



Local value capture from the energy transition: insights from the Solar PV industry in Kenya

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JUNE 2021

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ISBN: 978-87-94094-08-5

UNEP DTU PARTNERSHIP

Copenhagen, Denmark

www.unepdtu.org

GRAPHIC DESIGN: Kowsky

COVER PHOTO: Shutterstock

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Preface

This report is the product of an ongoing UNEP-DTU Partnership (UDP) project on technology, markets and investment (TEMARIN) that has the overall aim of supporting countries in accelerating the transfer, diffusion and uptake of specific climate technologies. TEMARIN is a three-year project (2018-2021) funded and supported by DANIDA, the Danish International Development Agency which covers two countries: Kenya and Uganda. It focuses on strengthening the domestic markets for climate technologies, reducing the bottlenecks for domestic firms operating in these markets and increasing cooperation among private actors, public actors and international actors to build partnerships to scale up implementation. In Kenya, this work was carried out in collaboration with our local partner in Kenya, Strathmore Energy Research Centre (SERC), and an independent consultant.

This report aims to bring attention to the local companies operating in the solar PV market in Kenya and the ways in which they became competitive in a market dominated mainly by international companies while also operating under several constraints. It describes the companies' respective characteristics and com-

petences and their various resources, linkages and networks, both formal and informal. It also narrates the development trajectories and strategies that have allowed local companies to survive and thrive. This report aims to make more visible and increase awareness of local solar PV companies, which are often overshadowed and sometimes crowded out in a market characterised by strong international linkages, high dynamism and volatility.

We hope that the wider sector stakeholders, particularly the specific ministries (Energy, Industry and Finance), international organisations, donors, industry associations, financial institutions and research centres, will find this knowledge product useful and will be able to build on it and provide further support to the local entrepreneurial ecosystem and local industrial development.

Several stakeholders have been involved and supported implementation of the project in Kenya over the past one and a half year, not least the local companies who participated in the interviews, co-creation sessions and informal discussions.

Acknowledgements

The authors of this report would like to extend a special thank you to the participating company representatives and to the bank representatives, sector experts, government officials and reviewers who have contributed through interviews, in discussions and dialogue sessions as well as with feedback to this report and the complementary [policy brief](#).

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Thanks also for project support to

Sammy Mwiti (Independent Consultant), Hope Njoroge (Strathmore Energy Research Centre), Prof. Izael Da Silva (Strathmore Energy Research Centre) Prisca Atieno Ochieng (Strathmore Energy Research Centre) and Judith Wangata (Strathmore Energy Research Centre).

Contents

Abbreviations	7
1. Introduction	8
2. Analytical approach	10
Solar PV market segments	11
3. Report methodology	13
PART I. Findings on the domestic solar PV market	16
4. Market presence and business models in PV market segments	17
4.1. Market presence and roles of local companies	17
4.2. Portfolios of the local companies	19
4.3. Business models adopted by the companies to grow in the market	19
5. A closer look at local solar PV companies in Kenya	23
5.1. Company characteristics.....	23
5.2. Educational profiles and work experience	24
5.3. Firm competences	25
5.4. Support networks	26
6. Development trajectories and business strategies of local companies	29
6.1. Development trajectories of local companies	29
6.2. Business strategies	32
7. Summarizing insights on the domestic solar PV markets	35
7.1. Market presence and business models.....	35
7.2. Company characteristics, education profiles, competences and support networks	36
7.3. Firm competences	36
7.4. Development trajectories and business strategies of local companies.....	36
PART II. Challenges for further growth	38
8. Impediments to the future growth of local companies	39
8.1. Finance.....	39
8.2. Skills and competences	41
8.3. Policy and regulation.....	42
9. Conclusions and recommendations	44
9.1. Recommendations.....	44
References	48
Appendix A. Local company profiles: highlighting the individual journeys and a snapshot of their development over time	50
Appendix B. List of Interviewed Stakeholders	53
Appendix C. Broad Interview Guide/ Questionnaire for Local Companies	54
Appendix D. Methodology (specific process, case selection etc.)	55
Appendix E. Institutions relevant to supporting the MSME ecosystem in Kenya	56

