sources, such as solar energy. Finally, enterprises interviewed for this study noted that lack of standard water quality reports is a significant hurdle when exploring new markets, leading them to invest significant time and money in testing water quality and in R&D activities before scaling up or scaling out.

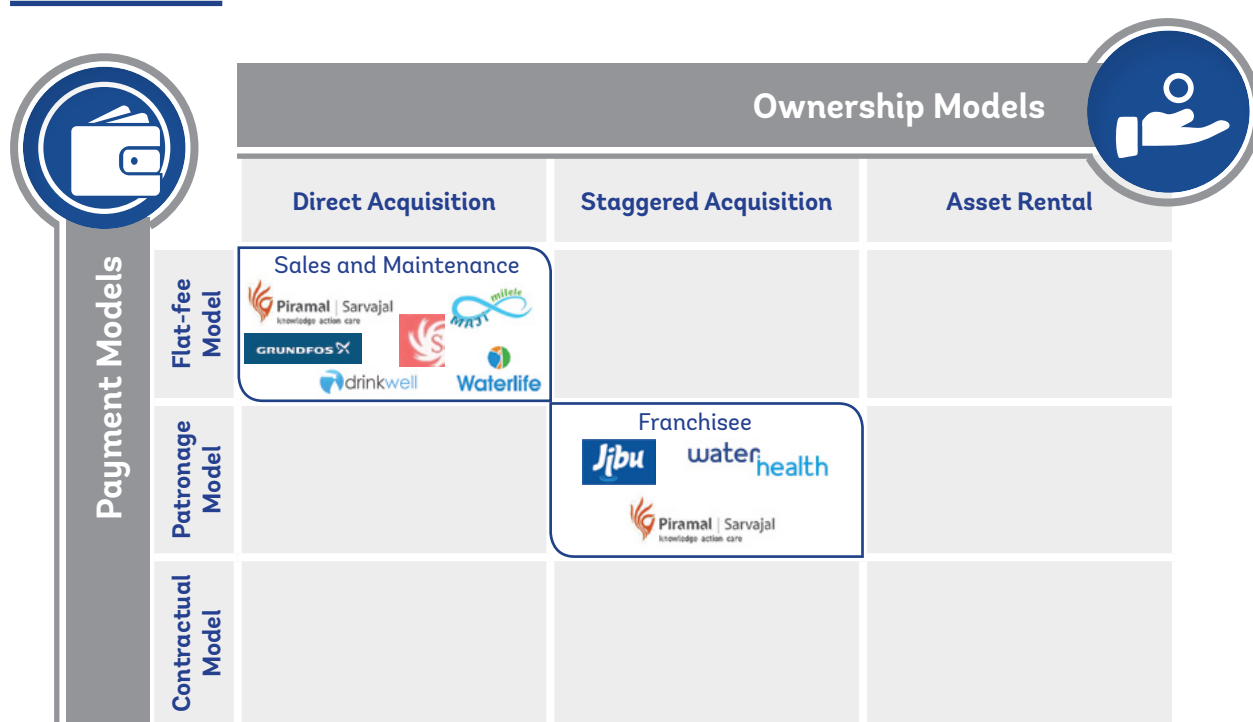
Figure 23. Key Drivers and Challenges for the CWP Market



#### 4. Mapping of Community Water Purification Enterprises into Business Models

In most markets, the government is a key customer for the water purification systems or water kiosks sold by CWP enterprises. Enterprises bid for government tenders either directly or with partner integrators and capex financiers to execute government community water projects. While government projects are often their largest revenue stream, CWP enterprises also work directly with private sector actors such as CSR foundations of large companies to provide safe drinking water in remote villages. Some enterprises adopt a franchise model to identify and support micro-entrepreneurs to set up small-scale water purification systems and retail water to end-use customers. Established CWP enterprises have developed multiple verticals with different business models to diversify their revenue sources.

Figure 24. Enterprises Across Business Models in CWP Market



Based on their revenue strategy, market opportunity, and capacity to make the initial investment, CWP enterprises typically follow one of two models:

- 1. Sales and maintenance model:** Enterprises sell community water systems directly to the government, local communities or local NGOs, typically through a financing partner. They continue to maintain the system for a fee as part of a maintenance contract. A few enterprises provide only technology and equipment to NGOs or government agencies that directly operate the systems. Some enterprises initially offered water as a service, retaining ownership of the system; however, they shifted to the sales and maintenance model to recover their initial investment upfront.
- 2. Franchise model:** Enterprises identify micro-entrepreneurs from local communities in remote locations to provide water as a service to end-use customers. This model emerged in response to the need to create awareness, generate demand, and build customer willingness to pay in



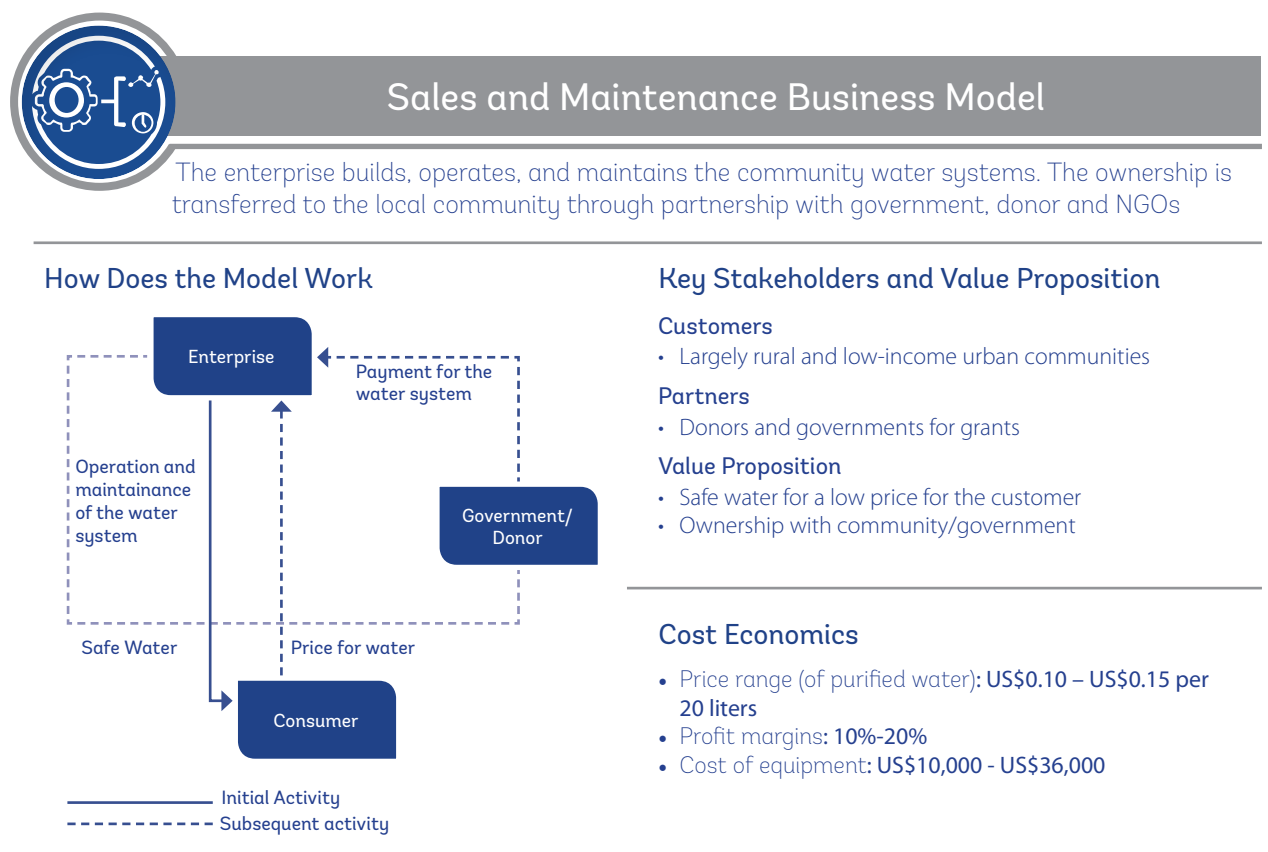
communities. Enterprises coopt community members to become micro-entrepreneurs and operate the water purification systems. These micro-entrepreneurs or franchisees invest in the technology and equipment, and enter a revenue sharing arrangement with the CWP enterprises. The enterprises provide them financial and non-financial support to retail branded purified water.

A few enterprises, such as India's Sarvajal, use both the sales and maintenance model and the franchise model depending on the availability of partners and donors and the location of the units with respect to ease of maintaining and operating the water purification plant.

## 5. Scalability Analysis of 'Sales and Maintenance' Business Model

Enterprises in the sales and maintenance model usually partner with a capital provider who provides significant upfront funding to cover the initial capital and installation costs. This includes support from the government, CSR sponsorship, and DFI funds. The enterprises operate the CWP unit and provide sales and maintenance support for a fee, which covers their operating expenditure. The price of the improved water is usually determined by the project sponsor. Grundfos Lifelink and Maji Melele in Kenya; Sarvajal, Drinkwell, Synergy Solar, Waterpoint, and Waterlife in India; and dloHaiti in Haiti are some CWP enterprises that deploy this business model.

Figure 25. Sales and Maintenance Business Model in CWP Market





## 5.1 Internal Factors

### Customer Engagement

CWP enterprises need to engage with both institutional customers and end users that purchase water from their kiosks. Government agencies procure and establish CWP units through a tendering process (least cost selection), while CSR foundations select CWP enterprises as partners through a concept-based collaborative process. Tapping into these different opportunities requires significant marketing effort. For instance, India-based Drinkwell establishes partnerships and provides services to third-party integrators and capex financiers<sup>132</sup> who bid for and execute government projects. In areas where government projects are not implemented, the enterprise seeks CSR initiatives to establish water purification units.

Enterprises that provide operations and maintenance services engage with end-users for demand generation, which can be a challenge to scale. They usually target areas where water quality is visibly poor in terms of color and taste, so that the benefits of their CWP solutions are visible and well received by the community. For instance, Sarvajal was able to penetrate markets where groundwater was the primary source of drinking water and had very apparent quality issues.<sup>133</sup> Similarly, dloHaiti is able to demand a comparatively higher price for its water cans compared to surface water and municipal drinking water as their product is cleaner and better in taste. Enterprises also offer door-step delivery for convenience. Synergy Solar operates water ATMs and uses electric rickshaws for doorstep delivery of water to customers in rural India.<sup>134</sup>

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### Box 10 Developing different verticals to serve safe drinking water: Piramal Sarvajal, India

Piramal Sarvajal, seeded by the Piramal Foundation in 2008, provides sustainable water solutions to almost 300,000 consumers daily through over 570 installations across 12 states in India.

Sarvajal currently operates through three main business verticals: franchisee model, CSR partnerships, and government tenders. Sarvajal started with a pure franchisee model but transformed it significantly. The enterprise now sells the units to the franchisee and undertakes O&M activity as and when required. The price of water is also decided by the franchisee. Sarvajal also operates through CSR partnerships

in rural and remote locations that are not financially viable (capital expenditure) for the enterprise alone. The CSR fund covers the upfront cost, the local operator gains a livelihood and eventually becomes an entrepreneur. Consumers either do not pay (e.g., school children) or pay very little (e.g. households in very remote locations) for the safe water. Sarvajal works with local partners such as NGOs or enterprises running mid-day meal program for daily maintenance of CWP systems. The enterprise also bids for government tenders to install CWP systems in rural areas.

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<sup>132</sup> These include agencies that bid to design and build government projects related to provision of safe drinking water usually on EPC basis.

<sup>133</sup> Intelicap primary interviews with stakeholders

<sup>134</sup> At most of the places consumers come on their own to collect the water, hence, enterprise own only 10 such e-rickshaws for transportation of water.



## Operations

Sales and maintenance enterprises invest in developing innovative products, technologies and solutions to treat different contaminants, and seek to recoup capital expenditure for viability. Enterprises that earn a significant proportion of their revenue through sales of CWP units to government agencies are often impacted by bureaucratic delays. The construction and maintenance of water purification plants is affected by other factors too, such as rainfall, groundwater levels, and availability of electricity. Several CWP enterprises such as dloHaiti and Kenya-based Safe Water Enterprises operate on captive solar power to address this challenge, but this adds to the overall cost of the units. Enterprises have also developed innovative solutions that work in the absence of grid power. For example, Safe Water Enterprises operates small kiosks equipped with mobile SkyHydrant water filters with hair-thin membrane fibers, which remove suspended solids, bacteria, and viruses from water and can operate without grid connectivity.<sup>135</sup>

Given that the units are dispersed, sales and maintenance enterprises improve efficiency by adding remote monitoring components to the system. While this adds to the upfront cost of the unit, it reduces down time, operational costs, and the need for physical checks. Sarvajal and Synergy Solar have installed remote monitoring systems in all their units to capture information on water output, daily collections, and to relay any faults in the system on mobile phones and email.<sup>136</sup> However, success of such remote monitoring mechanisms is dependent on the availability of a well-trained local team. Such skilled resources may be difficult to hire or train in many developing countries.

Enterprises also engage with local NGOs to build awareness about safe drinking water and seek their support in operating the water kiosks. Indo-Canadian Village Improvement Trust (ICVIT), an NGO that adopts villages and supports overall development, works with Synergy Solar to install its water automated teller machines (ATMs) in these villages in India.<sup>137</sup> CWP enterprises also leverage local administrations and government departments to connect with communities and educate them about the health implications of safe water. Waterlife conducts health awareness programs and medical camps in association with village administrations and the public health engineering departments (PHED) in India. Such intensive engagement and dependence on external agencies to connect with customers can be difficult to sustain at scale in a highly competitive market.

## Unit Economics

Sales and maintenance enterprises typically incur capital costs on research and development and manufacturing of the CWP units. Maintenance of the units, cost of consumables such as purification cartridges, and human resources are the key operating costs for enterprises. Many of the enterprises included in this research seek grants or technical assistance programs to support their R&D efforts. For instance, Drinkwell received a total grant of US\$400,000, and used

135 "Safe Water Enterprises," Empowering People Network/Siemens-stiftung.org, accessed May, 2017. <https://www.empowering-people-network.siemens-stiftung.org/en/solutions/projects/safe-water-enterprise-swe/>

136 Intellect primary interviews with stakeholders; "Soochak Remote Monitoring," Piramal/Sarvajal, accessed May, 2017. <http://www.sarvajal.com/remote-monitoring.php>

137 "Partner NGO," Synergy Solar, accessed on February 14, 2017, <http://synergywatervendingmachine.com/technology/partner-ngo/>

most of it to fund R&D activities.<sup>138</sup> Smaller enterprises also need to develop innovative product design and lower costs through frugal engineering, but may lack skilled resources and the financial bandwidth to set up such R&D facilities.

Sales and maintenance enterprises interviewed for this research currently earn gross profit margins of around 10 to 20 percent. A major part of the profit comes from sales and installation of the CWP unit, which typically costs between US\$10,000 and US\$50,000, with margins in the range of 20 to 30 percent.

Enterprises leveraging innovative technologies are able to earn much higher margins. For instance, Drinkwell, which has developed an innovative ion exchange (resin) technology to remove toxic heavy metals from water, can earn more than the typical 20 percent gross margins in the sector.<sup>139</sup> Several enterprises that were interviewed are targeting high growth ranging from 100 percent to 300 percent for the next two to three years. While they aim to break even in around three or four years, they find that it is difficult to do so when they operate at a small scale. Grundfos Lifelink shared that operating at the village level with a total population of 200 might not be profitable, whereas operating at a village cluster level with a total population of 2,000 could generate profits.

### Financial Strategy

The CWP subsector is capital intensive. Enterprises interviewed for this study shared that installation and set up costs are typically in the range of US\$10,000 to \$50,000 per unit, with capacities of 12,000-65,000 liters/day serving larger villages or urban slums with around 1,000 to 1,500 households. In some locations, CWP enterprises not only purify the water, but also transport the water from longer distances, which adds to the capital costs. Enterprises such as Water Heath or Waterlife in India need to invest around US\$3 million to US\$5 million to set up 100 medium- to large-sized CWP units with capacity of 50,000 liters per day.<sup>140</sup> Annual operational costs typically range between US\$100,000 to US\$300,000 for managing these 100 CWP plants. Enterprises also seek debt for working capital because of delayed payments from the government that could run into six to eight months.

A few enterprises such as Grundfos Lifelink that are part of large firms can obtain funds internally and pay for the operational costs of the business. While many enterprises in this business model earn operating profit margins ranging between 10 percent to 20 percent, risk capital and equity investors expect an internal rate of return (IRR) in excess of 20 to 25 percent. A few impact investors such as Aavishkaar, Michael & Susan Dell Foundation (MSDF) and Acumen have explored this subsector in the last few years, and have supported CWP enterprises largely in South Asia. There are fewer investments in CWP enterprises in Africa due to higher perceived risks and challenges that enterprises face in expanding their operations across countries.

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138 Intelcap primary interviews with stakeholders, Grad student's water startup wins U.S.-India grant. Lehigh University, accessed May 2017. <http://www1.lehigh.edu/news/grad-student%E2%80%99s-water-startup-wins-us-india-grant>

139 Intelcap primary interviews with stakeholders

140 Intelcap primary interviews with key stakeholders. Analysis based on information available at <https://www.outlookbusiness.com/enterprise/trend/filling-up-fast-1033> and <http://www.mydigitalfc.com/news/waterhealth-set-6000-plants-five-years-386>



## 5.2 External Factors

### Market Context

Governments purchase CWP units through a tendering process and in some countries such as India and Kenya, control water prices, which caps the price that sales and maintenance enterprises can charge for CWP units and improved water. Enterprises operating in these countries share that the low water prices charged by CWP units owned by government agencies are a disincentive for private water providers, who are unable to charge a higher price and remain competitive. Many CWP enterprises advocate more flexible regulatory controls on water prices.

The market has few entry barriers; enterprises can enter and compete in this market if they are able to maintain the required quality and have access to capital. While norms and standards exist, monitoring of water quality is not very stringent. In most countries, the market has small local players who install unbranded purification units and sell water at competitive prices. Enterprises share that customers may prefer them, although these units may not adequately purify the water. Since a significant proportion of enterprise revenues are currently dependent on government engagement, enterprises following the sales and maintenance business model find it difficult to scale in the absence of supportive market mechanisms and capital infusion.

### Financing Ecosystem

The sales and maintenance business model is largely supported by donors and DFIs in the form of grants and soft loans. They typically subsidize the high upfront capital costs of enterprises that can demonstrate higher impact and where the CWP plant can endure for many years. However, enterprises also need support to develop lower cost solutions that can inherently support a low price of water for end-use customers to ensure the operational and financial sustainability of the model. Many enterprises charge prices that are higher than those offered by other low-cost alternatives for purifying water, and consequently are unable to achieve operational sustainability. This impacts the market's ability to scale, making it difficult to assess its overall sustainability.

Access to commercial capital for expansion is also a major challenge. Waterlife, for instance, counts lack of capital infusion as a major barrier to scale. Most of the available funding is focused on setting up of new units, with limited resources available for maintaining existing systems. Sarvajal stressed the need for viability gap funding for enterprises in this subsector to help enterprises scale up in low-income rural areas.<sup>141</sup> Some impact investors, however, have supported this subsector and this business model in particular.<sup>142</sup> For instance, Waterlife received seed investment from Aavishkaar in 2009 and between 2009 and 2011, the enterprise has raised around US\$4.87 million from different VC investors including Aavishkaar, Michael & Susan Dell Foundation (MSDF) and Matrix Partners.<sup>143</sup> Waterlife has installed nearly 4,500 CWP

<sup>141</sup> Intellect primary interviews with stakeholders

<sup>142</sup> "Opportunities for Water Technology Commercialization via Spinoffs," Water @Venture Center, Venture Center, accessed on February 14, 2017, <http://venturecenter.co.in/water/investing.php>

<sup>143</sup> "Aavishkaar Pumps Money Into Waterlife," VCCircle (2009), Accessed on February 14, 2017, <http://www.vccircle.com/news/general/2009/10/15/aavishkaar-pumps-money-waterlife>

systems in India since its inception in 2008.<sup>144</sup> Similarly, Acumen Fund has invested US\$130,000 in Spring Health in 2011, to scale up the pilot phase of its project and prepare for market entry on a larger scale throughout India.<sup>145</sup>

Large enterprises or public sector entities working on government contracts such as Punjab Saaf Paani Company in Pakistan and Rand Water in South Africa issue bonds to raise funds for their capital expenditure.

### Policy and Regulations

Government procurement of water purification systems to complement the piped water network allows CWP enterprises to tie up bulk sales. However, water price controls, either by mandate or through signaling by government-run CWP plants who offer low prices, tend to make the private units unviable. Government bureaucracy and ambiguous guidelines are major barriers for the growth of this business model in developing countries.<sup>146</sup> For instance, a recent water policy amendment in Kenya's 47 counties elaborates tariffs and subsidies for water provision by the government in rural and urban areas, which is lower than the tariff charged by private community drinking water providers in the country.<sup>147</sup> Similarly, Sarvajal adds that community water purification tends to be neglected in the safe water discourse in India, where the focus is often on piped water networks and household purification solutions, which are not practical or viable for all locations and customer segments.<sup>148</sup>

However, governments are recognizing the potential of decentralized solutions, particularly in areas that face extreme water scarcity, and are working with the private sector to provide clean drinking water. For instance, in the Barmer district of Rajasthan, India, a mobile any-time-water kiosk dispenses chilled water, as part of Cairn India's CSR program that is supporting the state government in providing safe drinking water through CWP systems.<sup>149</sup>

## 5.3 Scaling Out

Sales and maintenance enterprises have been able to scale to new markets despite their dependence on donor support and government procurement to meet capital expenditure. Their growth is driven by water scarcity and lack of access to safe water, which is a looming crisis, and the fact that governments are often unable to meet demand at scale without private sector support. Most of the enterprises interviewed in this segment are in the growth phase, and are expecting an average annual growth of 20 to 30 percent in their countries of operation. For example, Maji Melele has already completed a project in Somalia, and is planning to

144 The Waterlife India Safe Drinking Water Program. Industrial Business Mart CSR Update, accessed May 2017. <http://www.martupdate.com/index.php?r=site/CSRInitiativesDetails&alias=The-Waterlife-India-Safe-Drinking-Water-Program>, <http://www.waterlifeindia.com>

145 "Investment in Spring Health," Acumen Website, Accessed May 2017. <http://acumen.org/investment/spring-health/>

146 The enterprise describes the policymakers and government agencies often advise the enterprises to keep the prices of water low (typically KES 2 for 20 liters in rural areas), but they also suggest keeping the water prices sustainable for the enterprise

147 Smith School of Enterprise and the Environment, Oxford University, "Water Policy Choices in Kenya's 47 Counties," Policy Brief, February 2016, accessed on April 5, 2017, [http://www.smithschool.ox.ac.uk/research-programmes/water-programme/Policy%20Brief\\_Water%20Policy%20Choices\\_JKoehler\\_Feb2016.pdf](http://www.smithschool.ox.ac.uk/research-programmes/water-programme/Policy%20Brief_Water%20Policy%20Choices_JKoehler_Feb2016.pdf)

148 Intellect primary interviews with stakeholders

149 Swati Bansal, "Rajasthan Gets Chilled Water Kiosk," India Water Portal (2016), accessed on February 14, 2017, <http://www.indiawaterportal.org/articles/rajasthan-gets-chilled-water-kiosk>



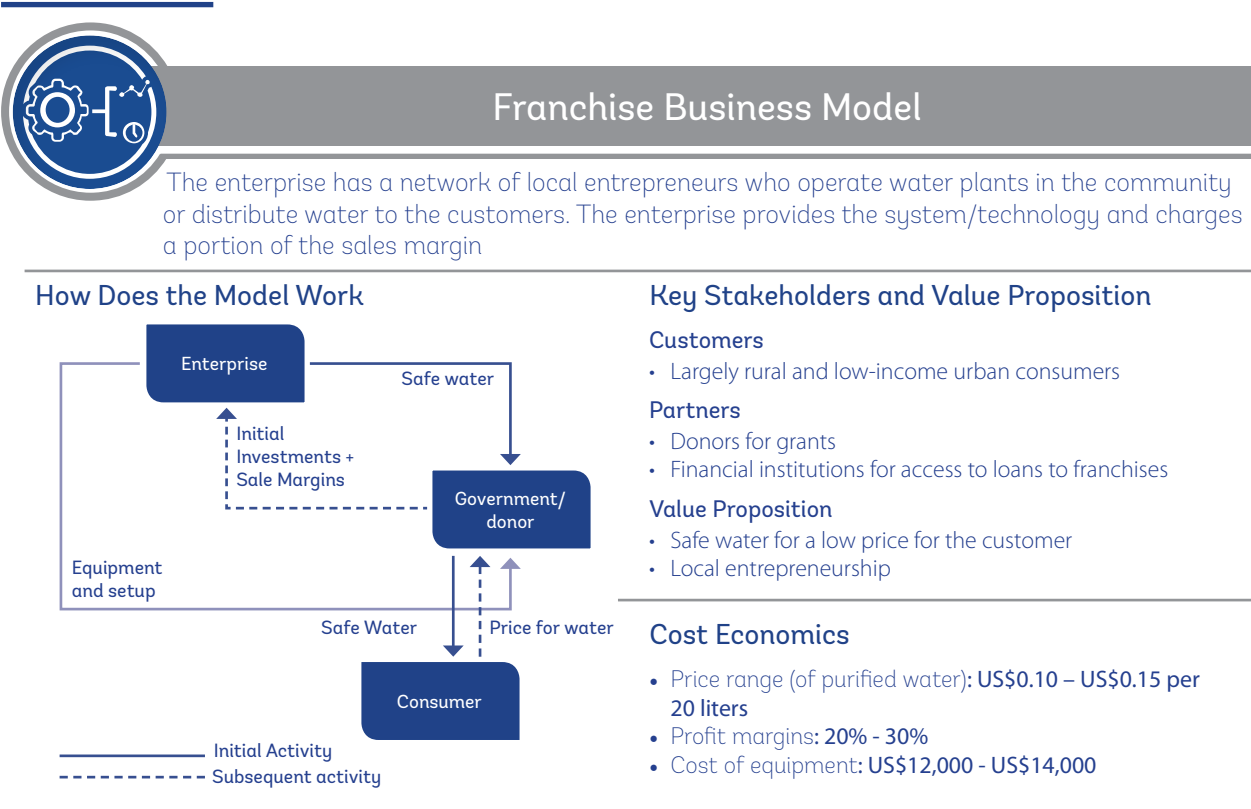
expand to Uganda and Ethiopia. Grundfos Lifelink is expecting an annual growth of 20 to 30 percent in Kenya, Uganda, Tanzania, Ghana, Burkina Faso, Mali, India, and Bangladesh. Synergy Solar has installed approximately 250 units in India and is expected to take this number to 1,000 units in the next few years.

CWP systems are replicable, which supports easy scale out for these enterprises. The products need little modification in terms of equipment size and construction, with only technology being the variable depending on the type of contaminants in the water. They do need to adapt their engagement based on customer willingness to pay, geographic conditions, and regulatory environment. Some strategic initiatives that could support growth of this business model include clustering of villages for viability, and building the community buyer market.

### 6. Scalability Analysis of the ‘Franchise’ Business Model

CWP enterprises adopt the franchise model as they see an opportunity to sell uniform quality of water under their brand name and scale rapidly through local entrepreneurs. Enterprises also see potential for the franchise model in markets that require intensive demand generation and where it is difficult to provide direct maintenance support. The franchisee makes an initial investment (down payment), with direct or indirect financial support from the CWP enterprise, and operates the unit under a revenue sharing agreement with the enterprise. Sarvajal in India, Jibu in Africa, and WaterHealth with presence in India, Bangladesh, Ghana, Nigeria and Liberia are some CWP enterprises that follow this business model.

Figure 26. Franchise Business Model in CWP Market





## 6.1 Internal Factors

### Customer Engagement

CWP franchisees are usually micro-entrepreneurs who operate water kiosks in their community or village. While they have the advantage of being local, they have limited capacity and funds to invest in awareness building initiatives. Consequently, CWP enterprises often have to support them in demand generation. Jibu, with operations in Uganda, Kenya and Rwanda, helps franchisees to build physical infrastructure and provides them with promotional material such as flyers for door-to-door distribution to build awareness.<sup>150</sup>

CWP enterprises find it difficult to identify the right micro-entrepreneurs and invest significant time and money in hiring and training them. Micro-franchisees may drop off if they do not earn enough from their sales, or if they are not interested in pursuing it as a business at scale. Sarvajal incurs nearly 40 percent of its costs in identifying suitable micro-entrepreneurs in this model.<sup>151</sup> Jibu counts entrepreneur training as one of its top cost components. However, these enterprises are able to leverage investment made by franchisees in setting up the CWP units and kiosks. The franchise model is scalable if enterprises and franchisees are able to effectively build the market through customer engagement.

### Operations

To ensure the smooth functioning of franchisees, CWP enterprises train local entrepreneurs and ensure that they have adequate supply of consumables to operate the units. For instance, the core team at Jibu manages the training program along with regional managers. Franchisees that are doing business for the first time are trained in the basics of business management such as accounting and recording sales, and operational nuances. Jibu also provides bottles, seals and labels as well as marketing materials to the franchisees. The enterprise is developing a solution for remote monitoring of water treatment output and water quality.<sup>152</sup>

### Box 11 Introducing Efficient and Innovative Technologies: Drinkwell Systems, India and Bangladesh

Drinkwell Systems provides clean water solutions in regions affected by large scale arsenic and fluoride contamination in India and Bangladesh. The enterprise has a proprietary filtration technology, using ion exchange resins to purify contaminated water, licensed in its name for use in South Asia. Its systems can be installed onto existing arsenic-affected tube wells, which removes arsenic, fluoride, iron, and

other metal from contaminated water. The technology used by Drinkwell is 100 percent locally sourced, delivers 40 percent more water, is 66 percent cheaper than reverse osmosis technology, requires 17-times less electricity, and reduces waste by six orders of magnitude.

Drinkwell's key customers are capex financiers and integrators who bid for government projects that will eventually

<sup>150</sup> Intellect primary interviews with key stakeholders

<sup>151</sup> Intellect primary interviews with stakeholders

<sup>152</sup> "Seeding Social Enterprises in Papua New Guinea," Intellect (2015), accessed on February 14, 2017, <http://www.intellect.com/publications/seeding-social-enterprise-papua-new-guinea>





serve the rural population residing in Eastern India in the states of West Bengal, Assam and Jharkhand, where the total dissolved solids (TDS) levels are over 1,000 parts per million (ppm). The enterprise does not directly set up systems or bid for government projects,

and is hence removed from the last mile. This enables it to make direct sales and earn revenues on delivery, without suffering the delays normally associated with government projects. Its proprietary technology allows it to earn high profit margins.

Although enterprises adopt the franchise model for rapid scale with limited direct intervention, they find that they need to be a part of the demand generation process along with the micro-entrepreneurs. Franchisees also need to invest in transportation in case of doorstep delivery. For instance, Sarvajal franchisees deliver chilled water to households and need to invest in an appropriate vehicle. According to Sarvajal, franchisees can break even when they sell 3,000 liters of water per day (serving 150 households and selling 20 liters to each household), typically priced at Indian rupee (Rs) 0.75-Rs 1 (US\$0.011-US\$0.015) per liter for doorstep delivery.<sup>153</sup>

### Unit Economics

Enterprises generate revenue through the down payment that the franchisee pays at the time of installation of the CWP system, and the revenue share from the franchisee on an ongoing basis. While enterprises try to cover a higher portion of their capital expenditure in the down payment, the franchisee may not be able to pay the amount upfront. Additionally, enterprises are constrained from increasing their revenue share as franchisees may drop off if they are unable to retain enough revenue to break even. Jibu franchisees need to make an upfront investment of US\$1,000 for access to equipment and filtered water. They must focus on volumes as the price of water is low (US\$0.90 for 20 liters). A franchisee has to sell at least 1,000 liters of water every day to break even. In case of Sarvajal, the franchisee keeps 60 percent of the revenue, and can earn around Rs 20,000 (US\$300) per month if s/he caters to 175 households a day.<sup>154</sup>

### Financial Strategy

Enterprises typically need to assist franchisees with access to finance to set up CWP units. Sarvajal helps them mobilize finance from microlending institutions to enable them to cover their share of the capital cost. Jibu offers direct loans to its franchisees. Not all enterprises are able to facilitate such support, which is also the reason why few enterprises follow this business model. Insufficient alternate sources of capital constrain the ability of enterprises and franchisees to deploy this model effectively, impacting their potential to scale.

153 Intelcap primary interview with stakeholders. Data available at <https://thewaternetwork.com/article-FfV/sarvajal-s-solar-powered-water-atm-franchises-provide-clean-water-in-india-XcHpOr7dRwOIEx0mE9Aw>

154 "Sarvajal: Water for All," SIES College of Management Studies (blog), accessed on February 14, 2017, <https://thesiescomsblog.wordpress.com/2012/09/24/sarvajal-water-for-all/>

A few enterprises such as WaterHealth, which operates about 500 plants across Ghana, India, Liberia, Nigeria and Bangladesh, have been able to attract funding from multiple sources. WaterHealth's investors include Dow Venture Capital, Sail Venture Partners, Plebys International, Tata Capital Innovations Fund, Acumen Fund, and IFC. By 2009, the total external investment in WaterHealth was around US\$26 million.<sup>155</sup> In 2015, the enterprise received funding from Dutch Water Partners (DWP), Global Women Development Partners (GLOWDEP), Ministry of Local Government and Rural Development (MoLGRD), Ghana for a five-year project to construct community-based water service facilities, called Decentralized Water Health Centers (DWHCs). However, investors push for early capital expenditure recovery, which may be difficult to achieve for enterprises adopting this business model. Consequently, they prefer to source grants and soft loans from donors to set up the CWP systems, while attempting to attract risk capital through demonstration of scale and sales volumes.

## 6.2 External Factors

### Market Context

Most franchises do not have experience in managing finances and teams or building out a retail space. CWP enterprises have to provide them intensive business management and marketing support in addition to technology and finance. This becomes an attractive package for the micro-entrepreneurs, and motivates them to be a part of this business model. Eventually, all these factors support scale up and scale out of the franchise business model but cause considerable strain on the resources of the CWP enterprises.

Given the variation in culture and language, enterprises often leverage partnerships with local NGOs and authorities to support market-building activities. WaterHealth engages through its NGO partner – Jaldhara Foundation to spread awareness regarding the benefits of consuming safe and purified drinking water along with good WASH (Water, Sanitation and Hygiene) practices in rural mother and child care centers and schools. Local governments provide land, water source and electricity for setting up the water purification units (known as a WaterHealth Centres).

### Financing Ecosystem

According to most of the interviewed enterprises, the current financial ecosystem for commercial capital is not adequately supportive, and they need alternate sources of finance to achieve scale, such as CSR programs and other soft debt alternatives by donors. For instance, Jibu has been supported by Segal Foundation, Social Capital Foundation, Cordes Foundation, Soderquist Family Foundation, and the Richard Petritz Foundation, which has enabled the enterprise to scale a network of locally-owned franchise business owners providing high-quality drinking water. The franchise business model allows enterprises to create jobs and livelihoods, and build the means for wider customer education for social change and development of communities.

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<sup>155</sup> Jess St. John, "WaterHealth Lands \$10M for UV Water Purification," Greentech Media (2009). Accessed on February 14, 2017, <https://www.greentechmedia.com/articles/read/waterhealth-lands-10m-for-uv-water-purification-5526>



### Policy and Regulations

As in the case of the sales and maintenance model, government directives regarding water pricing are a barrier to scale for enterprises. In addition, there are no standards or checks on maintaining quality of water at the point of sale that can differentiate enterprises from competitors selling insufficiently purified water. Most interviewed enterprises shared that there are many small operators that do not own licenses to operate and are not monitored for their water quality. They can offer very low prices, and pose a threat to the franchises, particularly if the community (and the market) is small.

## 6.3 Scaling Out

The franchise model has the potential to scale up and out to countries in Africa and South Asia. The business model leverages the local connection of franchisees, and delegates the task of operating and maintaining the systems. However operationally, it is difficult to administer this model since it is a hands-on and intensive process, instead of being decentralized as initially imagined by enterprises. CWP enterprises may get financial support to scale out from donors and CSR arms of corporations that are looking to create jobs and develop remote, rural communities. However, they will find it difficult to attract commercial investors and capital unless they demonstrate better sustainability and scale.

## 7. Comparison of Business Models in Community Water Purification

Across the CWP subsector, financial viability in terms of capital expenditure recovery is a major challenge. The subsector is evolving in terms of technology, which is enabling the production of more efficient products and components and the ability to detect different types of contaminants. For instance, Grundfos Lifelink and Drinkwell in sales and maintenance and franchise model respectively have innovated to provide better solutions, which have enabled them to scale..

Sales and maintenance enterprises mostly incur costs on R&D and manufacture of the CWP units. According to the interviewed enterprises, their capital expenditure is covered by government tenders or CSR activities, and the operating profit margins range between 10 percent to 20 percent. The sales and maintenance business model will scale better in geographies with adequate government support and CSR policies. A few enterprises have adopted specific technologies to combat respective water contaminants, and this specialization helps them scale better as there is little or no competition. This model is able to replicate in countries with positive regulatory push and established quality standards such as those for bottled water. Enterprises such as Waterlife of India and Grundfos Lifelink of Denmark, which invest in developing unique products through frugal engineering, have scaled rapidly.

Franchise enterprises invest in identification, establishment and training of franchisees. This business model is characterized by low profit margins unless they scale and faces considerable challenges in generating demand. Although there is increasing awareness about affordable clean drinking water in rural communities of several developing countries such as India and Kenya, most consumers still prefer to boil water instead of purchasing water. Low margins and high initial investments can affect the scalability of small franchisees. However, remote monitoring can help accelerate the replication of the franchise model as it helps the enterprise monitor the volume of water and the performance of the water ATMs.

Both business models are easy to replicate, and similar models can be scaled up and out with minimal customization necessary to suit local geographic and regulatory conditions and requirements. Enterprises can also form an association like the Water Quality Association<sup>156</sup>, a business association for the residential, commercial, and industrial water treatment industry, to further their interest and create a market context to help them scale.



The franchise model is likely to become an important solution to improve access to clean drinking water in most developing countries. However, scaling up of the model requires large enterprises that are backed by effective management teams and expert finance partners to establish and manage this model.

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<sup>156</sup> Water Quality Association, <https://www.wqa.org/>



Table 8. Comparison of Business Models in Community Water Purification

	Franchise	Sales and Maintenance
	<b>Internal Factors</b>	
<b>Customer Engagement</b>	Engages with customers (franchisees) through direct acquisition models	Engages with customers (government, corporations) through tenders and CSR initiatives
<b>Operations</b>	Enterprises train micro-entrepreneurs in operations, and support them with technology and finance	Enterprises establish CWP systems, and operate and maintain the systems
<b>Unit Economics</b>	Generates revenues through down payment from franchisee and ongoing revenue share	Generates revenues by sale of technology, equipment, and water; also through operation and maintenance fee
<b>Financial Strategy</b>	Largely supported by donors and grants or aid money	Supported by government and corporations
	<b>External Factors</b>	
<b>Market Context</b>	Need to generate demand and develop end user market	Established market through government tenders and CSR programs
<b>Financing Ecosystem</b>	Access to commercial capital is a major challenge. Need for alternate sources of finance such as blended capital	
<b>Policy and Regulations</b>	No regulation to monitor smaller shops and establishments that operate without license	No regulation to control poor quality, low-price products

## 8. Looking Ahead

The high dependence on subsidy and grants tends to delay efforts by the market to build sustainability. Enterprises in this subsector therefore need to attract mainstream investors and capital providers who understand the complexities of this market and yet direct them to move towards stronger performance and reporting. Early-stage enterprises and local entrepreneurs should be provided with technical assistance and training, and collateral-free financing rather than the provision of subsidy or pure grant-based funding to encourage them to scale sustainably. Blended finance<sup>157</sup> could provide an opportunity for these enterprises to mobilize commercial funds over time. A joint role of the government regulatory bodies and private sector finance providers is critical to enable such facilities.


<sup>157</sup> Defined by the Organisation for Economic Co-operation and Development (OECD) as the 'strategic use of development finance and philanthropic funds to mobilize private capital flows to emerging and frontier markets'

# Case Study: Drip Irrigation Systems

## 1. Drip Irrigation Market Description

Water scarcity and unsustainable irrigation practices are growing challenges for farmers across the developing world. Drip irrigation systems that deliver water directly to crop roots through porous or perforated tubing have emerged as sustainable alternatives to traditional flood irrigation, demonstrably improving farm productivity, reducing consumption of pesticides and fertilizers and better water management. Drip irrigation systems can be configured for different farm sizes. Small drip irrigation kits serve farms ranging from 20 square meters (m<sup>2</sup>) to 500 m<sup>2</sup>, while larger units can be scaled to meet the requirements of half acre to over 10-acre farm plots.<sup>158</sup>

Figure 27. Key Product Categories in the Drip Irrigation Market

	Small-Sized Drip Kits for Farm Sizes up to 500 sq. m	Large-Sized Drip Kits for Farm Sizes Exceeding 10 Acres
	Enterprises	Enterprises
<b>Outreach Strategy (Typical)</b>	Small-scale enterprises with frugal or basic drip systems	Large-scale enterprises with high end / innovative drip systems
<b>Cost per Acre (Typical)</b>	Donor and public support, Focus on reducing cost through frugal innovations	Well-established distribution channels with financial partners; Focus on R&D and product efficiencies
<b>Enterprise Examples</b>	Ranges from US\$200-500 per acre	Ranges from US\$500-800 per acre
	SunCulture, Kenya MyRain, India Driptech, India	Netafim, Global Jain Irrigation, India Digengoff, Ghana

158 Jack Keller and Andrew A. Keller, "Affordable Drip Irrigation for Small Farms in Developing Countries," Irrigation Toolbox, accessed on February 12, 2017, <http://irrigationtoolbox.com/ReferenceDocuments/TechnicalPapers/IA/2003/IA03-0415.pdf>



Customers for drip irrigation systems include small and large farmers, commercial greenhouses, and residential gardeners. In developing countries, smallholder farmers are a largely untapped customer segment and drip irrigation enterprises reach out to them through community development programs, direct sales through dealers and collaboration with government agencies.

This research interviewed enterprises based across Asia and Africa that provide a wide range of drip irrigation systems with different quality and characteristics.<sup>159</sup> To represent the different types of enterprises in this market, the sample includes larger, multinational enterprises such as Jain Irrigation and Netafim as well as smaller enterprises like SunCulture and MyRain. Larger enterprises rely on the strength of their distribution partners and financial partners to offer their products. These enterprises also support government and state agencies to develop large drip irrigation projects to benefit smallholder farmers. In comparison, smaller enterprises sell low-cost drip irrigation kits designed through frugal engineering and usually rely on donor and public sector support for awareness building and marketing activities.

Prices of drip irrigation kits for similar plot sizes vary widely based on quality of materials used, donor support, markets, and customer segments. The upfront cost of a drip irrigation kit can be as much as 30 to 40 percent of the annual income of an average smallholder farmer in South Asia and Africa who largely grow cereals and food crops.<sup>160</sup> Drip irrigation might therefore be more suitable for farmers involved in cultivating cash crops that provide quicker pay back on the investment. Increasing the uptake of drip irrigation, however, has not been easy across price points and farmer segments, and enterprises have had to support their marketing efforts with extension services and other pre-harvest support.

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159 The research team interviewed Jain Irrigation (India), Netafim (Global), Claro Energy (India), SunCulture (Kenya), Dizengoff (Ghana), Dear Auto Comps (India), Driptech (India/Global), MyRain (India), and Micro Drops (India). Information from secondary sources was obtained on iDEal Technologies (Nicaragua), Toro (Zambia), Micro Drip (Pakistan), and Global Easy Water Products.