List of Tables and Figures

TABLES

TABLE 1. Characteristics of PV market segments	12
TABLE 2. Market segments in which the interviewed local companies operate.....	18
TABLE 3. Highlights of some of the key projects and installations of domestic companies	20
TABLE 4. Overview of PV business models and means of financing for the off-taker	22
TABLE 5. Educational profiles of the local entrepreneurs.....	24
TABLE 6. Overview of the key linkages through which the fourteen companies have accessed knowledge and financing.....	27
TABLE 7. Development trajectories of companies moving towards new, improved functions within PV	30
TABLE 8. Development trajectories of companies moving into new market segments within PV and/or acquiring more sophistication within the same segment.....	31
TABLE 9. Development trajectories of companies moving into allied sectors and non-solar markets.....	32
TABLE 10. Business strategies employed by local companies	33

FIGURES

FIGURE 1. Sequence of methodological steps followed	13
FIGURE 2. Age and size of domestic solar PV companies in Kenya.....	23
FIGURE 3. An overview of the development trajectories of local companies.....	29
FIGURE 4. Key finance-related challenges and their implications	40
FIGURE 5. Key skill-based challenges and their implications	41
FIGURE 6. Key policy-level challenges and their implications.....	43

Abbreviations

AFD	French Development Agency	MSME	Micro, Small and Medium Enterprises
AfDB	African Development Bank	MW	Megawatt
C&I	Commercial and Industrial	NGO	Non-Governmental Organization
DFI	Development Finance Institutions	O&M	Operation and Maintenance
EIF	Energy Inclusion Facility	PFAN	Private Finance Advisory Network
EPC	Engineering, Procurement and Construction	PPA	Power Purchasing Agreement
EPRA	Electricity and Petroleum Regulatory Authority	PV	Photo-Voltaic
ESCO	Energy Service Company	REA	Rural Electrification Agency
FSD	Financial Sector Deepening	SACCO	Savings and Credit Cooperative Organization
GIZ	German Development Agency	SDG	Sustainable Development Goals
GOGLA	Global Off-Grid Solar Association	SE4ALL	Sustainable Energy for All
IEA	International Energy Agency	SERC	Strathmore Energy Research Centre
IFC	International Finance Corporation	SHS	Solar Home System
IRENA	International Renewable Energy Agency	SIDA	Swedish International Development Agency
KAM	Kenya Association of Manufacturers	SIMA	Social Investment Managers and Advisors
KCIC	Kenya Climate Innovation Centre	SME	Small and Medium Enterprises
KCV	Kenya Climate Ventures	SSA	Sub-Saharan Africa
KEPSA	Kenya Private Sector Association	STI	Science Technology and Innovation
KEREA	Kenya Renewable Energy Association	TVET	Technical and Vocational Education and Training
KPLC	Kenya Power and Lighting Corporation	UNEP	United Nations Environment Programme
KW	Kilo-watt	UNIDO	United National Industrial Development Organization
MFI	Micro-Finance Institutions	VAT	Value Added Tax
MoE	Ministry of Energy		

1. Introduction

In emerging economies, the transition to clean energy has the potential to solve several integrated challenges, like access to energy, cheaper energy provision and broader social challenges such as job creation, skills development and development of small businesses and industries (IRENA, 2014, 2019, 2020), and improved health, agricultural and industrialization outcomes. Maximizing these local benefits from the energy transition is crucial if the host countries are to achieve sustainable development goals (SDG 7), sustain a long-term commitment to low-carbon development (IRENA, 2018) and not least recover better in a post-COVID scenario (SE4All, 2020).