160 "The Market for Small-Scale Drip Irrigation in East and Southern Africa," USAID and Fintrac (2016), accessed on February 12, 2017, [http://www.partneringforinnovation.org/docs/Resources\\_The\\_Market\\_for\\_Small\\_Scale\\_Drip\\_Irrigation.pdf](http://www.partneringforinnovation.org/docs/Resources_The_Market_for_Small_Scale_Drip_Irrigation.pdf)



## 2. Global Market for the Drip Irrigation

The global market for drip irrigation systems was valued at US\$2.1 billion in 2015, and expected to grow to US\$3.6 billion by 2020, at a CAGR of more than 10 percent.<sup>161</sup> The Asia-Pacific region accounts for almost 50 percent of the drip irrigation market, driven by sales in India and China. India leads the world with almost 2 million hectares under micro-irrigation methods, followed closely by China. Despite this, the penetration of micro-irrigation in India and China is very low as only 2 percent and 0.6 percent of arable land in India and China respectively utilizes drip irrigation systems.<sup>162</sup> With growing water stress, increasing awareness about drip irrigation, and government initiatives promoting the uptake of micro-irrigation systems among farmers and agriculturists,<sup>163</sup> the Asia-Pacific region is expected to drive the growth of the drip irrigation market. It is estimated that the market in the Asia-Pacific region, led by India and China, will grow faster than the world average at a CAGR of 13 percent.

Latin American countries such as Brazil have been utilizing micro-irrigation systems for many decades for water intensive crops such as sugarcane. In the Middle East and North Africa (MENA), countries such as Iran, Morocco and Egypt are key markets. This region is expected to grow at more than 18 percent CAGR between 2013 and 2020 to reach over US\$300 million by 2020.<sup>164</sup>

The uptake of drip irrigation has been low in Africa, where it is mostly utilized in large commercial farms. This is partly due to the absence of local drip irrigation manufacturers in these countries. The cost of importing the drip irrigation kits coupled with supply chain inefficiencies increase prices and act as deterrents. Smallholder farmers in Africa have also been reluctant to adopt drip irrigation due to the high upfront cost, lack of awareness, and limited availability in rural markets.<sup>165</sup> However, South Africa, which produces a number of water intensive crops such as sugarcane and cotton, is a potential market for drip irrigation enterprises.

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161 "Drip Irrigation Systems Market Worth 3.56 Billion USD by 2020," Markets And Markets, accessed on February 12, 2017, <http://www.marketsandmarkets.com/PressReleases/drip-irrigation-systems.asp>

162 "Developing Countries Look to Micro-irrigation to Boost Crop Yields," Technavio (2015), accessed on February 12, 2017, <http://www.technavio.com/blog/developing-countries-look-to-micro-irrigation-to-boost-crop-yields>

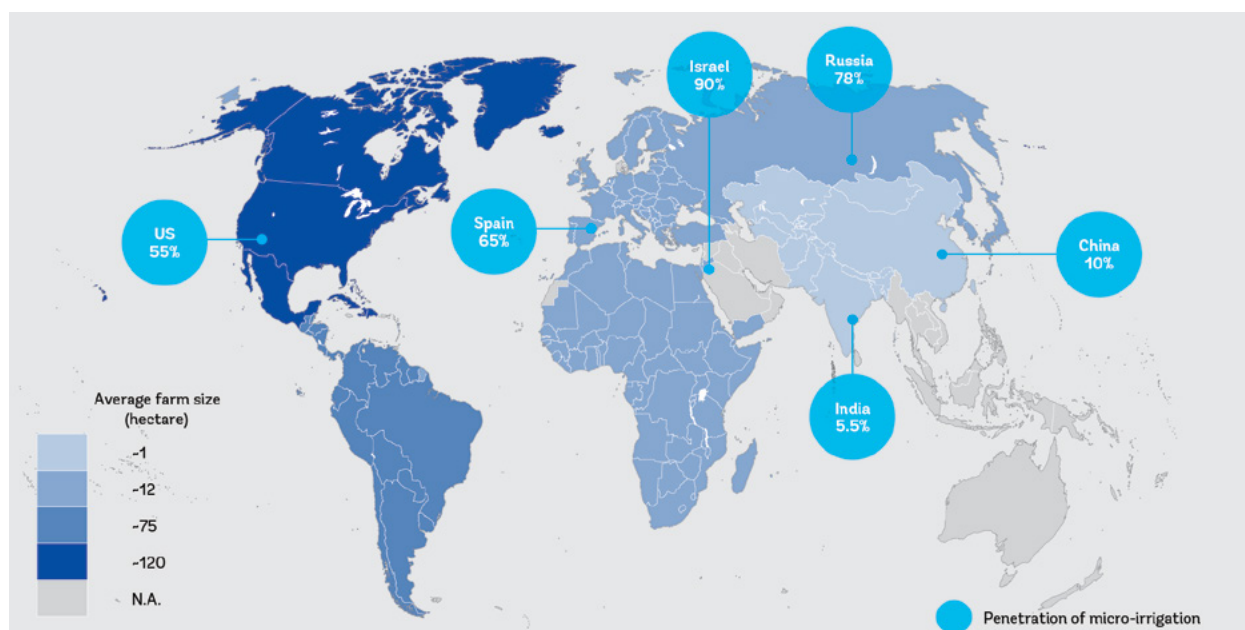
163 "Global Micro-Irrigation systems market - By Type, Crop Type, Regions - Market Size, Demand Forecasts, Industry Trends and Updates (2014- 2020)," Research and Markets (2016), accessed on February 12, 2017, <http://www.researchandmarkets.com/research/6skpn2/global>

164 "Drip Irrigation Systems Market - Middle East and North Africa Industry Analysis, Size, Share, Growth, Trends and Forecast 2014 – 2020," PRNewswire (2015), accessed on February 12, 2017, <http://www.prnewswire.com/news-releases/drip-irrigation-systems-market---middle-east-and-north-africa-industry-analysis-size-share-growth-trends-and-forecast-2014---2020-300093777.html>

165 "Drip Irrigation Technologies: Lessons Learned when Working with Smallholders," Fintrac (2016), accessed on February 12, 2017, [https://www.fintrac.com/sites/default/files/DriplrrigationBrief\\_Fintrac.pdf](https://www.fintrac.com/sites/default/files/DriplrrigationBrief_Fintrac.pdf)



Figure 28. Drip Irrigation Market Size<sup>166</sup>



Note: The penetration of micro-irrigation is used as a proxy for drip irrigation market.

### 3. Key Drivers and Challenges for the Drip Irrigation Market

The growing need to boost agricultural yields along with ensuring minimal water wastage and high water efficiency are some of the key factors fueling growth of the drip irrigation market. However, farmers in developing countries have been slow to adopt drip irrigation systems due to poor awareness of its long-term benefits. High initial costs and the need for sophisticated management and maintenance are expected to hinder growth in these markets. For instance, in a major market such as India, the cost of drip irrigation systems can be 1.5 to two times that of traditional irrigation systems.<sup>167</sup> While the higher upfront cost for drip irrigation units can be offset by an increase in farmers' incomes, this happens over a period of four to five years.

Distribution of drip irrigation units to small and remote farms is expensive, driving up costs and limiting availability to rural farmers. Uptake of drip irrigation is heavily dependent on factors such as favorable policies and regulations, availability of price support mechanisms such as subsidies, and awareness programs undertaken by government agencies. In India, many state governments have formulated specific irrigation policies that promote the use of drip irrigation systems for water intensive crops such as sugarcane. In Morocco, the government established a program to finance about 50 percent to 80 percent of the cost of drip irrigation units. Agronomists, extension service providers, and technical experts play a critical role in educating farmers about the benefits of drip irrigation and ensuring that they install appropriate and well-designed drip irrigation systems.

<sup>166</sup> Ken Research 2014 report on Jain Irrigation

<sup>167</sup> Intelicap market analysis 2016

Figure 29. Key Drivers and Challenges for the Drip Irrigation Market



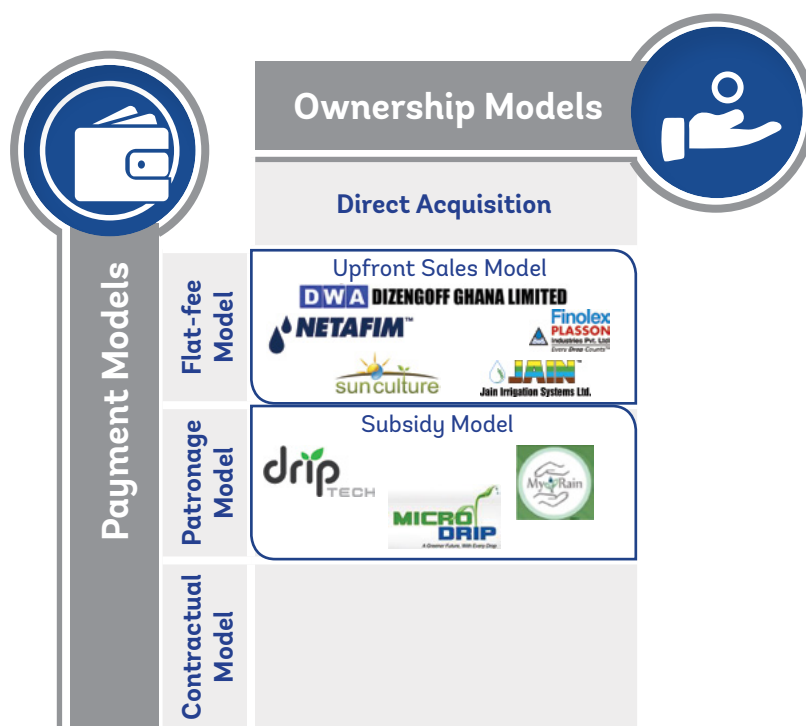


#### 4. Mapping of Drip Irrigation Enterprises into Business Models

Drip irrigation enterprises adopt different strategies to address customer needs and challenges, such as high costs, complex installation and maintenance, and long payback periods. They have developed large and small systems to suit various farm sizes and price preferences, and have designed different outreach strategies. Given the high degree of customization in the product, enterprises deploy either an upfront sales model or a subsidy model:

1. **Upfront sales model:** Enterprises charge farmers the full upfront price for the drip irrigation kits. This price does not include any subsidy component; the customer or distributor may obtain a subsidy directly from the government. Some enterprises facilitate consumer finance, especially for small farmers, by connecting them to microfinance institutions or other financial intermediaries.
2. **Subsidy model:** Enterprises charge a subsidy linked price, where they receive one part of the payment from the customer and another as subsidy from the government agency or donors that support the price. While the farmer directly acquires the drip irrigation unit, the enterprise accepts a lag between transfer of ownership and receipt of full payment from the buyer and government or donor.

Figure 30. Enterprises Across Business Models in Drip Irrigation



*Note: The products related to drip irrigation always are directly acquired by the end customers (i.e. farmers).*

In both models, farmers may obtain finance to purchase the product from traditional consumer finance avenues. Drip irrigation enterprises opt for either model based on the market context and need. For instance, Netafim uses both the subsidy-based model and upfront sales model in different states of India.

In states where the local government has proactive agriculture and irrigation policies, Netafim sells the drip irrigation systems to farmers at a lower, subsidized price and is responsible for applying and availing of the subsidy from the government. In other states, where payments from the local government are usually delayed, the enterprise follows the upfront sales model

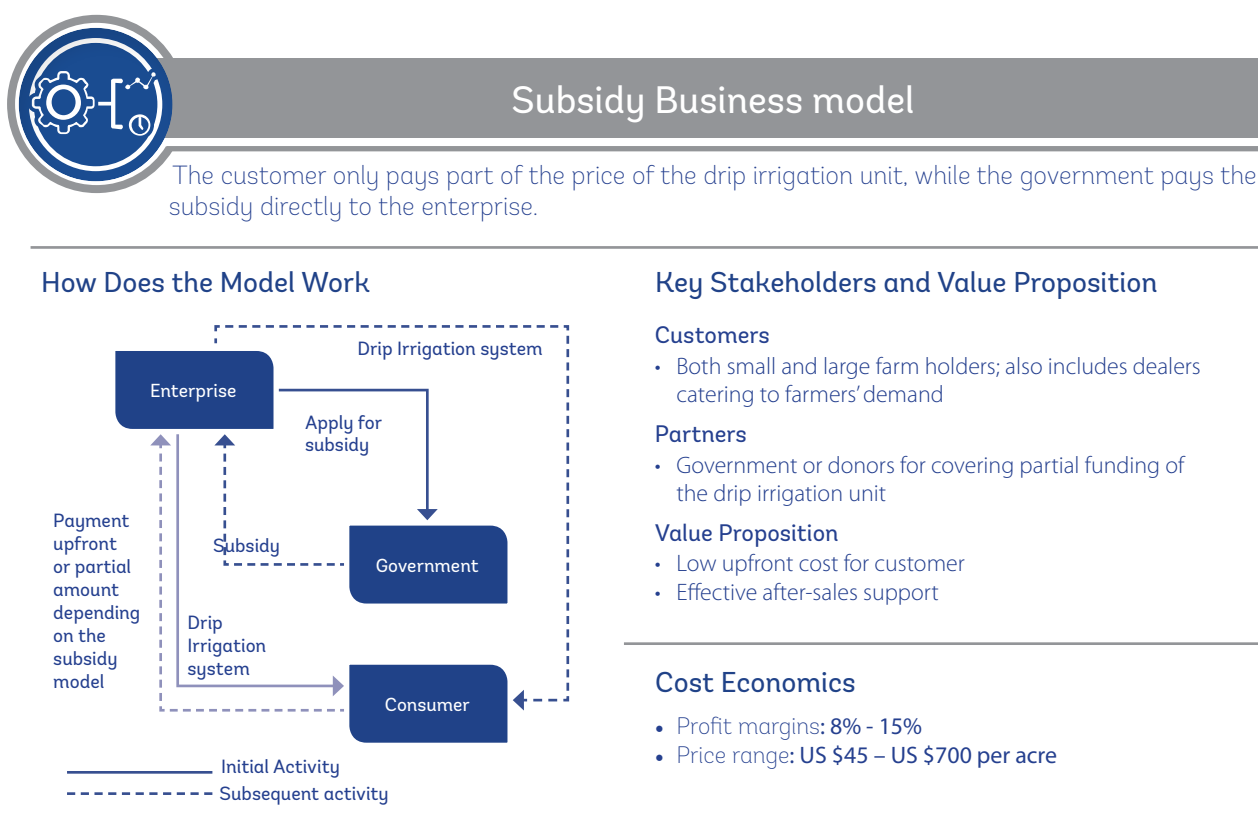
where the farmer or dealer is responsible for availing the subsidy. The enterprise helps farmers to access loans from banks or NBFCs for the purchase of the product under both models.<sup>168</sup>

India-based Jain Irrigation moved from the subsidy model to upfront sales model due to delays in disbursement of government subsidy, which often ran for a couple of years and resulted in a high working capital and interest cost for the enterprise. Its receivables collection cycle, which peaked at 369 days in March 2011 under the subsidy model, is down to around 190 days in 2015 and is expected to stabilize at around 120 days in the next few years.<sup>169</sup>

## 5. Scalability Analysis of Drip Irrigation Market

Given the high degree of interchangeability between the two business models, this note analyzes scalability at the subsector level. It draws out key differences between the models in sections where scalability can be impacted by the dependence on subsidy payments.

Figure 31. Business Models in Drip Irrigation



<sup>168</sup> Intelcap primary interviews with stakeholders

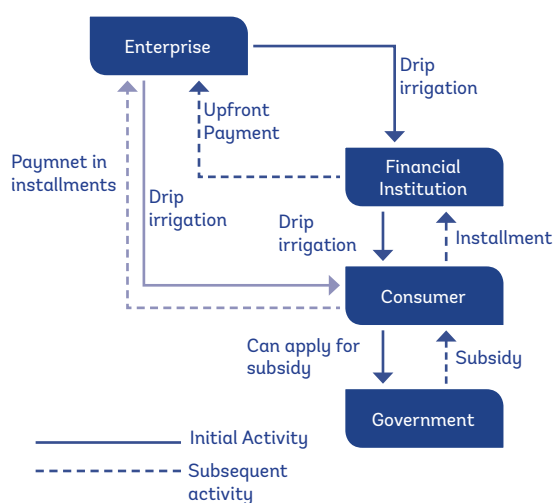
<sup>169</sup> "Jain Irrigation: A Model for Rural Success," Business India (2015), accessed on February 12, 2017, [http://www.jains.com/PDF/BI\\_JainIrrigationCoverStory-June8-21\\_2015.pdf](http://www.jains.com/PDF/BI_JainIrrigationCoverStory-June8-21_2015.pdf)



## Upfront Sales Business Model

The customer secures a loan for paying the entire upfront cost of the irrigation system. The enterprise provides financing or supports the customer access financing through its financial partners.

### How Does the Model Work



### Key Stakeholders and Value Proposition

#### Customers

- Small and large farm holders; also includes dealers catering to farmers' demand

#### Partners

- Financial institutions for consumer finance

#### Value Proposition

- Immediate ownership transfer
- Effective after-sales support

### Cost Economics

- Profit margins: 15% - 30%
- Price range: US \$45 – US \$700 per acre

## 5.1 Internal Factors

### Customer Engagement

Identifying and educating customers, building the market, customizing the drip irrigation units, and offering periodic maintenance support requires intense customer engagement. Given that smallholder farmers in developing countries are often remotely located, access and service provision has been a challenge for drip irrigation enterprises. They either develop their own marketing and distribution teams or enter strategic tie-ups with partners who can support in last-mile reach. Jain Irrigation, for instance, has exclusive dealer networks of nearly 5,000 dealers to cover most of rural India. Each dealer network has engineers and skilled technicians who are responsible for assessing farmers' irrigation needs, providing installation services, and training farmers in basic operations and maintenance of the drip irrigation systems.<sup>170</sup>

170 "The Market for Small-Scale Drip Irrigation in East and Southern Africa," USAID and Fintrac (2016), accessed on February 12, 2017, [http://www.partneringforinnovation.org/docs/Resources\\_The\\_Market\\_for\\_Small\\_Scale\\_Drip\\_Irrigation.pdf](http://www.partneringforinnovation.org/docs/Resources_The_Market_for_Small_Scale_Drip_Irrigation.pdf)

### Box 12 Experimenting with Business Model Innovations: Netafim

Netafim was founded in 1965 and now counts 28 subsidiaries and 17 manufacturing plants worldwide. It controls over one-third of the global micro-irrigation equipment market. Its focus on combining technology and business model innovation has led to its market expansion. Netafim sees itself as a smart irrigation solutions provider that leverages partnerships with peers as well as larger agri-inputs and processing companies to consolidate market share. It has shifted its focus from creating the most technologically advanced irrigation system to helping farmers improve their farm productivity and incomes.

The enterprise has continuously innovated its business model. Netafim is experimenting with patronage models like the revenue share model (part payment linked to farm yield improvements), an EMI model (installments to ease the burden of upfront payment) and a PAYG model (the farmer doesn't own the unit, but rents it on demand). Netafim also has an NBFC subsidiary, which disburses loans for drip irrigation systems, thus enabling it to serve both small and large farms.

As the high upfront cost of drip irrigation limits its uptake among smallholder farmers, some enterprises have developed patronage and staggered acquisition models, and are piloting innovations in pay-as-you-go services. In Kenya, SunCulture recently piloted US\$2 a day drip irrigation system using the pay-as-you-go model to improve the affordability of its products.<sup>171</sup> It is exploring the concept of 'irrigation as a service' and will leverage mobile money payments and PAYG technology.<sup>172</sup> The enterprise expects that this strategy will help in achieving scale and outreach to customers who need drip irrigation solutions but have limited capacity to pay lump sum for the units, which can be priced as high as US\$2,000 per acre. Similarly, Netafim is testing a revenue share model where farmers can pay in installments based on increased yields and associated increase in farm incomes. The farmer pays 50 percent of the cost as advance and Netafim collects the remaining 50 percent over four to five years, based on the increased farm income attributed to drip irrigation.

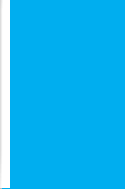
### Operations

To build robust demand and address market needs, enterprises have added innovative product features that adapt drip irrigation solutions to the geographical context and customers' financial constraints, while ensuring that efficiency improves. SunCulture and Jain Irrigation have introduced solar powered drip irrigation systems to serve farmers in villages that are not electrified. Similarly, Micro Drop's investment in frugal engineering to lower costs and manufacturing some key components at almost half the price have assisted the enterprise to scale faster, especially among small holder farmers.

171 Anjli Raval, "Kenyan Farmers Use SunCulture Solar Power to Help Water Dry Land," Financial Times (2016), accessed on February 12, 2017, <https://www.ft.com/content/cf52b0b2-2c98-11e6-bf8d-26294ad519fc>

172 "One-on-One with Samir Ibrahim of SunCulture," Poweringag, accessed on February 12, 2017, <https://poweringag.org/news-events/news/one-one-samir-ibrahim-sunculture>





**Box 13 Investing to Build the Market: Jain Irrigation**

Jain Irrigation is one of the first enterprises to foray into development, manufacturing, and sale of drip irrigation kits in several countries, and has inspired others to follow its lead. Jain Irrigation currently serves nearly 5.2 million farmers in India alone. The enterprise has invested significantly in addressing two key barriers to the growth of the subsector—customer outreach and acquisition, and product efficiency.

Jain Irrigation invests nearly 5 to 6 percent of its revenues on research and development, one of the highest in the industry. Its team has nearly 75 staff with doctorates and hundreds of postgraduate educated and skilled researchers. Its products are best in the class in India: its self-cleaning systems have minimal clogging, are low maintenance and have a life span of 10 years. Similarly, Jain Irrigation has invested in building an exclusive dealer network of nearly 5,000 dealers in India to cover most rural areas in the country. It also has a team of 1,000 field extension workers. These extension workers are responsible for creating awareness about the use and benefits of drip irrigation systems, organizing village community sessions, and offering a number of other extension services.

Drip irrigation enterprises need skilled field resources and agronomists that not only understand the technical aspects of drip irrigation, but also can explain the potential economic benefits of the systems to farmers. Interviewed enterprises shared that talent is a major operational challenge. For instance, Kenya-based SunCulture finds it challenging to hire people with technical capabilities and financial knowledge to adequately explain the long-term benefits of drip irrigation to small farmers. Netafim also identified talent acquisition as a significant challenge. The enterprise feels that there is lower availability of talent who understand technical details as well as rural marketing and consumer behavior.<sup>173</sup>

As drip irrigation solutions are evolving, enterprises have to spend significant resources on product development and innovation to improve efficiency and quality while meeting the price expectations of customers. Since subsidies are a key driver of sales, price caps and product specifications are often indicated upfront by the government.<sup>174</sup> Cost of materials is a major component, accounting for nearly 50 to 60 percent of the cost of goods sold. Customer

174 Subsidies are offered as a percentage of the price, with a cap on the absolute amount that will be paid for certain specifications. Farmers are unlikely to pay too much over this ceiling and hence enterprises must price the drip kits accordingly.

needs vary by crop, soil type, and climatic conditions. Hence, enterprises need to deploy technically qualified staff to visit farms to assess and customize the solution for every sale, which increases marketing costs. Jain Irrigation, for instance, has a strong sales team of 1,000 extension workers that sells around 0.5 million drip irrigation systems a year. The enterprise also spends nearly 6 percent of its revenues on R&D and earns margins of less than 10 percent from most of its operations. Dizengoff Ghana reported higher profit margins in the range of 15 to 20 percent; however, it collaborates with Netafim to design and sell drip irrigation units, and is a part of a large group of companies. The enterprise also collaborates with third party agencies to reduce transportation and distribution costs.<sup>175</sup>

### Financial Strategy

In developing countries, drip irrigation is largely supported by government subsidies and donor funding. Banks, NBFCs and MFIs in many developing countries do not have a specialized financial product for drip irrigation and view it as a highly depreciating asset class with low secondary market sales. Dizengoff Ghana shared that the current cost of borrowing from banks in Ghana is as high as 25 percent for purchasing a drip irrigation system, which limits access to finance for enterprises and farmers. Jain Irrigation has been trying to replicate its business model of cash and carry and subsidy in Africa.<sup>176</sup> However, uptake has been slow due to lack of awareness about the solution and the high cost of consumer finance in the region.

Small farmers lack financial support to pay upfront for the drip irrigation systems. Large scale enterprises overcome this challenge by providing finance through in-house financial services enterprises. In India, Netafim established its own financial institution, Netafim Agricultural Financing Agency (NAFA),<sup>177</sup> to offer customized financial solutions to farmers and other stakeholders in the micro-irrigation value chain. Jain Irrigation has also set up an NBFC, Sustainable Agro-commercial Finance Limited (SAFL),<sup>178</sup> to provide financial services to farmers. Establishing SAFL has also helped the enterprise to transfer the burden of subsidy receivables from its books to the NBFC.

However, not all drip irrigation enterprises may have the financial capacity and capital reserves to set up NBFCs to facilitate consumer financing. Some of the smaller drip irrigation enterprises seek grant funding from donors to address this challenge. SunCulture received US\$2 million from USAID in 2016 to scale up the distribution of its AgroSolar irrigation kit to three additional countries.<sup>179</sup>

## 5.2 External Factors

### Market Context

Enterprises often bundle other complementary pre-harvest products and service offerings with drip irrigation kits to attract customers and increase uptake. Jain Irrigation supplies

<sup>175</sup> Intelcap primary interviews with key stakeholders

<sup>176</sup> Cash and carry is the upfront sales model that is supported by the government subsidy programs in a few countries

<sup>177</sup> Company website <http://www.nafa.co.in/>

<sup>178</sup> Company website <http://safl.in/>

<sup>179</sup> Intelcap primary interviews with stakeholders



drip irrigation systems with other agricultural inputs as well as provides technical training through Jain Gram Sevaks – a network of local extension services staff.<sup>180</sup> This further enhances productivity of farms by almost 40 to 50 percent per acre compared to traditional cultivation practices.

Enterprises shared that farmers need technical assistance and extension services, as well as maintenance support to encourage uptake. These can best be provided by partners, who seek a share of the revenues, or by in-house experts, resulting in higher costs.<sup>181</sup> Jain Irrigation faced significant market challenges while expanding to Africa as the smallholder farmers in the region were less aware of efficient agricultural practices and drip irrigation. Given the diverse cultural and language contexts across the region, the enterprise partnered with local NGOs to build awareness. Driptech also partners with NGOs for market building, and finds that this requires significant investments in manpower and marketing. Dizengoff Ghana conducts awareness drives to promote the benefits of drip irrigation, and encourages farmers to seek clarifications about the product. However, the enterprise shared that the ability of these initiatives to convert need into demand is constrained by the absence of concrete proof of concept or illustrative examples within the community.

The market has several low-cost local drip kit suppliers that compete with the established brands on price. Enterprises interviewed for this research share that several such enterprises supply local brands or unbranded drip kits at lower prices by using low-cost inputs that are likely to have shorter lives. This impacts the sales of higher quality solutions that cannot compete with these low-cost options. To address this challenge, the Tanzania Agricultural Productivity Program (TAPP) controls the prices of its drip kits by using less expensive filters and basic drip lines to increase uptake among smallholders.<sup>182</sup>

IDE has convened the multi-stakeholder Drip+ Alliance to address the challenge of scaling drip irrigation uptake around the world. Together with its partners, which include Netafim, Toro and Jain Irrigation, the alliance seeks to increase the number of farms using drip irrigation (currently over 150,000 across Africa, Asia and South America) to one million by promoting drip irrigation along with bundled services.<sup>183</sup>

### Financial Ecosystem

The financial ecosystem for drip irrigation is largely supported by donors and development financial capital in the form of grants and soft loans that are directly or indirectly routed to enterprises and farmers. For example, the USAID Feed the Future program has provided commercialization grants to the tune of US\$1.6 million to promote drip irrigation. It works with large NGOs such as IDE and Catholic Relief Services, which collaborate with enterprises such as Netafim and Toro to develop low-cost solutions. Similarly, several recent World Bank Group projects on sustainable irrigation support governments in promoting drip irrigation. The

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180 Agriculture Services, Jain Irrigation, accessed on March 24, 2017, <http://www.jains.com/agriculture.htm>

181 "The Market for Small-Scale Drip Irrigation in East and Southern Africa," USAID and Fintrac (2016), accessed on February 12, 2017, [http://www.partneringforinnovation.org/docs/Resources\\_The\\_Market\\_for\\_Small\\_Scale\\_Drip\\_Irrigation.pdf](http://www.partneringforinnovation.org/docs/Resources_The_Market_for_Small_Scale_Drip_Irrigation.pdf)

182 Drip Irrigation in Smallholder Markets: A cross-partnership study, USAID 2016

183 Dripplus Org website <http://www.dripplus.org/>

World Bank Group has provided such support to the governments in Morocco and Pakistan<sup>184</sup> through soft loans for improving drip irrigation uptake.

Larger enterprises such as Netafim and Jain Irrigation with strong balance sheets and sizable number of customers can raise long-term loans, revolving short-term loans and lines of credit for working capital and project-related guarantees from commercial banks. In 2015, Netafim raised US\$500 million for expanding its operations in India and China from a consortium of banks, including HSBC, Union Bank of Israel and others.<sup>185</sup>

Drip irrigation enterprises earn low profit margins given the capital-intensive nature of the business and competition from traditional and less expensive alternatives such as diesel pumps. As a result, the payback period for investments can often exceed five years, making the segment less attractive for private equity and venture capitalists. However, impact investors with longer investment horizons and a focus on impact creation have made equity investments in drip irrigation enterprises. Some of these investments include Series A funding by Khosla Impact in Dripteck in 2012,<sup>186</sup> and investment by IMNPACT Angels<sup>187</sup> in MyRain in 2014.<sup>188</sup> Similarly Acumen invested US\$500,000 in Micro Drip, an enterprise that provides affordable drip irrigation systems to smallholders in Pakistan.<sup>189</sup> Corporate CSR programs of companies connected with agriculture support drip irrigation for small holders through funding and technical support. For instance, Unilever, through its Knorr Partnership Fund, helps Indian farmers adopt drip irrigation.<sup>190</sup>

Given that this market is characterized by low margins, a large number of enterprises with asymmetric size of operations, and the need for significant and patient investment in market building, there is potential for consolidation through mergers and acquisitions. Dripteck, for instance, was acquired by Jain Irrigation in 2015-16 as a part of its strategy to consolidate operations in rural India and technology know-how for developing low cost efficient drip irrigation systems.

The market has been constrained by the financial capacity of farmers, who have to pay 30 to 40 percent of the cost even after they apply a subsidy. Banks are unwilling to offer them loans for drip irrigation even with crop buy back guarantees. MFIs prefer to provide loans that can be repaid in 12 months or less, while drip irrigation loans are needed for between 18 and 24 months, as the farmer begins to reap the benefits of higher productivity and higher earnings.<sup>191</sup>

184 A US\$250 million in Punjab and US\$187 million program in the Sindh province

185 David Shamah, "Netafim Gets \$500m for India, China Project Financing," Times of Israel (2015), accessed on February 12, 2017, <http://www.timesofisrael.com/netafim-gets-500m-for-india-china-project-financing/>

186 Press Release, "Dripteck, Inc. Closes Series A Funding from Khosla Impact," Dripteck (2012), accessed on February 12, 2017, [http://www.dripteck.com/downloads/A\\_Round\\_press\\_release\\_final.pdf](http://www.dripteck.com/downloads/A_Round_press_release_final.pdf)

187 An investor network affiliated with Gopher Angels

188 Katharine Grayson, "MyRain Startup Gets Backing from Angel Network for Social Entrepreneurs," Biz Journals (2015), accessed on February 12, 2017, <http://www.bizjournals.com/twincities/news/2015/05/27/myrain-imnpact-funding-drip-irrigation.html>

189 Micro Drip: Affordable Drip Irrigation for Farmers in Pakistan, accessed on February 12, 2017, <http://acumen.org/investment/micro-drip/>

190 "Conserving Water through Drip Irrigation, Working with Our Suppliers to Manage Water Use," Unilever, accessed on February 12, 2017, <https://www.unilever.com/sustainable-living/the-sustainable-living-plan/reducing-environmental-impact/water-use/using-water-wisely-in-agriculture/working-with-our-suppliers-to-manage-water-use/>

191 "Drip Irrigation Technologies: Lessons Learned when Working with Smallholders," Fintrac (2016), accessed on February 12, 2017, [https://www.fintrac.com/sites/default/files/DripIrrigationBrief\\_Fintrac.pdf](https://www.fintrac.com/sites/default/files/DripIrrigationBrief_Fintrac.pdf)



## Policy and Regulations

Provision of subsidy or government benefits is linked to the quality of raw materials used in the drip irrigation unit. Low-cost suppliers use thinner plastic (low micron) that are less expensive and have a shorter life. They believe that small farmers do not need and cannot afford systems that last 10 to 15 years at a significantly higher cost, and fear that the subsidy system will not support their frugal innovations to develop low cost solutions.

This subsector has significant potential in developing countries where a sizable portion of smallholder farmers cultivate cash crops. The technology is easily replicable, although uptake would depend on improved awareness about efficient irrigation practices resulting in increased readiness of farmers to change their traditional irrigation practices. Countries facing water scarcity and cultures that are open to experimentation and innovation are ideal for drip irrigation forays. While rain-fed India and China have been early adopters of this technology, pilot studies in Africa indicate there is considerable interest in the region too.

Smaller enterprises such as Dear Auto and Micro Drops have opted for trade partnerships and export drip kits and components to other countries. Acumen investee GEWP transferred knowledge to support the setting up of Micro Drip in Pakistan.<sup>194</sup> Some Indian enterprises plan to expand within the country to other states where the local governments are more supportive and prompt in subsidy payment.

194 GWEP: Providing affordable drip irrigation to smallholder farmers, ACUMEN.ORG

Many large enterprises that have scaled out, such as Jain Irrigation and Netafim, offer an array of irrigation products and other agriculture services. This allows them to cross subsidize and focus on high margin products within their portfolio. However, enterprises that exclusively focus on drip irrigation systems may struggle to scale because of high costs, low margins, and greater need for customer education. This indicates that enterprises in the drip irrigation market may have to expand their product portfolio or diversify into related business segments to expand operations quickly.

### 6. Comparison of Business Models

Both the subsidy and upfront sales models require enterprises to invest in technology, research for efficiency and quality improvements, and outreach activities. While the subsidy model provides direct financial support to customers through reduced prices for the product, the upfront sales model transfers this to other financial services companies or to dealers and distributors. Enterprises are also experimenting with patronage models that can provide farmers the option to pay in installments, and thus avoid debt.

The upfront sales model is likely to scale better in regions with a well-developed financial ecosystem of banks and financial intermediaries. Studies have found that farmers rarely opt for drip irrigation of their own volition until they are specifically educated regarding its benefits.<sup>195</sup> Government agencies and donors can play a key role in creating this awareness. The upfront model has also scaled in developing African economies like Kenya and Ghana, where enterprises have established partnerships with donors and financial institutions to increase farmers' access to finance. For instance, Dizengoff Ghana recently partnered with the German development agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and a local bank to provide financial facilities as well as training and field services for small-scale farmers.<sup>196</sup>

Although the subsidy model is highly dependent on favorable government policies, subsidies remain an important driver for the uptake of drip irrigation systems among small holder farmers. The model enables farmers to access the product initially, but does not support operations or maintenance. Existing donor funding and government subsidies have served to build the case for drip irrigation by demonstration. While enterprises in this subsector aim to be independent and financially sustainable, they recognize the need for support in market building while they continue to invest in R&D to reduce prices.

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<sup>195</sup> Intelcap primary interviews with key stakeholders

<sup>196</sup> Intelcap primary interviews with key stakeholders





### Table 4. Comparison of Business Models in Drip Irrigation

Subsidy Model		Upfront Sales Model
Internal Factors		
Customer Engagement	Both develop their own marketing channels or enter into strategic tie-ups with local partners	
Operations	Investment in internal finance and recovery teams	Investment in innovative technologies and development of internal R&D teams
Unit Economics	Cost of materials is a major component accounting for 50%-60% of the total cost	
Financial Strategy	Enterprises are mainly supported by government and donors; no financing options offered by enterprise to its customers	Large enterprises borrow funds from banks or through cross subsidization within the group; some enterprises offer customized financial solutions to farmers
External Factors		
Market Context	Enterprises provide technical assistance on drip irrigation and other extension services, and build the market with the help of local NGOs	
Financing Ecosystem	Impact investors with longer investment horizons have invested in some enterprises	Commercial capital providers disburse loans to enterprises with strong balance sheets and large number of customers
Policy and Regulations	A few countries/ local governments do not allow international enterprises to avail benefits	Relaxed mandates and regulations across the business model

## 7. Looking Ahead

Supportive policies, subsidies, and awareness creation will continue to drive opportunities for scale for drip irrigation enterprises. Consumer finance is a challenge since commercial capital providers consider drip irrigation as a highly depreciating asset class and do not favor lending for its acquisition. Product innovations such as lowering the cost of material to reduce the drip irrigation kit price can significantly support scaling of the drip irrigation subsector. Enhancing product portfolio with integration of solar pumps and drip irrigation systems offer improved efficiency and better opportunities for farmers to take advantage of multiple government benefits and subsidies. Likewise, adopting innovative payment mechanisms such as pay-as-you-go and revenue sharing, and including formats such as contract farming are some other financing strategies that could promote scaling of the subsector.



# Case Study: Online Platforms for Waste Management

## 1. Online Platforms for Waste Management Market Description

Online platforms for waste management (OWM) enterprises work with waste generators, waste collectors, and waste recyclers to collect or facilitate the collection of solid waste, primarily from urban households, institutions and corporations. OWM enterprises aggregate waste from different sources and sell it to recyclers or conduct recycling themselves.

OWM enterprises mostly collect high value recyclable waste such as paper, plastic, and metals; organic solid waste that could be converted to bio compost or bioenergy; and electronic waste (e-waste) such as mobiles and computers that could be either refurbished or recycled. The enterprises offer on-demand, professional and doorstep solutions to collect recyclable waste, which appeals to waste generators such as large residential complexes and businesses based in urban areas.

Figure 32. Key Service Categories in the OWM Market

	Waste Collection and Value Addition	Marketplace for Stakeholders in Waste-Management
 <b>Platform Users (Typical)</b>	Urban households, collection agents/partners, downstream customers	Urban households, bulk waste generators, recycling enterprises
<b>Typical Cost Heads</b>	Transportation and logistics along with human resource for collection of waste	Development of platform, management of partners and outreach
<b>Enterprise Examples</b>	Waste Masters, Uganda Karma Recycling, India Binbag, India	I-Got-Garbage, India Paperman, India My Waste, South Africa



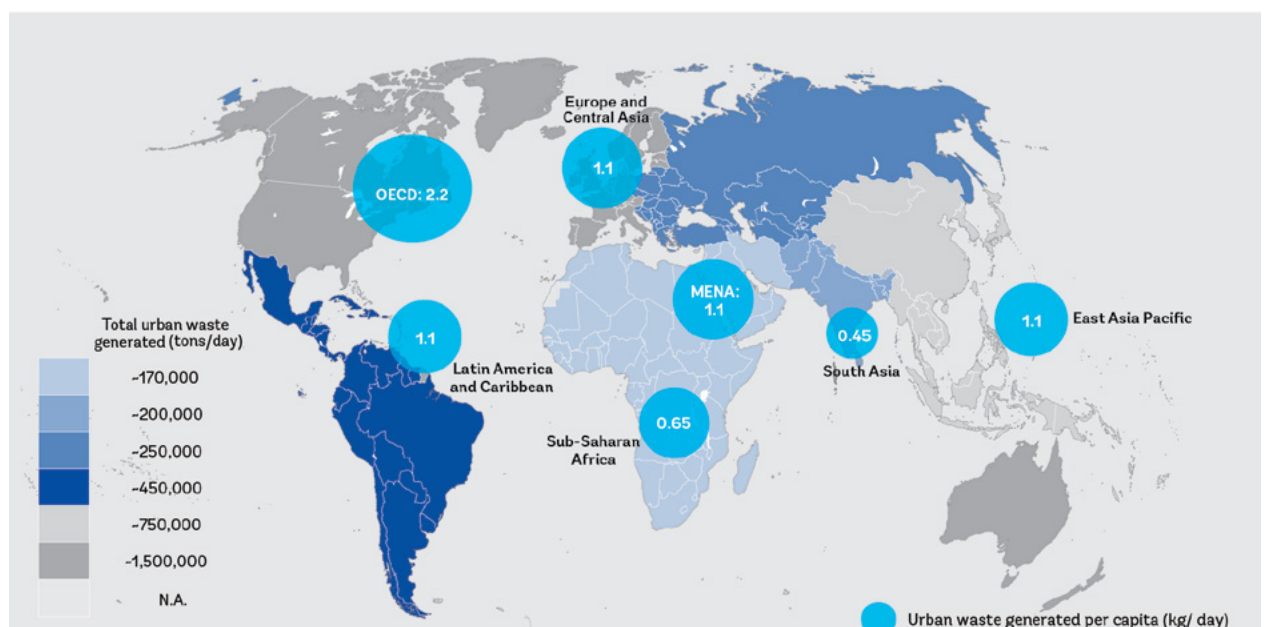
This research analyzed 14 OWM enterprises<sup>197</sup> operating across Asia and Africa. Some enterprises such as Binbag in India and Taka Taka Solutions in Kenya collect, sort, grade and recycle all types of solid waste. Other enterprises such as Waste Takers in South Africa and Waste Masters in Uganda only facilitate collection of waste and are largely active within one city or urban area limit.

## 2. Global Market for Online Platforms for Waste Management

The global solid waste management market was valued at US\$ 180 billion in 2015 and is estimated to exceed US\$300 billion by 2023, growing at a CAGR of over 8.5 percent.<sup>198</sup> Most of this market is addressed by large municipal corporations (often owned by the government in developing countries) in partnership with local small and medium enterprises that focus on collection and landfilling of waste in specified areas. Government-provided solutions are unable to address the increasing amount of waste generated by urban centers, particularly plastic waste and e-waste. Private sector waste management enterprises have emerged in response to the huge waste management challenge in urban centers across developing countries.

OWM enterprises are likely to see high growth in densely populated and information and communication technologies (ICT)-connected urban areas, in countries such as India, Brazil, Nigeria, and South Africa, where waste generators such as households and corporates can conveniently use the internet to effectively dispose of waste.<sup>199</sup>

Figure 33. Global Solid Waste Generation



Source: Intelicap analysis based on primary interview, World Bank Group Data on Municipal Solid Waste Generation

197 The research team interviewed RaddiConnect (India), Binbag (India), I Got Garbage (India), Paperman (India), Waste Masters (Uganda), My Waste (South Africa), Taka Taka Solutions (Kenya), Waste Takers (South Africa), and E-Incarnation (India). Information from secondary sources was obtained on Karma Recycling (India), Daily Dump (India), EnCashea (India), Waste Ventures (India), and Wecyclers (Nigeria).