In Sub-Saharan Africa (SSA), the market for solar photovoltaic (PV) systems has been growing significantly and holds out the potential for further development. The market has been evolving from donor-backed projects to market-led diffusion of technology, a development driven by private companies and facilitated by international financiers, private investors and supportive local regulations (Nygaard et al., 2016). As such, donors are now playing a predominantly supporting role, kick-starting and de-risking projects that otherwise operate on commercial grounds. This movement from project to market creates new challenges and opportunities for African governments and their development partners, allowing them to optimize the enabling framework for clean energy markets and to ensure that domestic firms capture larger shares of the value.

Kenya is among the frontrunners in SSA with regard to the diffusion and uptake of PV technologies and is a global hub for clean energy companies, particularly in the context of small-scale decentralized energy-generation and consumption. This has created a mature and vibrant market, with large investments coming into the sector that were worth USD 467 million in 2018 (UNEP, 2019). This growth in the solar PV market presents opportunities for the Kenyan economy that goes beyond clean energy and access to electricity in rural

areas and include key socio-economic benefits like industrial development, private-sector development and job creation. This market penetration is largely dependent on international linkages, whether in terms of finance, hardware, skills or knowledge.

However, much of the growth and economic value in the market is being captured by a relatively small number of internationally owned companies operating in SSA countries (Wood Mackenzie, 2020). According to a recent report by GreenMax (G4A, 2020), international companies have captured nearly 90% of the identifiable transactions (and total investments of USD 1.6 billion) in the off-grid solar PV sector in SSA. While such figures are not available for other, relatively newer solar PV market segments, such as rooftop PV and solar-powered water pumps, nor for individual countries within SSA, it is safe to assume that this situation resonates with other PV segments as well. In a recent WRI report (Sanyal et al., 2020), the authors note the issue of investment concentration, that is, that capital has been concentrated mainly in foreign-owned and foreign-managed companies operating in the market for off-grid solar PV.

International linkages are crucial for continued growth. However, there is a large development potential to be exploited by increasing the market share of domestic companies within these markets. Domestic companies are facing challenges (financial and non-financial) that are restricting their ability to grow, scale up and take full advantage of the prevailing market opportunities. Many local entrepreneurs lack access to the knowledge, venues and organizations that can help them secure capital. WRI (2020) reveals some of the reasons for the lack of funding of African-owned companies, which include the economic incentives of investing larger amounts in a relatively small number of high-risk, high-return companies, rather than making a large number of small investments, and the preferences of investment managers, who tend to come from developed countries, for investments in their networks. In

addition, there are also concerns around the corporate governance of local companies and the quality of technical and management expertise. These challenges and bottlenecks need to be systematically addressed and reduced. In addition, domestic solar companies, like any other micro-, small and medium-scale enterprises (MSME), rely on a well-functioning business ecosystem and supportive measures to enable their growth and competitiveness. A suitable supportive and enabling environment therefore needs to be prioritized and strengthened.

While there is a large international focus on how to support the diffusion of solar PV in order to increase access to energy, comparatively less attention is being paid to improving understanding of how domestic companies can capture a larger share of the economic value in this market. Specifically, little is currently known about the size of domestic companies' shares of the market and, more importantly, about how domestic companies operate and the main factors hindering their market growth.

Against this background, the overall aim of this report is to contribute to providing new knowledge aimed at improving the understanding of how to increase the domestic share of the solar market and to expand knowledge about domestic companies operating in the solar PV sector. The report focuses on the market for solar PV in Kenya. As Kenya is a leading country in diffusing PV technology, this allows us to generate insights of broader relevance for other countries in SSA.

The report has two objectives:

- i) **Objective I:** to raise the level of information and awareness about domestic PV companies, thereby generating insights into firm-level characteristics, strengths and strategies pursued.
- ii) **Objective II:** to consolidate information about the critical challenges and bottlenecks that are specific to domestic companies in the solar PV industry, thereby providing recommendations for strengthening the support system for domestic companies.