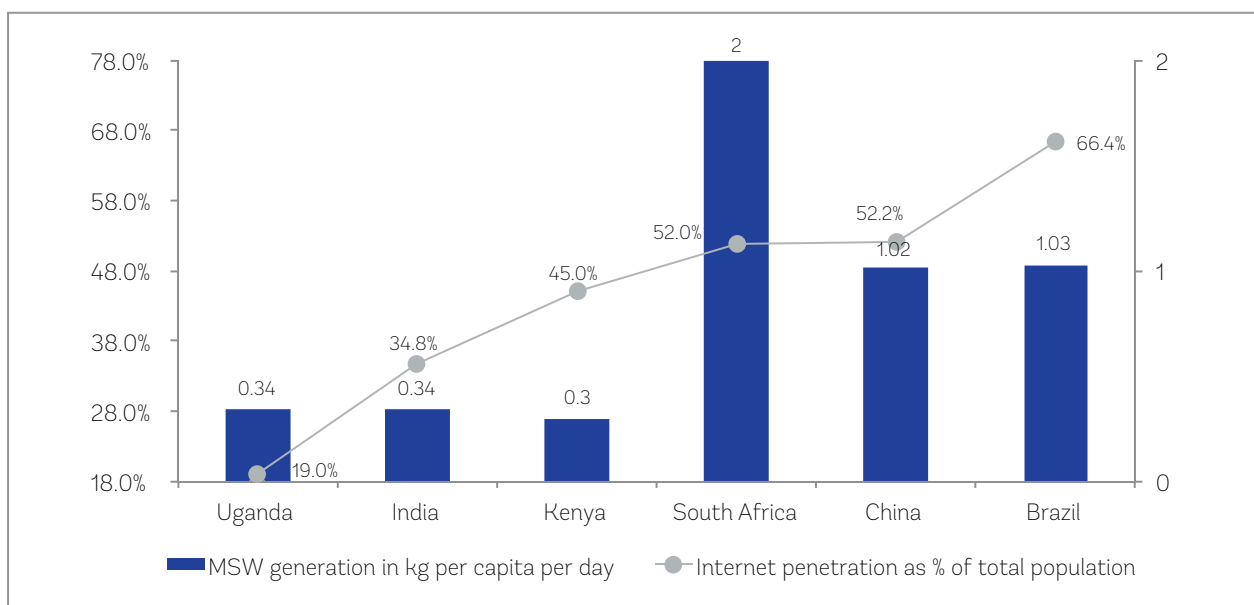
198 <https://www.gminsights.com/industry-analysis/solid-waste-management-market>

199 <http://www.marketsandmarkets.com/PressReleases/smart-waste-management.asp>

### 3. Key Drivers and Challenges for the Online Platforms for Waste Management Market

Urban consumers seek convenience and minimal effort when disposing waste. OWM enterprises therefore have to build awareness about the importance of recycling and offer convenient solutions such as door-step, on-demand services for consumers to dispose waste. ICT-supported convenience-at-a-click solutions can potentially reach more people quickly and allow for incremental sales at lower costs than physical outreach solutions. OWM enterprises develop and manage online platforms and web-based analytics to provide real-time information that connect waste generators (households and businesses) with recyclers and refurbishing enterprises.

**Figure 34. Internet Penetration and Municipal Solid Waste Generated in Select Countries**



Source: Internet Live Stats, 2016, World Bank Group MSW Generation Data



### 4. Mapping of Online Platforms for Waste Management Enterprises into Business Models

OWM involves waste collection and selling the waste to recyclers. While there are many private sector enterprises in the broader waste management market, online solutions are relatively new. Catering to different market requirements and types of waste, OWM enterprises typically follow one of two business models<sup>200</sup>:

- 1. Inventory model:** Enterprises use online media to conduct outreach and awareness building exercises for waste generators, schedule waste collection, and make or collect payments. They also physically collect the waste from waste generators. For 'valuable' waste such as newspapers, glass bottles, and cardboards, OWM enterprises pay the waste generators. For mixed waste, OWM enterprises collect payments from waste generators. The enterprises either supply the waste to recyclers or recycle the waste themselves.
- 2. Marketplace model:** Enterprises maintain an online platform, aggregate requests from waste generators and pass these on to waste collectors without physically collecting any waste themselves. Waste collectors/agents (rag pickers, local scrap dealers, NGOs) are informed about the request for waste collection and are supported with bulk orders. The enterprises earn a commission from waste generators for services at the doorstep and from waste collectors for aggregating demand from households.

In an emerging model, enterprises share benefits derived from the recycled waste with the waste generator through credits instead of paying for it upfront. This model is being tested in The Hague.

### 5. Scalability Analysis of the Marketplace Business Model

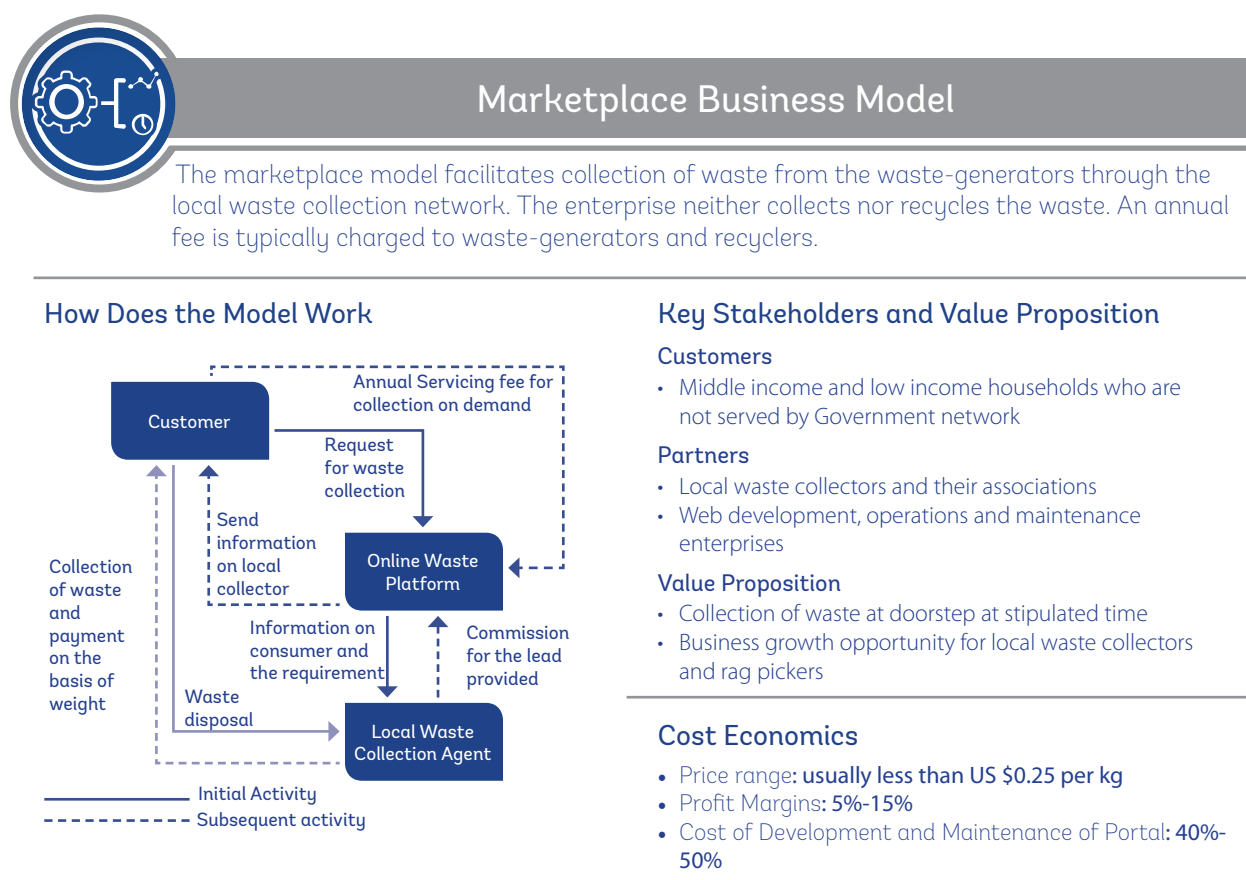
Marketplace OWM enterprises connect the waste generators with local networks of waste pickers. They do not collect or recycle the waste. This model is easy to establish as it requires low investment in physical infrastructure. Examples of marketplace OWM enterprises are I-Got-Garbage (India), Paperman (India) and My Waste (South Africa).

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<sup>200</sup> For OWM subsector, the payment versus ownership model does not apply fully as the green enterprises across business models provide services, not products, to end customers.



Figure 36. Marketplace Business Model in OWM market



## 5.1 Internal Factors

### Customer Engagement

Waste collection is dependent on local scrap dealers who may or may not be reliable. Customers associate the entire service experience with the marketplace OWM enterprises and delays in collection discourage them from calling for the service again. India-based Paperman had to scale down its partnership with 270 local scrap dealers in 2014 to 30 in 2016 because of poor service quality.

Marketplace OWM enterprises build the ecosystem for waste collection and collaborate with government agencies to ensure that sustainable waste management practices percolate down to the waste generators. Some enterprises, such as I-Got-Garbage, share impact reports and scorecards with their subscribers to motivate them to contribute towards environmental sustainability and encourage repeat engagements. The enterprise coordinates with 12 social enterprises, five municipal bodies, and several central and state government entities under the 'Zero Waste Mission' campaign. It has also committed over 8,000 waste-pickers onto the platform and enables them to have self-sustaining microbusiness models.<sup>201</sup> Paperman allows citizens to

<sup>201</sup> Intellectcap primary interviews with stakeholders

donate their trash to NGOs of their choice through the platform and charges a commission from the NGOs to build strong brand associations and raise funds for its waste management efforts. Such institutional partnerships are critical for enterprises to reach more customers and scale up operations.

### Operations

Waste collection is an informal market, especially in Asia and Africa, and marketplace enterprises invest considerable time and effort in coordinating with local waste collectors to ensure that the process is efficiently carried out and its value is reported correctly. As the organization expands, it becomes difficult to track every waste collector.

Enterprises also need a dedicated team to creatively educate both waste generators and waste collectors, and develop unique value propositions to garner support from CSR initiatives. For example, South Africa-based My Waste works with corporate partners to display its logo on their products and add customized widgets that guide users to the closest drop-off points and buy-back centers. It also facilitates connections between waste collectors, emerging small businesses, recycling facilities, SMEs, and others involved in sustainability and waste management that can register their services at no charge.<sup>202</sup> The marketplace model needs to reach a minimum scale<sup>203</sup> for it to be operationally attractive for partner waste collectors. Consequently, enterprises have to invest in significant upfront effort, often involving behavior change among consumers.

### Unit Economics

Marketplace OWM enterprises mainly incur costs on human resources (50 percent) and ICT platform development and maintenance (40 percent). These enterprises earn thin margins, usually in the range of 5 to 15 percent, and therefore require a large customer base to achieve economies of scale and sustainability. To do so, they strive to build their brand image, corporate partnerships, and expand operations to multiple locations. The enterprises also help their partners achieve profitability by benchmarking revenues and costs for a given geographic or operational unit.

### Financial Strategy

Although the marketplace model is less capital intensive, enterprises need capital to scale operations to other cities as well as working capital to manage the platform before revenues start flowing in. Given the inherently asset light nature of the model, it is unattractive for long-term debt financing. Also, the nascent nature of the marketplace model offers limited proof of concept for private equity and venture capital (PE/VC) investors.

Only a few marketplace OWM enterprises have attracted commercial investments. Most are bootstrapping or supported by grants from philanthropic foundations and corporate social responsibility (CSR) funds until they demonstrate financial sustainability. For example, South Africa-based My Waste received grant support from POLYCO to enhance its website and become an education and consumer awareness platform on material identification, drop-off locations, green product directories and green calendar events.<sup>204</sup>

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202 Intelcap primary interviews with stakeholders

203 Ranging from a few hundred to a few thousand households, depending on operational intricacies and modalities

204 Polycos is a not-for-profit industry body established in 2011 that focuses on reducing the amount of polyolefin waste going to landfills. <http://polyco-api-test.pl-dev.co.za/2016/08/24/mywaste/>

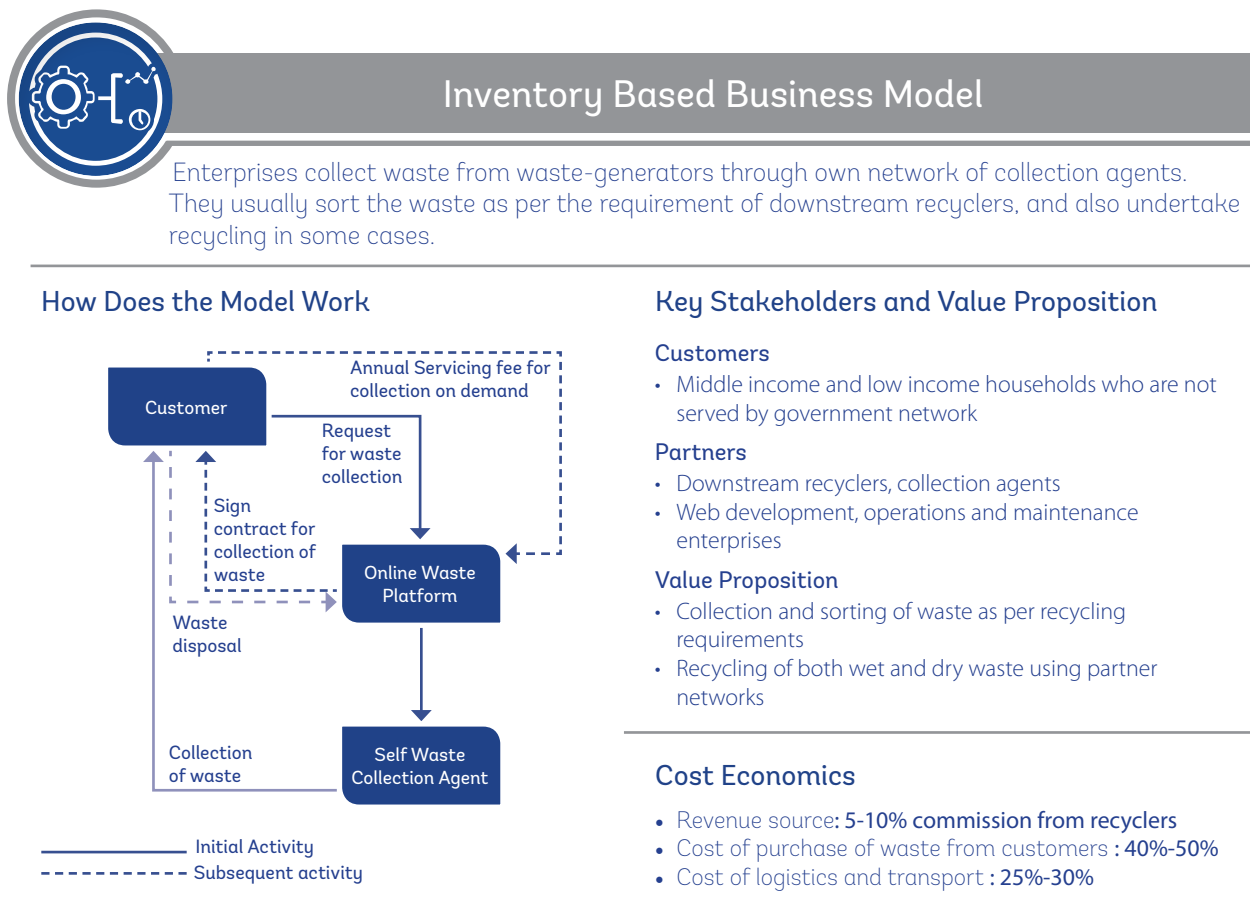




## 6. Scalability Analysis of the Inventory Based Model

The inventory model emerged as enterprises sought to address the waste collection needs of customers and generate revenues from recycling the waste. It also saw an opportunity for entry where waste generators were dissatisfied with informal agents who often used improper weighing mechanisms for valuable waste such as paper or metal. Inventory OWM enterprises deploy their own or outsourced staff and facilities for collecting, sorting, grading, and recycling waste. Examples of enterprises following this model are Binbag (India), Waste Masters (Uganda), Taka Taka Solutions (Kenya), and Karma Recycling (India).

Figure 37. Inventory-Based Business Model in OWM Market





## 6.1 Internal Factors

### Customer Engagement

Inventory OWM enterprises seek to collect large volumes and a variety of waste (e-waste, plastics and metals). This is necessary as high value waste such as metals are found in small quantities and are economically inefficient to extract at lower volumes. These enterprises tap into a variety of waste generator segments such as households, schools, colleges, and community centers to collect waste. Businesses and multinational corporations are also important sources of waste.

Inventory OWM enterprises usually provide rapid response waste collection services. Karma Recycling of India, for instance, schedules pickup of unused mobile phones within hours of negotiating a price with the seller.<sup>206</sup> For its regular waste collection services subscription customers, it provides bags to store the waste and routinely collects them on a weekly or fortnightly basis. Enterprises also use innovative methods to efficiently source and collect waste: for example, Taka Taka Solutions has a mobile phone application that allows people to report unattended garbage in the area.<sup>207</sup>

### Operations

The model requires investment in backend support for online engagement such as communication and analytics software and staff, significant manpower for waste collection and investment in logistics. Most enterprises collect only dry waste, although some also collect wet waste for composting. For example, Binbag collects dry waste and supports consumers in managing wet waste at source with the help of its partner, Daily Dump.<sup>208</sup> The inventory model allows enterprises to control the operational process, ensure quality, and retain margins. This has prompted many OWM enterprises such as Taka Taka Solutions in Kenya and Paperman in India to move away from the marketplace model to the inventory model.

### Unit Economics

Inventory OWM enterprises incur logistics and transportation costs (40 percent to 50 percent) and human resource costs for collection of waste (30 percent to 40 percent). The online format allows them to minimize waste acquisition costs. Cost optimization could be achieved through higher automation in sorting and grading of waste. For instance, in India, waste sorting and grading plants with manual services incur nearly 50 percent higher operational expenditure than centers with trolleys and machines for the same tasks.

Inventory OWM enterprises that undertake recycling incur high initial capital expenditure for a recycling plant, ranging from US\$10,000 to US\$1 million depending on its capacity. Enterprises such as Binbag also factor in the inventory holding cost, since it can take anywhere from two days to two months before paper waste is sent to recyclers, which increases their working capital requirements. High working capital requirements coupled with thin margins make

206 Karma Recycling Help Center. Accessed on May 2017. <http://www.karmarecycling.in/faq.php>

207 "New Global Startups Taking the Stage at AngelHack's Global Demo Day!" AngelHack. Accessed May 2017. <http://angelhack.com/2016/10/25/14-new-global-startups-taking-the-stage-at-angelhacks-global-demo-day/>

208 "Daily Dump Helps Households Manage Waste and Converts It to Useful High-Quality Compost," <http://dailydump.org/>

it difficult for enterprises to break even. EnCashea, a Bangalore-based scrap collection and recycling startup, received seed funding from angel investors but shut down eventually as working capital requirements were hampering scalability.<sup>209</sup>

### Financial Strategy

Inventory OWM enterprises have high working capital needs due to inventory holding costs and a time lag between waste collection and revenue generation from the sales of (recycled) waste. Inventory OWM enterprises could potentially leverage their inventory to finance their capital requirements. Waste Ventures India is investigating the launch of a waste impact bond, leveraging tangible and measurable impacts such as job creation and reduced/recycled volume of waste.<sup>210</sup> In Nigeria, the government supported the private sector for collection of waste and its disposal by providing initial funding for purchase of trucks and operational expenditure for Lagos-based Wecyclers.<sup>211</sup>

## 6.2 External Factors

### Market Context

The market for urban waste management and collection is highly fragmented and enterprises need an efficient collection process to stay competitive. The market is also populated with informal waste collectors who avoid paying taxes and make higher margins. Although there are socially and environmentally aware urban waste generators who wish to dispose waste properly and safely, the generally low awareness about the importance of recycling is a major barrier for all waste management enterprises. Waste Takers shared that low receptivity to recycling of waste as well as willingness to pay for such activities is a major barrier to scale.

### Financing Ecosystem

Most inventory OWM enterprises are relatively new and there is limited evidence of ROI for investors. Debt providers such as banks require collateral, guarantees, and profitable balance sheets, which the inventory OWM enterprises find difficult to provide during the initial years. Moreover, the enterprises that have approached development banks or other financial institutions for soft loans or grants have no benchmark or precedence to demonstrate the sustainability of this business model.

Some countries such as Kenya have interest rate subsidies for waste collection and management, and provide subsidized loans to enterprises with collection trucks serving as collateral. Taka Taka Solutions manages its own recycling plant, and has received grants from DEG, which aims to support the enterprise in reaching break even and becoming a viable investment opportunity for impact investors.<sup>212</sup>

209 Binu Paul, "Kunal Shah-Backed Scrap Collector EnCashea Shuts Shop," Tech Circle, November 3, 2016, <http://techcircle.vccircle.com/2016/11/03/exclusive-kunal-shah-backed-scrap-collector-encashea-shuts-shop/>

210 Waste Capital Partners Sees Value in Impact Bonds and Franchising, April 2016

211 Intellect primary interviews with stakeholders

212 "Financing Opportunities in East Africa," Report on a workshop organized by the German Business Association (GBA) and the Delegation of German Industry and Commerce in Kenya. Accessed May 2017. [http://www.kenia.ahk.de/uploads/media/2015-09-17\\_FinancingOpportunitiesinEastAfrica\\_GBA\\_Workshop-update.pdf](http://www.kenia.ahk.de/uploads/media/2015-09-17_FinancingOpportunitiesinEastAfrica_GBA_Workshop-update.pdf)



There is growing investor interest in the online waste management market especially from early stage capital providers such as angel and seed funds, and VC firms. Waste Masters in Uganda has raised angel funding from European investors to strengthen its operations and offer quick turnaround services for waste collection.<sup>213</sup> Similarly, Greentooth Technologies, which operates the online platform ExtraCarbon, raised US\$225,000 in a round led by Brand Capital.<sup>214</sup> A few established players such as Karma Recycling (Infuse Ventures, a VC fund) and Attero Recycling (Forum Synergies, a PE fund) have been able to raise Round C funding from a series of mainstream investors.<sup>215</sup>

### Policy and Regulations

The market has low barriers to entry as the government needs private players for waste collection and management. While enterprises may need licenses to operate, the processes and requirements in most countries are not very stringent. In India, enterprises need permission from the Pollution Control Board for waste collection. Some countries, such as Uganda, have stricter procedures, where enterprises need to own personal trucks and must have trained staff for waste collection before they can apply for a license. The cost of one truck is approximately US\$15,000 in Uganda, which is a sizable investment for startups.

## 6.3 Scaling Out

The OWM subsector is relatively new and most enterprises are in seed or very early stage of development. These enterprises aspire to scale out to geographies with high urban populations, access to internet, and rising awareness on sustainable practices of waste management, such as Bengaluru, Colombo, Jakarta, Lagos, and Nairobi. However, the capital intensity of inventory OWM enterprises remains a challenge for enterprises to secure funding and expand its businesses.