The domestic companies examined in this report are a sub-set of companies operating in the solar PV market in Kenya, which are growing despite limitations

on their resources, capacities and knowhow. In order to provide systematic support to this industry, it is important to unpack this category of local companies to understand a number of key questions regarding their activities, including:

- How have the local companies developed and become competitive over time?
- How do companies engage with supporting institutions in Kenya? What linkages have they been able to tap into to mobilize resources?
- What are the main impediments to their continued growth? How can the challenges identified be reduced by support organizations and institutions?

The report is structured as follows. Section 2 outlines the methods through which data and insights for this report were generated. Section 3 describes the analytical framing and approach employed in the report. The remaining part of the report is divided into two parts.

Part I elaborates the main findings regarding the domestic solar PV companies and the Kenyan market in terms of market presence and business models (Sections 4), company characteristics (Section 5) and development trajectories and strategies (Section 6). This is followed by a Section 7, which summarizes the insights learned in Part I.

Part II includes an analysis of the challenges that are impeding local companies from growing further and capturing a larger share of the market. Part II consists of Section 8 which was used as a baseline to conduct further co-creation sessions (documented [here](#)) and to define practical actions and recommendations for stakeholders (captured also in this [Policy Brief](#)). Section 9 concludes the report, sets out its recommendations and highlights areas for further work and research.

2. Analytical approach

This report draws on varied academic fields and has been inspired broadly by the three bodies of previous literature: on global value-chains (linkages, upgrading), firms' capability (age, size, competences, learning), and African enterprises (owner's background, business strategies etc.). This section will briefly describe each of these analytical aspects, as well as how we use them in this report.

Firstly, in the literature on global value chains (GVC), the key concept of upgrading has been developed to describe how firms may gradually move to more rewarding functional positions in a value chain or make products that have more value-added invested in them. The possible development trajectories that local firms may follow in order to improve the competitiveness and viability of their businesses does not necessarily proceed along a predefined trajectory (Ponte and Ewert, 2009), as such trajectories may differ based on the strategic choices of the individual firms. However, this literature has tended to treat the local firm as a 'black box' and has generally focused on the meso-level of industries, which has overlooked the micro-level perspective of individual firms (Coe et al., 2008; Morrison et al., 2008). There is limited understanding of the deliberate investments and efforts local firms make in order to make themselves competitive, of the firm-specific aspects of upgrading or of the business strategies adopted by local firms.

Secondly, within the literature on development and capabilities, research has tended to treat domestic firms as the passive recipients of spill-over benefits, and not as active competitors in a given market (Poulis et al., 2012). Accordingly, limited focus has been devoted to understanding the agency and active role of domestic firms in improving their competitiveness in their home-country markets (Zhang et al., 2010). There are a few exceptions of studies that have begun to place a greater focus on this aspect. For instance, Chang and Xu (2008) study domestic firms in developing countries as active agents capable of shaping their own develop-

ment paths in home markets with foreign competitors. A few scholars have shed light on how small domestic firms overcome their resource constraints and improve competitiveness in order to gain market share against larger foreign companies (Pouli et al., 2012).

Lastly, the literature on enterprise development in Africa generally highlights the entrepreneurial capabilities of a firm's managers as playing a key role in the performance of domestic firms in Africa (Tvedten et al., 2018; Upadhyaya et al. 2020). Entrepreneurial capabilities involve a combination of the cognitive resources, personality and experience of the firm's managers, including their educational background, which together influence their ability to manage the firm (Cooper and Gimeno-Gascon, 1992; Kuada, 2007, Akinboade, 2015). This literature has also placed emphasis on the ability of a firm to mobilize key resources needed to grow their businesses, such as knowledge and capital, through various types of network (Bhamidipati et al., 2019). For example, firms may obtain access to training from linkages with support institutions, such as local universities or donors, and to the financial resources of NGOs, foreign investors and local sources, such as personnel contacts. Such 'networking capabilities' are especially crucial to small firms due to resource constraints (knowledge, skills, capital etc.).

Having reviewed the literature, we now present the approach adopted in this report with a view to enhancing understanding of Kenya's local companies. In this report, we draw eclectically on these concepts and elements identified in the literature, focusing especially on:

- i) elucidating the characteristics of domestic firms in terms of age and size, and the founders' respective educational backgrounds, and shedding light on the networks and linkages they have been able to tap into

- ii) describing companies' development trajectories and business strategies, which have enabled them to become competitive in the market
- iii) highlighting the critical challenges that continue to hinder their growth and providing recommendations.

As the first focus area, the report examines the key characteristics of domestic firms, such as the size and age of the firm, its core competences and its support networks, which are often considered to play a key role in the performance of SMEs. Generally, older and larger firms develop better linkages and firm competences and may be more robust compared to younger and smaller firms. The characteristics of the owners and directors are also widely recognized as playing a key role in the performance and survival of the MSMEs. We assessed some of the owners' characteristics, including their educational backgrounds, their networks and their management skills (Kuada, 2007, Akinboade, 2015). A firm's capabilities and competences are dependent on factors that are external to it, including the availability of skilled labour, infrastructure, and the quality of the equipment or machinery that is used in its business operations. In addition, we also focused on analysing the support networks and linkages, both formal and informal, including those related to enhancing local capacities and access to financial resources, both of which are crucial for local companies to become competitive (Pouli et al., 2012).

As a second area of interest, the report focuses on highlighting and analysing the development trajectories of companies retrospectively in terms of how they have developed and grown since their inception with reference to market segments, specific functions performed and new business ventures. To this end, we employed a retrospective approach in analysing individual firms, enabling the development of narrated company biographies as a main element of the investigative process (Miller, 2017). We adopt a bottom-up company perspective on how their businesses have developed and on how they manoeuvred the various roles and markets, thus becoming competitive over time. While the analysis of development trajectories reveals 'what' the companies chose to do to stay competitive, the underlying factors of 'how' they did so is explained through the business strategies. Our approach therefore entailed identifying some of the key business strategies employed by the

local companies, including i) niche specialization; ii) diversification; iii) business innovation; and iv) networking, among others (Adane, 2018; Hansen et al., 2018; Wamalwa et al., 2019)

Lastly, the report highlights the inhibiting factors and challenges of the local companies, including access to working capital, business and financial skills, and the policy and regulatory challenges. The approach entailed using the most common challenges from the literature (Cant, 2014; Muriithi, 2017) as a starting point, and drawing on interviews as well as feedback through workshops to identify the most critical and most immediate challenges inhibiting their growth and scaling-up. The report also focuses on identifying the appropriate actions and measures that need to be taken by stakeholders and organizations in removing some of the challenges.

In sum, this sub-section has attempted to describe the approach adopted by the report with reference to the relevant literature from which it takes its inspiration. Before moving on to the methodology section, we also briefly introduce the core empirical concepts used in discussing the solar PV market segment in order to clarify our interpretation and understanding early on.

Solar PV market segments

The PV market is diverse in terms of its technologies, business models and regulatory complexity. It is therefore useful to distinguish between the various segments that compose the PV market and across which Kenyan PV SMEs operate, as well as the types of roles and activities the domestic PV companies perform. **Table 1** provides an overview of the five market segments across which Kenyan solar PV companies operate, including their characteristics, size, customer base and the activities conducted by the companies in each segment.

While an attempt was made to categorize the various solar PV market segments as much as possible, it is important to note here that the market is becoming increasingly dynamic and diverse, with new categories emerging (solar water heaters, solar cooling, solar water pumps, PULSE appliances etc.) serving various size-spectrums and through various business models.