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213 Intellect primary interviews with stakeholders



214 <http://techcircle.vccircle.com/2016/08/03/exclusive-bccls-brand-capital-bets-225k-on-online-waste-management-startup-extracarbon/> Accessed May 2017

215 Waste Management Start-Up ExtraCarbon To Raise \$225K from Brand Capital, Others. VC Circle. August 3, 2016. <http://www.vccircle.com/news/urban-infra/2016/08/03/exclusive-waste-management-startup-extracarbon-raise-225k-brand-capital>

## 7. Comparison of Business Models in Online Platforms for Waste Management

Both the marketplace and inventory models aim to increase awareness for waste collection and its sustainable management and depend on regulatory support and compliance norms for uptake. The marketplace model has a higher dependency on local waste collectors, which hinders its ability to scale given that waste collection is a highly unregulated market in nearly all developing countries. The inventory model allows enterprises to build a hybrid online-offline model and control the collection process. Enterprises in the inventory model, however, have to bear higher upfront capital costs as well as operational expenditures in logistics, human resources, and buyback of recyclable products. While this model ensures that waste is recycled, and disposed of in a sustainable manner, these additional costs can impact profitability.

Table 9. Comparison of Business Models in Online Platforms for Waste Management

	Marketplace Model	Inventory Model
 <b>Internal Factors</b>		
<b>Customer Engagement</b>	Standard operating procedures for partners to build awareness among citizens	Continuous engagement with citizens to convey environmental impact created
<b>Operations</b>	Continuous expansion of network of partners	Collection, sorting, grading as well as recycling of waste in some cases undertaken
<b>Unit Economics</b>	Low upfront investment (mostly ICT development)	Low upfront investment (mostly ICT development)
<b>Financial Strategy</b>	Subscription fees for waste collection and commission from partners for supplying in bulk	Subscription fees for waste collection and commission from partners for supplying in bulk
 <b>External Factors</b>		
<b>Market Context</b>	Market driven by partnerships with municipal bodies and NGOs to create awareness and co-opt informal waste collectors to add value to their lives	
<b>Financing Ecosystem</b>	Dominated by donors due to unproven commercial success	Active interest from impact investors due to higher ability to scale
<b>Policy and Regulations</b>	Active interest from impact investors due to higher ability to scale	



## 8. Looking Ahead

OWM enterprises have potential to take advantage of the increase in urban population with access to internet, favorable policies and regulations, and promotion of formal channels for collection and treatment of municipal waste. Enterprises with a strong online presence and established technology platforms could expand rapidly to cover additional cities if they can establish a strong network of waste pickers and recyclers.

Given that most enterprises in the OWM segment are in the early stages of development and still determining their best operating model, mainstream investors could consider demanding risk guarantee mechanisms for their investments. Non-traditional financial products such as program-related investments (PRIs),<sup>216</sup> impact bonds, credits for waste generators could be investigated. Donor and grant support could be utilized to enable these enterprises build their operations incrementally and establish proof of concept for scaling.

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<sup>216</sup> Program-related investments (PRIs) are investments made by foundations to support charitable activities that involve the potential return of capital within an established time frame



# Case Study: E-Waste Management

## 1. E-Waste Management Market Description

As sales of electronic devices have risen globally, safe disposal after their useful life has emerged as a significant challenge. The e-waste management (EWM) market involves dismantling and recycling, or refurbishing and reuse, of electronic products ranging from large equipment such as dishwashers, ovens and refrigerators to small equipment and information technology (IT) gadgets such as mobile phones, computers, TVs and lamps.

Figure 38. Key Product Categories in the EWM Market

	Recycled Material from Dismantled E-Waste		Refurbished Devices
	Products (Typical)	Recycled plastic pellets and metals ingots to be used as raw materials by SMEs	Refurbished, customer-ready devices for individuals or businesses
Outreach Strategy (Typical)	Partnerships with scrap collectors and long-term contracts with customers		Recover e-waste directly from users and sell through own or partner networks
Major Cost Components	Collection logistics, labor, infrastructure		Collection and distribution logistics, labor
Enterprise Examples	E-Parisara, India Descarte Certo, Brazil Desco, South Africa		Reboot, India Attero, India Device SA, South Africa



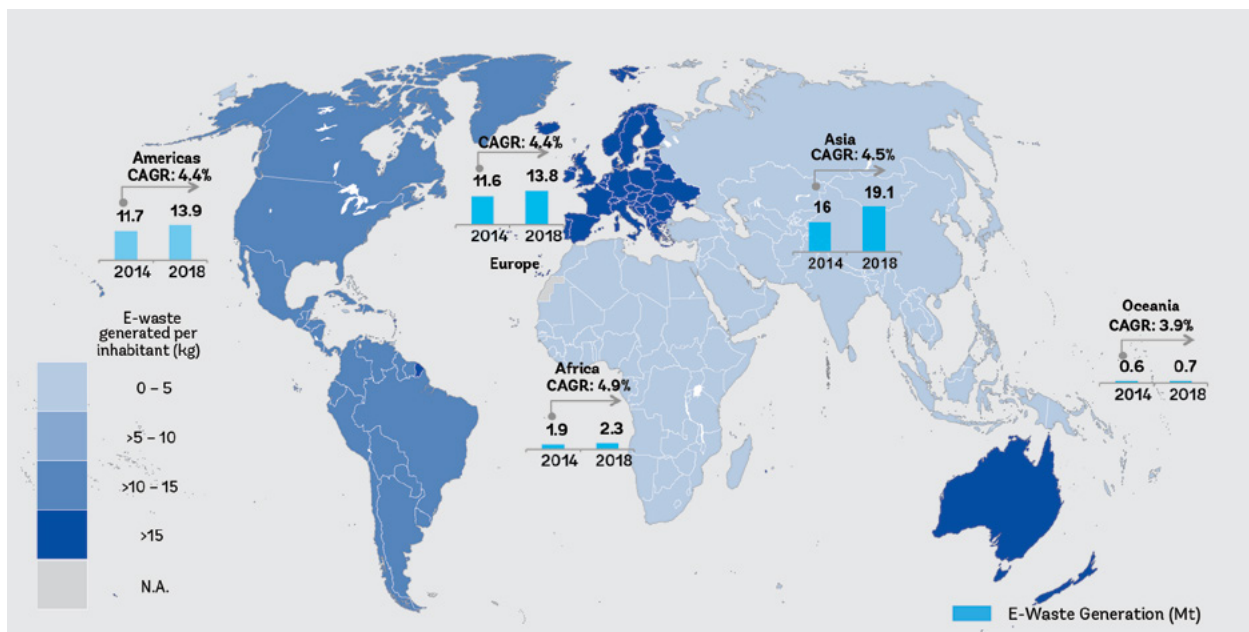
This research analyzed 15 EWM enterprises operating across developing countries in Asia, Africa and Latin America.<sup>220</sup> The selection of enterprises was based on representation across key developing countries and operations along the value chain from collection and dismantling to recycling and refurbishment of e-waste to understand specific opportunities and challenges facing the subsector.

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## 2. Global Market for E-Waste Management

Globally, 42 million metric tons (Mt) of e-waste were generated in 2014, and the amount is expected to increase to nearly 50 Mt by 2018, primarily due to increasing demand and consumption of consumer electronics in developing countries such as China and India.<sup>221</sup> For example, in China, the number of used and discarded television sets is expected to grow from 50 million units in 2010 to 137 million units by 2020.<sup>222</sup> Due to the high cost of treating or recycling e-waste in developed countries, it is often exported to large scale e-waste recycling operations in India, China, the Philippines, Nigeria, Pakistan, Thailand, Bangladesh, Indonesia, Kenya, Tanzania, South Africa and Ghana, often through illegal channels.<sup>223</sup> Recyclers in these countries process both domestic and imported e-waste.

Figure 39. Global E-Waste Generation<sup>224</sup>



221 Study on Indian electronics and consumer durables segment, Ernst & Young, 2015

222 "The State of Play on Extended Producer Responsibility (EPR): Opportunities and Challenges," OECD, 2014

223 For instance, it is estimated that 10 to 30% of the e-waste generated in the EU is exported. Source: "Countering WEEE Illegal Trade (CWIT)," primary inputs

224 United Nations University



### 3. Key Drivers and Challenges for the E-Waste Management Market

The EWM market is driven by three key factors: (i) increasing amount of e-waste that requires responsible disposal or treatment; (ii) policy drivers such as Extended Producer Responsibility (EPR) where manufacturers, not the consumer or government, take responsibility for the environmentally safe management of their product when it is no longer useful or discarded; and (iii) growing markets for high value material recovered from e-waste, and for refurbished devices, especially laptops and mobile phones.

Original equipment manufacturers (OEM) work with EWM enterprises to comply with EPR guidelines that mandate recycling of devices after their useful life. However, such policy mandates are not uniformly enforced in developing countries. End users are often unaware of proper channels to dispose their e-waste, and often store electronic items beyond their useful life. For instance, according to estimates, over 40 percent of unused mobile phones remain stored with end-users.<sup>225</sup> Additionally, EWM enterprises share that e-waste is often mixed with other waste and they must pay the polluter for procuring e-waste, which increases collection and sorting costs in developing countries. While less than 20 percent of e-waste is managed by formal e-waste enterprises and official take-back systems, over 80 percent is either stored by the user or managed informally, using harmful methods such as open-air burning or incineration, which cause significant damage to the environment as well as human health.<sup>226</sup>

225 Alex Scott, "Dialing Back on Cell Phone Waste," Chemical and Engineering News, Vol. 92 Issue 35, 2014, <http://cen.acs.org/articles/92/i35/Dialing-Back-Cell-Phone-Waste.html>

226 For instance, residents of Guiyu, China, once considered the largest e-waste recycling site in the world exhibit substantial digestive, neurological, respiratory, and bone problems.

Figure 40. Key Drivers and Challenges for the EWM Market





#### 4. Mapping of E-Waste Management Enterprises into Business Models

Enterprises across these categories follow the upfront sales model selling recycled materials and metals or refurbished electronic devices for a flat fee.<sup>227</sup>

- 1. Dismantling and recycling:** Dismantling of e-waste involves removal of components followed by manual or mechanical separation (by shredding, breaking or sequential sorting). The recovered material is recycled to manufacture raw plastic pellets or metal ingots through mechanized or semi-mechanized processes. Recycling is done either in-house or through recycling partners that specialize in handling certain kinds of materials. EWM enterprises procure e-waste by paying an upfront price per unit weight.
- 2. Refurbishment:** Enterprises repair and test used devices to extend their life and make them usable. They recover discarded electronic devices directly from end-users against an upfront payment either through a self-owned network of collection agents or through e-commerce marketplaces and brick-and-mortar stores. In some cases, enterprises charge a fee for collecting the e-waste, following the polluters pay principle. The devices are repaired and remodeled to be sold at affordable prices through dedicated e-commerce platforms or partner networks of retail and wholesale dealers.

E-Parisaraa, an India-based authorized recycler of e-waste, offers collection, handling, and recycling, as well as partial refurbishment services.<sup>228</sup> Similarly, South Africa-based Tshwane Electronic Waste Company offers both recycling and refurbishment services. It segregates waste that can be refurbished and sends the rest to its recycling plant where it is dismantled and processed. All EWM enterprises either directly collect e-waste, or procure it from waste pickers and scrap dealers.

#### 5. Scalability Analysis of E-Waste Management Enterprises

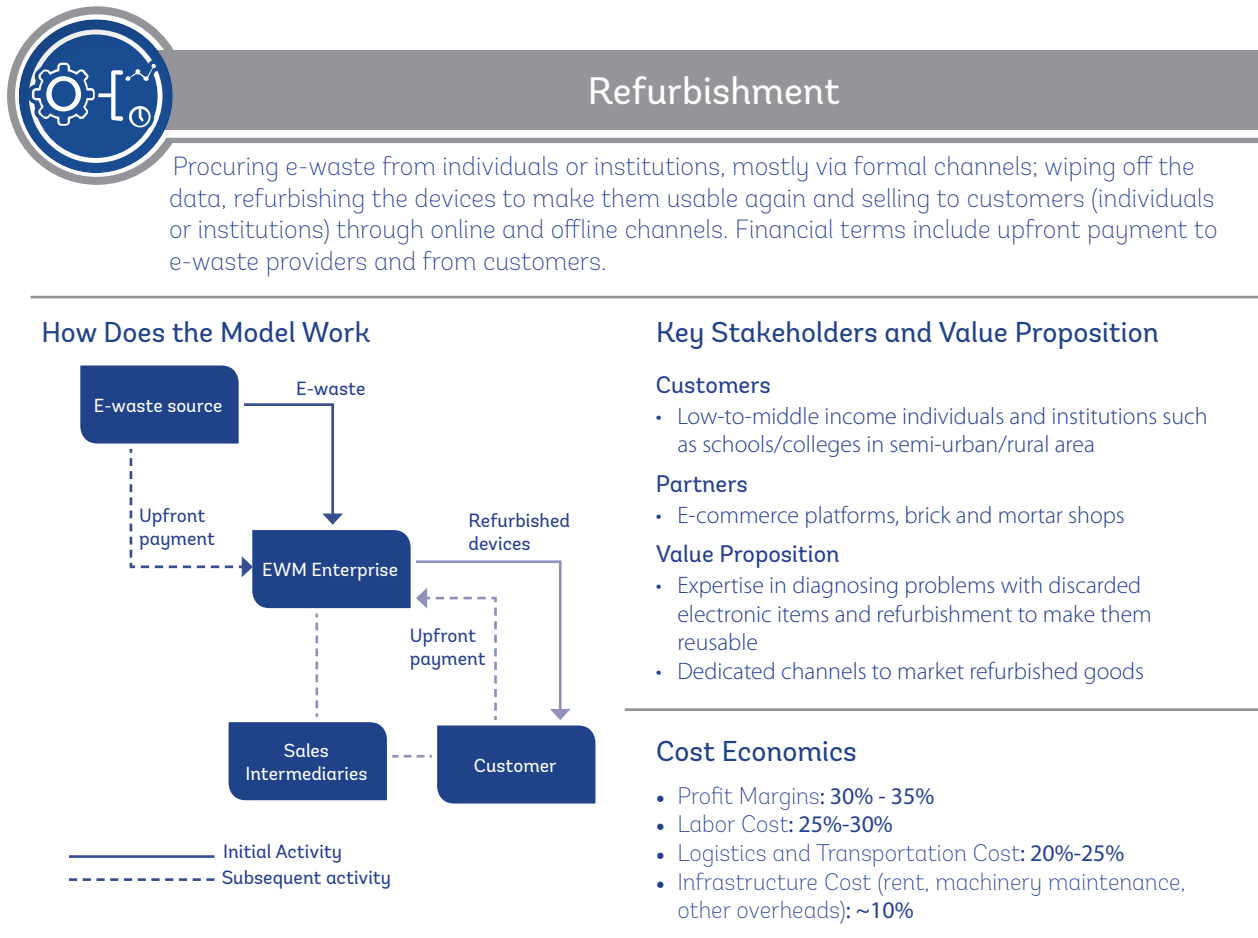
Given the similar payment and ownership models deployed by dismantling and recycling and refurbishment enterprises, this note analyzes scalability for the entire subsector. It draws out key differences between the two activities in areas where scalability can be impacted differently.

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227 For EWM subsector, the payment versus ownership model does not apply fully as the green enterprises across business models provide services, not products, to end customers

228 Devices are only partly refurbished and passed on to specialist refurbishers to make them client-ready

Figure 41. Business Models in EWM Market



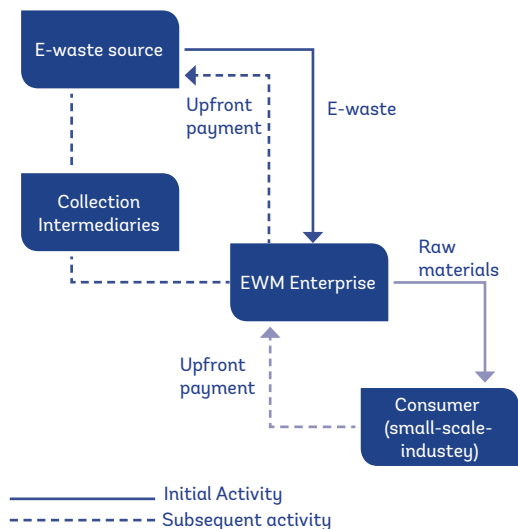




## Dismantling and Recycling

Procuring e-waste from individuals or institutions via formal and informal channels; and dismantling it into its components – plastics, metals and toxics. – to sell as raw material to downstream small industries. Financial terms include upfront payment to e-waste providers and long term payment contracts with downstream customers.

### How Does the Model Work



### Key Stakeholders and Value Proposition

#### Customers

- Small and medium industries that use raw material for manufacture of small household or office products, pipes, automotive components, medical equipment, kitchen appliances and toys

#### Partners

- Waste-picker collectives, scrap dealers for sourcing e-waste

#### Value Proposition

- Expertise in separating out e-waste components

### Cost Economics

- Profit Margins: **10% - 15%**
- Labor Cost: **40%-50%**
- Logistics and Transportation Cost: **20%-25%**
- Infrastructure Cost (rent, machinery maintenance, other overheads): **10-15%**

## 5.1 Internal Factors

### Customer Engagement

Enterprises engage directly with waste generators through social media and the internet, and with waste aggregators for international shipments to ensure that they have steady access to e-waste at low costs. Glean Eco Solutions uses its Facebook page and emails, while Tshwane Electronic Waste Company uses Twitter to inform waste generators about its collection drives and awareness programs. To highlight the positive environmental impact of EWM, South Africa-based Xperian promotes the concept through blogs and participates in conferences and events. Ecobraz based in Sao Paulo, Brazil depends on donations of e-waste from corporations, government associations as well as individuals, which reduces their operational expenses significantly.<sup>229</sup>

Dismantling and recycling enterprises cater to commodity traders and small manufacturing businesses that use recycled material, and typically enter long-term agreements with them. This allows them greater revenue visibility, and offers them opportunities to integrate across the waste management value chain. E-Parisaraa, for instance, is owned by Surface Chem

229 Ecobraz website: <http://www.lixeletronico.org.br/>

Finishers, which is engaged in surface treatment and gold plating.<sup>230</sup> It collects e-waste from major IT companies and passes the recovered metal to Surface Chem Finishers, which is assured of a steady supply of input materials. Other recovered material such as plastic and glass is sold to external customers.

Refurbishment enterprises address the growing demand for refurbished electronic products from middle-income customers. They benefit from the emergence of 're-commerce' portals, or online platforms such as India-based Atterobay and GadgetsShopi, which facilitate secondary sales of devices. ReGlobe<sup>231</sup> operates an online platform that facilitates sales of used devices, and has developed partnerships with original equipment manufacturers (OEMs)<sup>232</sup> such as Apple, Samsung and Microsoft, as well as with e-commerce platforms such as eBay and Shopclues, to make refurbished devices available to customers in India.

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### Box 14 Strategic Partnership and Low-Cost Proprietary Technology for Expansion: Attero Recycling

Attero, an integrated electronic asset management company, began operations in India in 2008 and has scaled out with processing centers in Mexico and Ireland. As a part of its geographical expansion strategy, Attero has recently partnered with Bee'ah, an environment and waste management company headquartered in the Emirate of Sharjah, to establish e-waste facilities in United Arab Emirates (UAE). As a part of the project, Attero will replicate its low cost recycling technology in the region.

Attero's success in rapidly expanding its operations is due to its strategic partnership for collection of e-waste from large companies such as Google, Wipro, Pepsi, LG

and Visa India. Moreover, Attero's proprietary technology allows it to recycle different types of e-waste in small recycling centers that can be established at costs as low as US\$1,500 to US\$2,000 per ton compared to capital costs of US\$10,000 per ton seen in more mature markets.

Attero has attracted several marquee investors, including IndoUS Venture Partners and Draper Fisher Jurvetson. In 2013, the enterprise raised US\$16.5 million in the third round of funding for its international expansion, as well as to enhance recycling technology and strengthen the collection process.

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### Operations

Procurement efficiency to ensure dependable supply of e-waste is critical for the operational sustainability of EWM enterprises. Karma Recycling has strategic tie-ups with retail stores and networks with scrap dealers in addition to its online platform for collection of e-waste from households and individual customers. Reboot recently launched a program called REBO - Reboot Empowered Business Optimizers - which trains and certifies scrap dealers to source e-waste and reduce their sourcing costs in the long run. In some countries, enterprises source e-waste through EPR mechanisms such as a 'disposal warranty', an arrangement where the retailers/OEMs partner with EWM enterprises to collect used devices directly from users.

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230 E-Parisaraa Private Limited (<http://ewasteindia.com/>) is owned by Surface Chem Finishers (<http://www.goldplatingindia.com/>)

231 ReGlobe operates as Cashify, <https://www.cashify.in/>

232 OEMs typically provide an abridged warranty for such refurbished goods.



Enterprises also use innovative technologies to maximize recovery of material from e-waste. E-Parisaraa has designed and developed equipment to recycle specific types of e-waste such as printed circuit boards and cathode ray tubes.<sup>233</sup> Virogreen, which operates across Asia, recycles plastic extracted from electronic devices. The plastic is melted and converted into oil which is sold to industries for commercial purposes. However, the technologies required for treating hazardous components and mixed plastics and for extraction of valuable materials are expensive, and may require large scale industrial processes. The scale needed to justify this investment could deter many enterprises from expanding operations.

Refurbishment requires an additional step of assessing whether a device is suitable for refurbishment or should be dismantled. Also, the refurbished device is tested before it is taken to market. These are skilled jobs, and require specific technologies and software. JSA Web Solutions, for instance, assesses e-waste products at the point of collection to determine whether it can be refurbished.<sup>234</sup> Additionally, refurbishment enterprises have to develop specific and targeted sales channels to engage with customers, and build operational efficiencies in working with online or offline channels or e-commerce companies.

#### Unit Economics

Inefficient waste segregation at source increases acquisition costs for dismantling and recycling enterprises. Profit margins are further squeezed due to operational costs and a low degree of value addition, and are in the range of 10 percent to 15 percent.<sup>235</sup> Dismantling and recycling enterprises compete with informal recyclers to procure e-waste from households, corporations and through EPR initiatives of electronics producers. Many enterprises such as Virogreen and E-WaRDD & Co identify high competition and a low degree of differentiation in services as key barriers to scale.

Enterprises try to minimize the cost of procuring e-waste. Acquisition from individual users can account for as much as 40 percent of the production cost of the refurbished device. Enterprises such as JSA Web-Solutions in India participate in auctions and tender processes by large companies and educational institutions to acquire e-waste in bulk at lower costs. Enterprises can sell refurbished devices at significant margins, often exceeding 25 to 30 percent. Some enterprises offer an abridged warranty to attract customers and ensure that prices are not too much lower than that of fresh unused devices.