TABLE 1. Characteristics of PV market segments

	Segment	Characteristics	Size – spectrum	Customer base	Tasks, Activities of MSMEs
1.	Small pico-systems: PV lanterns, LED lamps, PV chargers & solar home systems (SHS)	Lighting and charging of batteries and mobile phones mainly in non-electrified areas. Off-grid electricity demand in private homes in dispersed settlements, in smaller non-electrified villages and on the outskirts of electrified towns and villages far from existing distribution lines.	1-100 Wp	rural + urban customers	product import, sale, distribution, repairs, maintenance
2.	Stand-alone 'institutional PV systems': schools, health centres, refugee camps	Institutions located in villages without grid or mini-grid, or on the outskirts of grid-electrified villages: schools, health clinics, installations in refugee camps. These are typically donor, NGO or government projects.	100-1000 Wp 1kW-5kW	rural customers	feasibility studies, import/procurement, installations, O&M
3.	Mini-grids: single tech or hybrids	Mini-grids for productive use, connecting villages and local businesses - PV mini-grids, hybrid PV-diesel, hybrid PV-wind mini-grids	5kW - 1MW	rural customers	EPC, O&M, transmission & distribution lines
4.	C&I Captive PV	Commercial and industrial consumers self-generating electricity mainly through rooftop systems.	10kW - 2 MW	mostly urban, grid-tied customers	project development, project advisory, EPC, O&M, metering solutions, financial advisory
5.	Utility-scale	Large-scale PV systems, above 5 MW	5MW -	grid-connected customers	pre-feasibility, feasibility, impact assessments, PPA negotiations, project development, EPC, sub-EPC

Source: adapted from Hansen et al. (2015), Pedersen et al. (2016), Bhamidipati et al. (2020).

For this report, a few of the newer categories are mentioned under 'others' in the analysis section.

As will be shown in the subsequent sections, most local solar PV companies in Kenya operate in multiple market segments within the PV market. They consist of companies offering diversified products and services across different PV market segments and/or PV appli-

cation areas, such as electrification, health, irrigation and industry.

In the following section, the approach and methodology used in the report are described further.

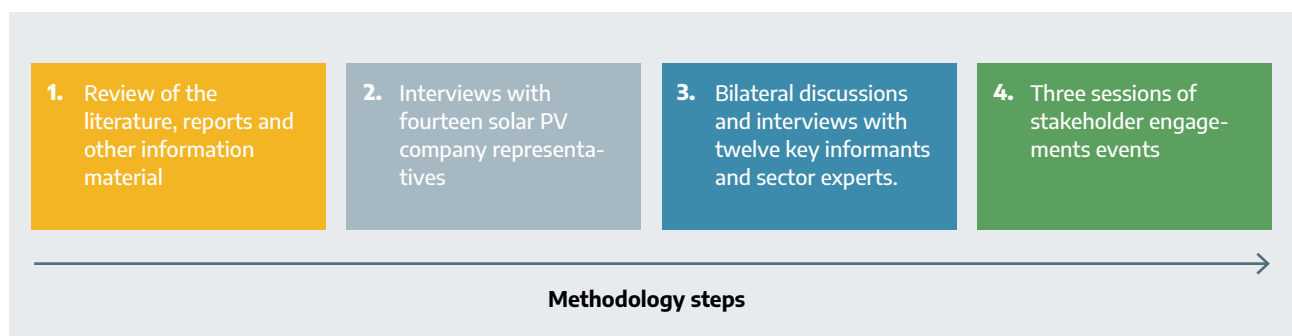
3. Report methodology

This report is the result of work over a year in which the project has interacted with stakeholders in Kenya and internationally to advance understanding of how to strengthen support for domestic companies in the PV sector in Kenya. The report draws on research methods like in-depth qualitative interviews with selected industry representatives and key experts, as well as co-creation methods through which project stakeholders take part in framing problems and in formulating ideas and recommendations.