#### Financial Strategy

Medium- to large-scale dismantling and recycling can be capital intensive, requiring investment in physical infrastructure and equipment of up to US\$1 million. Large enterprises that have a credit history, such as Attero, can access debt from banks. Smaller enterprises, however, face challenges in accessing long-term debt as they often fail to meet the banks' collateral requirements. For instance, Glean Eco Solutions, an Indian enterprise with a small dismantling unit, found it difficult to borrow from banks as the value of its fixed assets (land

233 "Our Processes," <http://ewasteindia.com/processes/>, accessed May, 2017

234 Intellect primary interviews with stakeholders

235 For example, the net value recovered from recycling a CRT-TV in Ghana was around US\$7. In India, the value recovered from recycling a PC is around US\$25.

and machinery) and raw material did not meet collateral requirements.<sup>236</sup> Working capital is not a major constraint as these enterprises are able to use internal cash flows or access short-term debt based on the asset value of their inventory.

Refurbishment enterprises have attracted equity investments due to their higher profit margins, innovative solutions and collection mechanisms such as online platforms. In 2014, Attero raised over US\$16 million in private equity to invest in technology and innovation as well as to set up a plant in Mexico.<sup>237</sup> Karma Recycling raised capital from Infuse Ventures and the Low Carbon Enterprise Fund to develop technology to refurbish smartphones and expand its retail operations across the country.<sup>238</sup> Manak Waste Management Private Limited raised early stage funding from Bessemer Venture Partners (BVP) and Blume Ventures for expansion and product innovation.<sup>239</sup>

There are few consumer finance solutions for secondary sales of electronics, which impacts sales of refurbishment enterprises. India-based Reboot, which received US\$0.5 million in angel funding, tried to develop a patronage model where it accepted staggered payments in equal monthly installments (EMIs). The model proved to be unviable due to the increased credit risk and associated expenses and the enterprise discontinued the facility after a few business cycles.

## 5.2 External Factors

### Market Context

Increased sales of electronic devices and the high volume of discarded products ensure potential supply for dismantling and recycling enterprises and enable them to scale operations.<sup>240</sup> Enterprises such as Reboot and Virogreen focus on small electronic gadgets since they are most likely to be discarded by users within five years of purchase. However, increasing competition and a fragmented market are barriers to scale. Xperian grew quickly in its initial years, but its growth was muted by competition from an influx of new entrants, especially smaller unorganized players.<sup>241</sup> Additionally, demand for recycled material dropped due to decrease in global prices of metals and plastics resulting from the fall in oil prices).

Developing countries such as India, China and South Africa have a sizable middle class that constitutes a large market for refurbished devices. Enterprises like Karma Recycling that specialize in refurbishment and services like data scrubbing and functionality resets

<sup>236</sup> Intellectap primary interviews with stakeholders

<sup>237</sup> "E-Waste management Firm Attero Raises Rs 100 cr," accessed May 2017, [http://www.business-standard.com/article/companies/e-waste-management-firm-attero-raises-rs-100-cr-114082800520\\_1.html](http://www.business-standard.com/article/companies/e-waste-management-firm-attero-raises-rs-100-cr-114082800520_1.html)

<sup>238</sup> "Karma Recycling Raises Funding from Infuse Ventures, Low Carbon Enterprise Fund," accessed on May 2017, <https://www.vccircle.com/karma-recycling-raises-funding-infuse-ventures-low-carbon-enterprise-fund/>

<sup>239</sup> "ReGlobe.in Raises Funds from Bessemer Venture Partners and Blume Ventures," accessed on May 2017, <http://www.livemint.com/Companies/zK9cUJtOxeEqVb3wrXsk6J/ReGlobein-raises-funds-from-Bessemer-Venture-Partners-and-B.html>

<sup>240</sup> According to the Pew Research Center, smartphone ownership rates in emerging and developing nations are rising at an extraordinary rate, climbing from a median of 21% in 2013 to 37% in 2015

<sup>241</sup> "Xperian Appoints New Managing Director," accessed on May 2017, [http://www.itweb.co.za/index.php?option=com\\_content&view=article&id=41220](http://www.itweb.co.za/index.php?option=com_content&view=article&id=41220)



can provide refurbished devices to this market at 40 percent to 50 percent of the original equipment cost.

### Financing Ecosystem

Risk finance and venture capital providers have shown little interest in dismantling and recycling enterprises since profit margins are modest and the business model is highly localized. These enterprises, therefore, seek debt finance from banks and government agencies. Public-private-partnerships (PPP), driven by entities specifically setup for the purpose, can also help EWM enterprises to scale.<sup>242</sup> For instance, in India, the Centre for Materials for Electronics Technology (C-MET) has been set up as an autonomous scientific society formed by the government under the Department of Electronics and IT to assist states in setting up e-waste processing units. However, there are limited long-term financing solutions for asset-light and early-stage enterprises such as Glean Eco Solutions that seek to expand to other geographies and set up local collection and dismantling centers. Such expansion will reduce expenses incurred to transport e-waste to the central facility. In contrast, better profit margins make the refurbishment model attractive for investors. Many clean-tech focused investors such as Infuse Ventures, Forum Synergies and Ariya Capital, have invested in refurbishment enterprises.

### Policy and Regulations

Official take-back systems, extended producer responsibility (EPR) mandates and producer-led initiatives have been effective in managing e-waste in developed countries,<sup>243</sup> and developing countries are following suit. In Latin America, governments in Chile, Brazil, Argentina and Colombia have introduced EPR as a policy. However, enforcement of EPR in developing countries has not been uniform or efficient. Enterprises such as Reboot and Device SA share that this impedes their ability to scale, and suggest that laws could encourage manufacturers to standardize components to simplify the process of recycling and make it more efficient. This follows the concept of 'Design for Disassembly (DfD)', which promotes design, manufacture and material selection that consider the future need to dis-assemble a product for repair, refurbishment or recycling.

Some policy initiatives and market developments have seen results, and could be replicated in other countries. Producer Responsibility Organizations (PROs) evolved in developed countries to carry out collection and recycling of e-waste on behalf of the OEMs.<sup>244</sup> Along similar lines, the E-Waste Association of South Africa (EWASA) was established in 2008 to encourage management of e-waste in a collective manner with industry partnerships. Similarly, in China, the government's "Old for New Program" incentivized consumers to hand in their e-waste to subsidized formal collectors, which helped channel more e-waste through the formal system.<sup>245</sup>

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242 Intellect primary interviews with stakeholders

243 According to The Global E-Waste Monitor of the United Nations University, 40% of the annually generated e-waste is officially reported treated through take-back systems in the EU.

244 For instance, Swico Recycling is a national not-for-profit PRO in Switzerland, operated by Swico, the Swiss Economic Association for the Suppliers of Information, Communication and Organizational Technology

245 Feng Wang, Rudeiger Juehr, Daniel Ahlquist and Jinhui Li, "E-Waste in China: A Country Report," StEP Green Paper Series, United Nations University, 2014

A few smaller and early-stage enterprises such as Glean Eco Solutions believe that developing countries should establish policies based on the polluters pay principle. This principle is applied in most of the developed countries and ensures that responsibility is equally assigned to customers and producers. Such policies make it easier for recyclers to achieve sustainability and earn better margins. Enterprises in countries that are hub-spots for legal or illegal imports of e-waste must compete with a large, unregulated and informal sector. Virogreen, an enterprise that operates across Southeast Asia, faces strong competition from the informal sector, which impacts its scalability.<sup>246</sup>

### 5.3 Scaling Out

Dismantling and recycling enterprises tend to be local; the few enterprises that have scaled out to new geographies have either set up local dismantling and recycling facilities or have partnered with local players. For instance, Virogreen has partnered with a local enterprise in Thailand to recycle imported e-waste. Virogreen provides its expertise in recycling while the local partner develops and manages relationships with local customers. UAE-based Bee'ah has partnered with three enterprises, including Attero Recycling, to develop an integrated recycling and refurbishment facility in the Middle East.<sup>247</sup> Desco, an enterprise based in South Africa, is considering expanding to countries like Tanzania, Namibia and Mozambique. However, insufficient legislation, lack of awareness and lack of commitment from bulk generators of e-waste are some of the challenges it is likely to face in scaling out.<sup>248</sup>

Given the large market for refurbished devices in developing countries, refurbishment enterprises are more likely to scale out within their geographic region to retain high operating margins. South Africa's Device SA plans to scale out to neighboring countries such as Zambia. However, variability in customer preferences and buying behavior pose a challenge for successful scale out.<sup>249</sup>

Increasing technological innovation and automation in the process of dismantling and material recovery offer enterprises opportunities to scale up and out. Additionally, an expected global shortage of specialty materials that the electronics industry demands – such as rare-earth metals – will further boost the case for material recovery from e-waste.

Refurbished devices are increasingly being accepted and there is significant market potential in developing countries where the middle class has more than doubled in size in the last decade. The working middle class<sup>250</sup> makes up almost 50 percent of the developing world's workforce. This aspirational and e-connected middle class in developing countries is expected to have on average four devices per individual by 2020. The emergence of 're-commerce' portals as the next wave of online shopping is likely to boost the market for refurbished devices further.

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246 Intellectap primary interviews with stakeholders

247 "Attero Recycling India to Build E-Scrap Facilities in Middle East," Recycling Today, 2017

248 Intellectap primary interviews with stakeholders

249 Intellectap primary interviews with stakeholders

250 Defined as those living on at least US\$4 a day







## 6. Comparison of Business Models in E-Waste Management

The dismantling and recycling, and refurbishment, models have similar waste collection channels, disposal mechanisms, and costs for acquiring e-waste. However, customer segments, value addition and profitability tend to vary significantly across the two models. Profitability of recycling enterprises depends on the volume and type of materials they recycle and is often dependent on global commodity prices such as that of recycled plastic and new plastic. Technological innovations and efficiency in the material recovery process would enable the dismantling and recycling model enterprises to scale faster. Refurbishment model enterprises included in the research earn higher profit margins and are banking on the increasing acceptance of refurbished electronic products among the aspirational middle class in developing countries. While the refurbished products market currently consists primarily of smart phones, demand for other refurbished products including electronic products such as laptops, desktops, and servers are likely to further boost the potential for these enterprises to scale.

Table 10. Comparison of Business Models in E-Waste Management

	Dismantling & Recycling	Refurbishment
 <b>Internal Factors</b>		
<b>Customer Engagement</b>	Long-term contracts with businesses that use recycled material	Individual or institutional customers served through online and offline channels, often dedicated
<b>Operations</b>	Partnerships with informal and/or institutional sources to acquire e-waste, mechanized or semi mechanized operational processes	
<b>Unit Economics</b>	Lower profitability; however economies of scale can be achieved	Higher profitability per unit due to significant value-addition
<b>Financial Strategy</b>	Need low-cost capital for increasing capacity; OPEX is met through retained earnings	Able to attract risk capital due to high profitability and market opportunity.
 <b>External Factors</b>		
<b>Market Context</b>	Market driven by regulations, awareness and increasing usage of electronics devices	Market driven by aspirational low-income customers
<b>Financing Ecosystem</b>	Limited interest from equity investors due to undifferentiated and low-cost offering	Significant interest from equity investors due to high profitability and large market size
<b>Policy and Regulations</b>	E-waste regulations, EPR guidelines and Govt. incentives such as rebates	No specific policy for refurbishment



### 7. Looking Ahead

An integrated model that combines refurbishment and recycling of e-waste holds the most potential to scale. Refurbishment enterprises invest significant time and effort in segregating and assessing the value of recovered devices. By developing dismantling and recycling capabilities, they can not only obviate the need for assessment at the initial stages, but also derive maximum benefits from the e-waste they collect. Additionally, enterprises can recover the refurbished devices at the end of their lifecycle for dismantling, thereby creating maximum green impact. Reboot is working towards such an integrated model in India.

Investments in R&D aimed at improving extraction efficiency, especially of valuable constituents of e-waste, will move the market towards greater effectiveness in value recovery. Additionally, concerted efforts to improve awareness among end users about responsible management will ensure more e-waste is channeled through organized EWM enterprises.




# Case Study: Industrial Wastewater Management

## 1. Industrial Wastewater Management Market Description

Indiscriminate discharge of untreated effluents from industries into water bodies poses a serious threat to the environment and human health. With rapid industrialization and increasing pollution, governments in developing countries have made wastewater management an important regulatory requirement. Industrial wastewater management (IWM) enterprises assist water-intensive industries such as cement, agricultural processing, mining, textiles, and electrical power to treat effluents before discharge.

Figure 42. Key Product Categories in the IWM Market

	Large ETPs of Capacity >1 MLD	Smaller ETPs of Capacity up to 1 MLD
	<b>Customers (Typical)</b> Large water-intensive industries such as textiles, cement and paper mills having large volumes of effluent	Small and medium enterprises engaged in activities such as agricultural processing and manufacturing
<b>Outreach Strategy (Typical)</b>	Well established customer and industry segments; Focus on R&D and product efficiencies	Customized solutions. Focus on reducing cost through outsourcing non core activities
<b>Typical Project Cost</b>	Collection logistics, labor, infrastructure Usually more than US\$1 million per project of ETP installation	Ranges from US\$15,000 to US\$1 million depending on capacity
<b>Enterprise Examples</b>	Osmoflo, Global Flagship Ecosystems, Singapore	Marcuras Water Treatment, India Peacock Aqua Engineers, India Keneco, Kenya

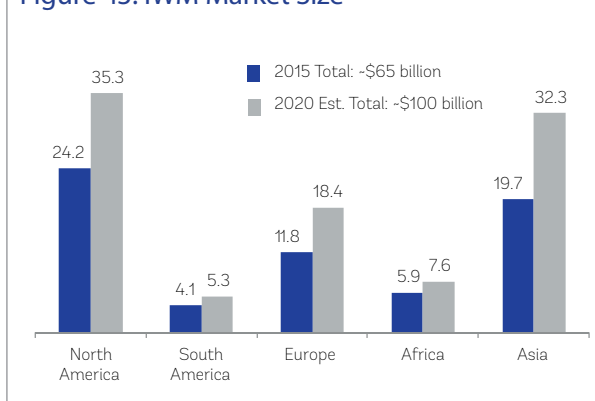
IWM enterprises design, build and/or maintain single effluent treatment plants (ETP) or common ETPs (CETPs) that treat multiple effluents through physical, chemical and biological processes. Enterprises either transfer operational control of the ETP after design and installation or take up operations and maintenance (O&M) for customers on fixed contractual terms after installation. To improve wastewater treatment processes and position its product as a value added operational activity rather than a regulatory mandate, IWM enterprises have introduced technology innovations for more efficient harvesting of energy from biosolids and zero liquid discharge, where all wastewater is purified and recycled.

This research analyzed 13 IWM enterprises operating across developing countries in Asia, Africa and Latin America.<sup>251</sup> These enterprises offer ETPs of capacities ranging from 10,000 liters per day (KLD) to 2 million liters per day (MLD), deploying different technologies depending on the composition of the effluents they treat. Although the regulatory regime, treatment technologies, required skillsets and operations and maintenance processes are similar for IWM enterprises irrespective of their size, very large multinationals with diversified product portfolios have been excluded from this research to facilitate meaningful analysis of scale challenges and identify ways to support early and growth stage enterprises in this market.

## 2. Global Market for Industrial Wastewater Management

The global market for the design, construction, operation, and maintenance of IWM systems was estimated to be US\$65 billion in 2015, with the projection to grow at a CAGR of about 8.5 percent to almost US\$100 billion by 2020.<sup>252</sup> Although North America will continue to have a large market size, significant market growth is expected in developing countries in Asia, along with modest growth in Africa. As the developing economies grow manufacturing and industrial sectors, demand for industrial wastewater treatment is expected to increase.<sup>253</sup> Countries such as Brazil, India, China and South Africa are expected to become hotspots for industrial wastewater treatment in the next few years driven by regulatory mandates, government push for compliance and advocacy from civil society to protect the environment and water resources.

Figure 43. IWM Market Size



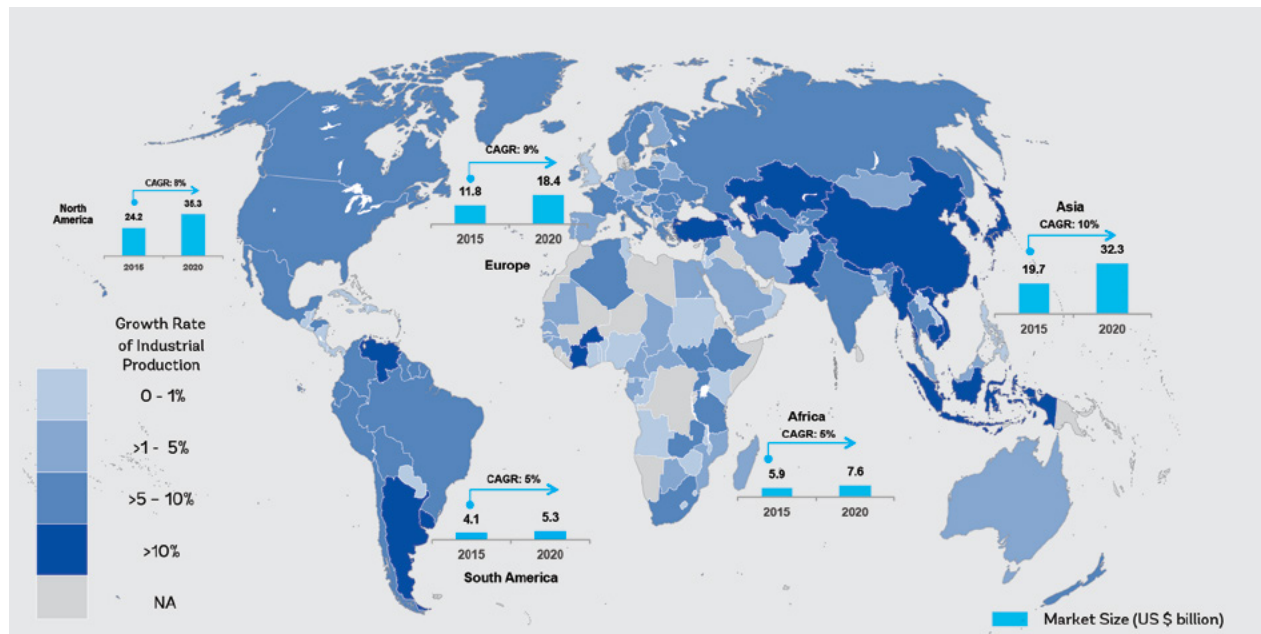
251 The research team interviewed Marcuras Water Treatment (India), Eco Green Solution Systems (India), Netsol (India), Keneco (Kenya), Osmoflo (Global), DNI Global (Bangladesh), Green Environment (India), United Envirotech (India), and Peacock Aqua Engineers (India). Information from secondary sources was obtained on Flagship Ecosystems (Indonesia), Aguas Nuevas (Chile), Ryali Technologies (India), and NanoSun (China).

252 Frost & Sullivan, Grand View Research

253 UNIDO Industrial Development report 2016



Figure 44. Global IWM Market and Industrial Activity<sup>254</sup>



### 3. Key Drivers and Challenges for the Industrial Wastewater Management Market

The IWM market is dependent on industry's need to comply with regulations and policies for wastewater and effluent discharge. The growing need for water conservation and tightening environmental regulations such as the mandate for zero discharge of untreated effluents under the **Swachh Bharat** initiative in India and the levy of Wastewater Discharge Fees for violation of discharge norms in China are expected to drive the market in the future. Growing environmental awareness among customers of water-intensive industries may also generate demand for wastewater treatment. For instance, installation of ETPs in the textile and dyeing industry in Bangladesh is driven by a push from the American and European brands that the industry serves. In recent years, many industries report wastewater discharge goals and achievement to their stakeholders as part of sustainability reporting, often in response to expectations from investors.

The push for compliance, applications across sectors and geography, and water-involving processes such as water purification, softening, demineralization and ultra-pure water generation offer diverse opportunities to IWM enterprises. Modern technologies such as electro-coagulation and value added services such as real-time monitoring of ETP parameters are expected to further drive the IWM market.

Additionally, increasing water stress around the world driven by climate change and resource mismanagement will eventually lead to increased water prices. The value proposition of

<sup>254</sup> Frost & Sullivan, CIA's World Factbook

wastewater management will become more apparent with eventual privatization of the water supply ecosystem. This will be a key market driver in the future.

Enforcement of environmental norms, however, is usually a challenge in developing countries. Industries tend to view effluent treatment as a cost and often continue to dump untreated wastewater in the environment undetected due to the lack of sufficient oversight. This, combined with the high upfront cost of an ETP installation, constrains the market for IWM enterprises in developing countries.

Figure 45. Key Drivers and Challenges for the IWM Market



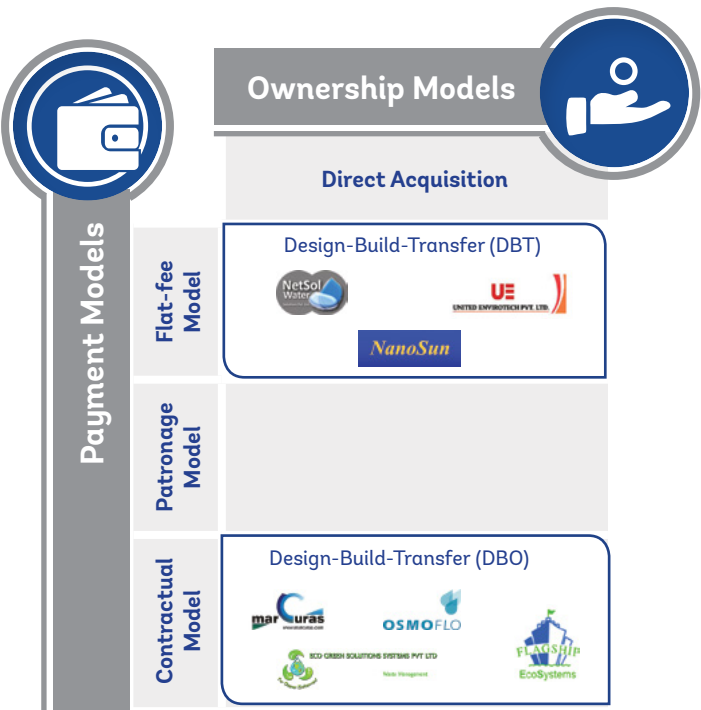


#### 4. Mapping of Industrial Wastewater Management Enterprises into Business Models

IWM enterprises design, build, operate and/or maintain complex effluent treatment plants. Given the high degree of customization, IWM enterprises usually adopt a direct sales model based on a flat fee structure. Some enterprises provide operations and maintenance (O&M) services, while others limit their client engagement to only technical design and installation. Most clients own the ETP installation but engage external service providers for O&M. As a result, several such outsourced services companies have emerged to only offer O&M support. However, they are not included in this research as they neither design and build the ETPs nor develop the technology.