The report draws on data and insights gained through the following four methods:

- 1) **Review of the literature, reports and other informational material.** This included reviewing several existing programs, reports and policy documents, as well as information materials allowing us to be better informed about ongoing initiatives, key stakeholders and the state of the art about various market segments and policy issues. This includes reports by international organizations, think-tanks, NGOs and donors, including IRENA, USAID, GIZ, SIDA, WRI, SE4ALL, UNEP, AFD and AfDB, among others.
- 2) **Interviews with fourteen solar PV company representatives.** For this report, the author team conducted an empirical study of domestic PV companies operating across all PV market segments in Kenya. We focused specifically on domestic Kenyan companies, which we define as companies that are fully owned or in which Kenyan nationals have a majority stake (see [Appendix D](#) for more details of the selection criteria of the local companies). In our definition, this does not include the Kenyan subsidiaries of international companies. Interviews with fourteen companies focused on the decisive events in each company's trajectories, business choices, strategies, partnerships, growth plans, milestones and past challenges (see [Appendix B](#) for a list of the companies interviewed and [Appendix A](#) for local company profiles.). It is important to note that we have selected and focused on those local companies that have grown and thrived for over five years, which is an indicator of a certain level of maturity and experience. Prior to this work, part of the team conducted a market study of the Captive C&I PV market in Kenya, which was published in May 2020 in a separate report (see [here](#)). As part of this, private-sector companies servicing the market and impact investors interested in clean energy were interviewed.

FIGURE 1. Sequence of methodological steps followed



Source: authors' own elaboration.

- 3) **Bilateral discussions and interviews with twelve key informants and sector experts.** The author team interviewed and engaged in bilateral discussions with fifteen stakeholders and key informants involving government representatives, financiers, industry associations and other international organizations active in the PV sector in Kenya, to gain insights into the themes of local entrepreneurship, access to capital and the supportive SME ecosystem in Kenya (refer to [Appendix B](#) for an overview of the stakeholders interviewed). Some of these interviews were also carried out in order to identify needs not covered by existing projects and programmes and to build on the ongoing activities and initiatives that provide support to the local PV SMEs. Lastly, the team have had ongoing exchanges and bilateral discussions with many of the fourteen domestic PV companies involved. This process helped us validate key findings, fill data gaps and discuss points that needed clarification. Subsequently, we have charted a roadmap, which is part of the previously mentioned policy brief, based on the suggestions of the workshop participants, interviews carried out with stakeholders, and several follow-up email and telephone exchanges with local companies on specific points identified during data analysis.
- 4) **Three stakeholder engagement events.** The project has hosted a series of stakeholder engagement events to present findings, obtain feedback and co-create actionable recommendations. The overall goal in these events and engagements was to move beyond problem-framing to ideation and the formulation of potential solutions. Events included: 1) on 20 May 2020, a webinar to discuss the market for captive PV with representation from UNEP, EPRA, OfGEN and KAM (summarised [here](#)); 2) on 24 June, a workshop to discuss findings specific to domestic firms across all market segments with representation from the Ministries of Industry and Energy, the Regulator and Renewable Energy Association and eleven Kenyan PV companies (summarised [here](#)); and 3) on 7 October, a dialogue session to discuss how to expand domestic finance for local companies with representation from five Kenyan commercial banks, nine Kenyan PV companies and expert stakeholders, including HiVOS, SUNREF, AfDB and RTI (summarised [here](#)).

It is important to note that there are some limitations in the data collected. In particular, it has been difficult to gather comprehensive quantitative data of projects or systems implemented for the individual companies, especially with regard to the sales of solar-pico and SHS systems, but we have captured the portfolios of the most important projects of the companies as far as possible. In addition, there are also some discrepancies in the data. In some cases project portfolios were reported in terms of the capacity of installations (kW, MW), in other instances in terms of the total number of projects or size of project investments (in USD). We also experienced cases in which it was difficult to obtain information about the exact role of the company in the project's implementation, meaning that there might be some duplication in counting portfolios across companies.