Due to long project durations and multiple checkpoints with the client – such as technical design, material procurement, installation, testing, commissioning and O&M – the payment models and modes of transfer of ownership of the installation often vary on a case-to-case basis. However, business models can be classified into two broad categories based on the inclusion or exclusion of O&M in the services provided by the IWM enterprise.

Figure 46. Enterprises Across Business Models in IWM market



*Note: The products in case of IWM are always directly acquired by the end customers i.e. industrial units.*

- 1. Design-Build-Operate (DBO) model:** After installation and commissioning, DBO enterprises operate and manage the ETP plants by having dedicated staff onsite for continuous monitoring of design parameters and consumable chemicals. Enterprises charge an upfront payment for the installation and offer an annual maintenance contract (AMC) for O&M activities. This business model is preferred by industries, particularly those that have variation in effluent properties or lack in-house staff or expertise for ETP operations.
- 2. Design-Build-Transfer (DBT) model:** IWM enterprises transfer operational control to the client and only provide low-touch technical consulting support when required. Financial terms typically include only an upfront payment for installation. The client manages the O&M of such installations, either in-house or through external support. This model is not widely deployed, although industries that have low variation in effluent properties or those which seek to keep their O&M costs low prefer this model. Some enterprises also provide skid-mounted portable or modular ETPs that are used in remote applications such as mining and drill rig sites. These are small systems having treatment capacities of up to 25 KLD. These are sold for a flat fee and customers manage the O&M of such systems.

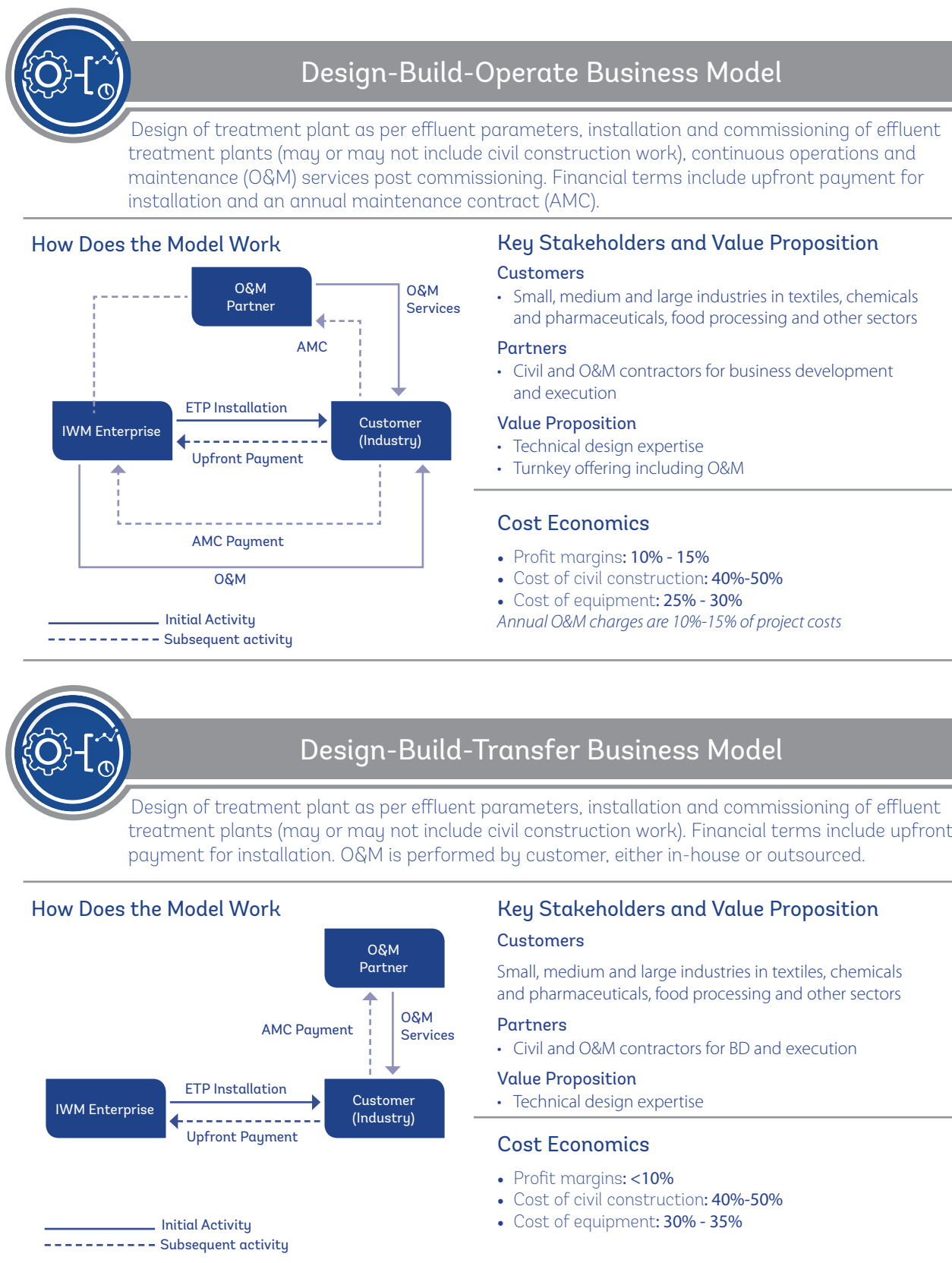
While the choice of DBO or DBT is largely governed by customer preference, other aspects such as technical and financial considerations, availability of land for ETP installation, physical location of the installation, and the presence of strategic partners also have a bearing on the decision. For instance, enterprises such as Eco Green Solution Systems (India), Flagship Ecosystems (Singapore), and Keneco (Kenya) deploy both DBO and DBT services according to customer requirements. Flagship Ecosystems typically follows the DBO model, but eventually transfer the ETP when clients have prior experience and the technical know-how to maintain and operate the ETP.

### 5. Scalability Analysis of Industrial Wastewater Management Enterprises

Given the high degree of interchangeability between the two business models, and the majority of the enterprises using the O&M component to boost their margins and scale operations, this note analyzes scalability largely for the DBO model. It draws out key differences between the models in sections where scalability can be impacted by the transfer of O&M activities.



Figure 47. Business Models in IWM Market



### 5.1 Internal Factors

#### Customer Engagement

DBO enterprises establish a strong regional presence through demonstrated installations, personal and professional networks, and dedicated local teams for O&M support to build brand value. When they scale out, these enterprises often face challenges as they may have to establish a local marketing team or scout for local partners for O&M. India-based EcoGreen Solution Systems found that the cost of managing dedicated marketing teams was prohibitive, especially given the long business development cycle from lead generation to contract closure, which can run up to a year.<sup>255</sup> Given the longer duration and intensive nature of DBO contracts, enterprises can anticipate customers' demand and offer additional products such as reverse osmosis (RO) plants and water softening installations to complete a package of solutions for varying needs of customers.

Some enterprises, such as India-based Peacock Aqua Engineers, rely on deep relationships with customers built over multiple years of engagement and word-of-mouth publicity to expand into new geographies. Leveraging positive feedback from clients in India, Marcuras Water Treatment has commissioned ETP plants in the UAE. In some cases, DBO enterprises forge strategic partnerships to help them scale out.<sup>256</sup>

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#### Box 15 Forging Overseas Partnerships – Flagship Ecosystems

Flagship Ecosystems is a Singapore-based enterprise that specializes in ETP installations for the textile, oil and gas and bio-processing industries. It operates in multiple geographies including Indonesia, Bangladesh and India. The enterprise has forged partnerships with local entities for expanding its offering, business development, and operationalizing ETP

installations. The enterprise has partnered with DNI Global in India, which has expertise in water purification systems. Flagship Ecosystems provides the technology support whereas DNI Global provides the local staff on the ground for outreach, installation of demonstration units and provision of O&M support for executed installations.

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The DBT model is also relationship and performance driven. Netsol has a dedicated team that periodically follows up with customers and tracks operational issues to ensure a positive experience for clients. DBT enterprises also undertake prominent onsite branding, and it is not uncommon for enterprises to install prominent signs with contact details at installation sites. This enables DBT enterprises to generate leads from visitors to client premises and O&M providers who are aware of local opportunities.

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<sup>255</sup> Intelicap primary interviews with stakeholders

<sup>256</sup> Intelicap primary interviews with stakeholders; "About Us," Marcuras, <http://www.marcuras.com/about-us.php>, accessed May 2017



## Operations

DBO Enterprises require dedicated staff for installation and O&M and typically procure chemicals consumed in O&M services, either centrally or at the site location. These activities absorb significant management time and attention. Marcuras, which has over 50 installations, prefers to form outsourcing partnerships with local O&M providers. It has three or four strategic partners that provide O&M for existing and upcoming installations, allowing it to focus on the core activity of technical design of ETPs.<sup>257</sup> Add-on services such as system analytics and remote monitoring allow enterprises to improve their services to customers and charge a premium for O&M services. Greenenvironment has developed an Internet of Things (IoT)-based sensor system that allows customers to track ETP parameters.<sup>258</sup>

DBT enterprises usually work with customer segments that have large in-house teams for managing the ETPs or with public sector enterprises that may prefer to separately release tenders for O&M activities. India-based Netsol, for instance, works extensively with local public works departments (PWDs) and municipal governments with the DBT model.<sup>259</sup>

## Unit Economics

External contractors for civil construction account for as much as 50 percent of the project cost.<sup>260</sup> Vision Earthcare, an enterprise in India, attempted to undertake civil works execution and soon realized that it is more economical to outsource it to civil contractors.<sup>261</sup>

Consumables such as chemicals, reagents and membranes are a major operating cost for DBO enterprises; however, efficiencies can be achieved by strategic procurement of non-branded materials of reasonable quality at affordable prices. Enterprises that deploy the DBO model generate gross profit margins up to 20 percent, with a higher contribution from O&M services. Profit margins for DBT enterprises tend to be lower, often less than 10 percent.

## Financial Strategy

Both DBO and DBT enterprises typically receive only 15 percent to 20 percent of the project cost as advances from the customer. Subsequent payments are received in multiple tranches over the project execution period. Kenya-based Keneco asserts that the financial terms are heavily tilted towards end payment cycles as customers often view effluent treatment as an overhead mandate.<sup>262</sup> The low advance payment is typically insufficient to cover capital costs incurred for civil construction and equipment purchase, and enterprises have to depend on internal accruals or bank debt for working capital requirements, which amount to around 40 to 50 percent of the project value. The project value typically ranges from between US\$15,000 to US\$1 million for meeting effluent treatment needs of small and medium enterprises, and more for larger enterprises. As the payment milestones are fixed, enterprises can estimate their cash flows and are able to access debt through receivables financing and cash-credit accounts.

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<sup>257</sup> Intellectap primary interviews with stakeholders

<sup>258</sup> Intellectap primary interviews with stakeholders; "Innovation," Greenenvironment, <http://www.greenenvironmentindia.com/innovation.html>, accessed May 2017

<sup>259</sup> Intellectap primary interviews with stakeholders

<sup>260</sup> Civil construction includes trenches, linings, walls, partitions and flow channels for the incoming effluent.

<sup>261</sup> Intellectap primary interviews with stakeholders

<sup>262</sup> Intellectap primary interviews with stakeholders

IWM enterprises that have an overseas presence or strategic partnerships with international equipment manufacturers can leverage the relationship by sourcing low-cost funds from the local financial institutions to meet their capital requirements. For instance, DNI Global operates ETPs in India and Bangladesh in a technology partnership with Singapore-based Flagship Ecosystems.<sup>263</sup> Since debt is expensive in India (roughly 15 percent) when compared to Singapore (less than 10 percent), DNI meets its financial requirements through the Singapore entity, and addresses foreign currency fluctuation and exchange risks with suitable hedging policies.

DBT enterprises have to ensure profitability from project design and installation activities, as there is no O&M component to ensure continuing cash flows. Unforeseen expenses caused due to market fluctuations and project delays are often covered by availing overdraft facilities from banks, however this may impact the overall profitability of the project. As most DBT enterprises have a larger product portfolio than DBO enterprises, they are often better placed to access debt. In some cases, enterprises operate completely on promoter equity and retained earnings to obviate the cost of external capital. Netsol, for instance, does not borrow any money from external sources for its operations.

## 5.2 External Factors

### Market Context

The IWM market is fragmented with many customer segments and hundreds of enterprises serving different industries. Each customer industry has its own business cycle and requirement based on the quantity and type of effluent it generates. Consequently, IWM enterprises need to be constantly updated about technological innovations and changing regulatory environment for the industries they serve. Marcuras, for instance, responded to the new 2016 regulation on ETP installations in India by implementing zero discharge IWM in ecologically sensitive regions such as the Ganga Basin, Tirupur region and Diu and Daman.<sup>264</sup>

Awareness about the importance and benefits of IWM is often lacking in developing countries, and industries choose to install ETPs only when pushed by regulators or upstream players. Marcuras is educating the industry about the potential water savings that ETPs can achieve with a goal to scale in the short-term and build a brand image for long-term success.

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<sup>263</sup> Intelcap primary interviews with stakeholders

<sup>264</sup> "Environment Ministry Notifies Revised Standards for Common Effluent Treatment Plants (CETPs)," CPCB website, available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=134504>



Enterprises often also face competition from local manufacturers that offer cheaper ETP installations. Peacock Aqua Engineers, for example, faces competition from local manufacturers that often use unbranded and substandard components, which in the long run necessitates higher operations and maintenance for the customer. Such competition hampers growth stage enterprises that offer high quality products, but have limited market presence. Larger and more established enterprises such as Osmoflo also face this challenge, but are able to counter it by virtue of their brand value.

### Financing Ecosystem

Enterprises need access to long-term capital due to insufficient advances from customers and long project durations, and short-term capital to address market volatility and the resulting cost escalations. Enterprises deploying the DBO models are basically service enterprises, and typically do not have assets to offer as collateral. Debt is often available only against material and work orders, and unsecured finance is rare and expensive. Keneco, for instance, notes difficulty to obtain long-term debt from a formal financial channel due to the low awareness of the IWM businesses and suggests that the local government could provide targeted green funds, credit guarantee programs and risk insurance. Governments could also blend grants and repayable loan to make bank debt accessible. In the Philippines, a revolving fund called the Philippines-Water Revolving Fund Support Program (PWRF) has been set up to mobilize ODA and local funds towards access to safe water and wastewater treatment.<sup>265</sup>

### Policy and Regulations

The extent of adherence to regulations varies across developing countries and often within countries. In India, although zero discharge norms apply to untreated effluents, enforcement is low. Effluent treatment norms in Latin American countries are outdated and often ineffective due to inefficient implementation, widespread informality and lack of information.<sup>266</sup> Consequently, industries avoid investing in ETPs. This has hampered scale for the IWM market. Increasing awareness about environmental degradation, water scarcity and the need to reuse water is expected to build greater buy-in from clients, which will help IWM enterprises to expand operations and scale out especially in the developing countries of India and China.

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<sup>265</sup> This fund was set up with support from the United States Agency for International Development (USAID) and the Japan Bank for International Cooperation (JBIC).

<sup>266</sup> "Water for a Sustainable World," The United Nations World Water Development Report, 2015.

Table 11. Indicative Regulatory Initiatives Supporting IWM

Country	Regulatory Initiative
<b>India</b>	'Zero discharge' norms that mandate industries to treat and reuse all of the wastewater generated. These norms are applicable to majority of the industries and are especially enforced in ecologically sensitive areas.
<b>China</b>	The 'Water Pollution Prevention and Control Action Plan' aims to control water pollution, encourage economic and industrial awareness regarding wastewater generation and encourage recycling of waste water. The plan lays out list of industries that are obligated to comply with relevant policies and standards, and run a risk of shutting down in case of non-compliance.
<b>Kenya</b>	The Kenyan environment sanitation and hygiene policy had defined terms of compliance for the companies generating industrial waste. It has mandated the companies producing liquid effluents to pretreat the discharge to the standards prescribed before releasing it into the environment.
<b>Brazil</b>	The industrial effluent law imposes high tariffs on companies disposing effluent discharge in the water bodies. The high tariffs make the onsite treatment cost effective for such companies discharging industrial effluents.

### 5.3 Scaling Out

The DBO model is difficult to scale out as it is challenging for enterprises to effectively manage operations and maintain the quality of O&M services across different geographies. Overseas site locations present the additional challenge of increased transportation costs of equipment (in case local equipment is not available) and long response time in case of breakdowns. Some enterprises, such as Marcuras, DNI Global and Osmoflo, have succeeded in scaling out with the help of local partners. Marcuras recently expanded to the Middle East, and DNI Global has scaled out to Bangladesh. Although outsourcing of O&M services reduces the profit margins, DBO Enterprises trains local partners to develop relevant skill sets for effectively managing O&M and gain insights into further expanding business in the region.



DBT enterprises are more suited to scale as they do not need support operations and can exit after installing the ETP. Enterprises such as Netsol which manufacture ETP components and undertake turnkey projects are present across India and have seen lower challenges to scale through their component sales activities. Enterprises that are able to straddle both the business models and build O&M expertise and networks to support customers throughout the lifecycle of the ETP installation are most likely to scale, provided they can access sufficient capital to cover HR costs and working capital requirements.



## 6. Comparison of Business Models in Industrial Wastewater Management

The fixed cost components of an ETP installation, such as civil construction, equipment, and design services, are similar for the DBT and the DBO business models. Profit margins, however, tend to be thinner for DBT enterprises, at around 10 percent, as customers negotiate and lower the one-time capital costs. Cost-conscious customers or those with in-house O&M capacities usually prefer the DBT model.

Table 12. Comparison of the Business Models in Industrial Wastewater Management

	Design – Build – Operate	Design – Build - Transfer
 <b>Internal Factors</b>		
<b>Customer Engagement</b>	Continuous engagement through O&M relationships	One-time engagement for installation
<b>Operations</b>	High dependence on local partners for O&M	Low dependence on local partners - no O&M
<b>Unit Economics</b>	Higher profitability from O&M activities	Lower profitability per installation
<b>Financial Strategy</b>	Enterprises need low-cost debt to meet working capital requirements in the absence of sufficient advances from customers	
 <b>External Factors</b>		
<b>Market Context</b>	Market driven by regulations, awareness and cost of water	
<b>Financing Ecosystem</b>	Limited interest from equity investors owing to insufficient returns; traditional debt available in lieu of collateral and/or work orders	
<b>Policy and Regulations</b>	Need to follow environmental protection norms. No specific incentives available	



### 7. Looking Ahead

Technological innovations and strategic partnerships can help IWM enterprises to scale in a regulatory- and policy-driven market environment. Enterprises can also build capabilities to provide allied water management services such as purification, softening and demineralization to offer turnkey solutions to customers. Although the need for compliance has been driving this market, intensifying water stress leading to increases in the price of water will make wastewater management a necessity for industries. As the price of water will have an impact on overall economics of water-intensive industries, there will be an increased interest in water reuse through wastewater management.



# Annex 1:

## List of Interviewed Enterprises

Subsector	Enterprise	
Solar Home Systems	» Aspiration Energy, India	» Off Grid Electric, Tanzania
	» Azuri, Kenya	» Onergy, India
	» Barefoot Power, India	» PEG, Ghana
	» Kenya Green Supply, Kenya	» Selco Power, India
	» Lumos, Nigeria	» Simpa Networks, India
Mini / Micro-Grids	» Avani Kumaon, India	» Powerhive, Kenya
	» Akur Scientific, India	» Mera Gaon Power, India
	» DESI Power, India	» OMC Power, India
	» Devergy, Tanzania	» PowerGen, Kenya
	» Gram Oorja, India	» Rift Valley Energy, Tanzania
Community Water Purification	» dloHaiti, Haiti	» Sarvajal, India
	» Drinkwell Systems, India	» Synergy Solar, India
	» Grundfos Lifelink, Denmark	» Water Health, India
	» Jibu, Kenya	» Waterlife, India
	» Maji Melele, Kenya	» Waterpoint, India
Drip Irrigation Systems	» Jain Irrigation, India	» Dear Auto Comps, India
	» Netafim, Global	» Driptech, India/Global
	» Claro Energy, India	» Micro Drops, India
	» SunCulture, Kenya	» MyRain, India
	» Dizengoff, Ghana	

Subsector	Enterprise	
Online Platforms for Waste Management	» RaddiConnect, India	» Waste Masters, Uganda
	» Binbag, India	» My Waste, South Africa
	» E-Incarnation, India	» Taka Taka Solutions, Kenya
	» I Got Garbage, India	» Waste Takers, South Africa
	» Paperman, India	
E-Waste Management	» Reboot, India	» Tshwane Electronic Waste Company, South Africa
	» Glean Eco Solutions, India	» Desco, South Africa
	» E-WaRDD & Co., India	» Device SA, South Africa
	» E-Parisaraa, India	» Virogreen, Multiple Locations
Industrial Wastewater Management	» DNI Global, Bangladesh	» Netsol, India
	» Eco Green Solution Systems, India	» Osmoflo, Global
	» Green Environment, India	» Peacock Aqua Engineers, India
	» Keneco, Kenya	» United Envirotech, India
	» Marcuras Water Treatment, India	



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1818 H Street NW

Washington, DC 20433

**Website:** [www.infodev.org](http://www.infodev.org)

**Email:** [info@infodev.org](mailto:info@infodev.org)

**Twitter:** [@infoDev](https://twitter.com/infoDev)

**Facebook:** [/infoDevWBG](https://www.facebook.com/infoDevWBG)