Furthermore, the development trajectories of the companies identified in this report capture mainly those movements that worked, being both feasible and possible. These obviously do not indicate directions and trajectories that the companies did not explore, or which they explored but were not successful. For example, in one instance, a company remarked that they tried distributing solar lanterns for a Chinese manufacturer, which subsequently proved not be worthwhile economically. There are other examples of such unsuccessful ventures which we have not covered in detail in this report, but which we consider to have been an essential part of various companies' development trajectories.

PART I

Findings on the domestic solar PV market

4. Market presence and business models in PV market segments

In this section, we describe the current market presence of the fourteen domestic companies in Kenya across the various market segments. We focus on their roles and activities within each of these segments before proceeding to give an overview of the various business models they use.

4.1. Market presence and roles of local companies

Table 2 provides an overview of the market segments within which each of the fourteen companies operate. As can be seen, the majority of companies operate across two or more market segments and only a few companies specialize fully in just one market segment. Furthermore, the table shows that the ‘captive systems’ segment is the one in most companies are active.

Pico products and solar home systems (SHS)

Companies in this segment sell small-scale solar systems, such as solar lanterns, mobile chargers and SHS, and typically collaborate with a financial institution to provide loans to customers. Some companies also sell clean cook stoves as a complement to the product portfolio they offer to customers for their solar products. Six of the interviewed companies operate in this segment. Many of the local companies operate as local distributors, sales agents and retailers of products supplied by importers and manufacturers, such as Davis & Shirtliff, Greenlight Planet, d.light and Sunking. The companies operate mostly on the basis of a direct purchase model and rely on traditional third-party distribution networks, including local co-operative societies and micro-finance networks, such as supermarket chains, bank branch offices, electrical shops and even

local churches. While the local companies act as distributors, they also arrange last-mile credit for rural customers.

Stand-alone institutional systems

In this segment, companies are engaged in procurement, installation and servicing the installations, typically as part of government contracts or NGO contracts. Six of the companies actively bid for Ministry, County, NGO and donor contracts and tenders to install PV systems usually below 10kW as a way of safeguarding themselves from market uncertainties and ensuring a steady flow of income. These engineering, procurement and construction (EPC) contracts are typically followed by annual operation and maintenance (O&M) contracts that are mostly given to the same companies. Some of these contracts are voluminous multi-year contracts spread across the country, for instance, covering three hundred schools or more. Reportedly they also typically involve bureaucratic tendering, medium- to long-term implementation timelines and payment delays.

Mini-grids for rural centres and villages

In this segment, companies design, procure and construct mini-grids using small hydro- or solar PV technology for another organization that operates the grids, sometimes supporting the local community in maintaining the grids. There are only a few domestic companies currently active in the mini-grid segment, but many others are waiting for KOSAP¹ tenders to be issued for carrying out more mini-grid projects in fourteen under-served north-eastern counties. In our sample, two companies are active in this segment, one which is experimenting with collaborating with a community over a model for a mini-hydro project,

¹ The Kenya Off-Grid Solar Access Project (KOSAP) is a project of the Ministry of Energy, financed by the World Bank, and aimed at providing electricity to parts of the country that are not served by the national grid using off-grid and mini-grid PV installations. KOSAP has a target of providing 1.3 million households in large swathes of north-east and northern Kenya with electricity. These counties are West Pokot, Turkana, Marsabit, Samburu, Isiolo, Mandera, Wajir, Garissa, Tana River, Lamu, Kilifi, Kwale, Taita Taveta and Narok. The project is being implemented jointly by the MoW, KPLC and REA.

TABLE 2. Market segments in which the interviewed local companies operate

Company Name	Pico products and SHS	Stand-alone institutional systems	Mini-grids	Captive systems	Utility scale	Others
Automax		x	x	x		Energy audits
Epicentre Africa		x				Water pumps, water treatments, water filtration
Go Solar	x	x	x			Other electrical appliances
Harmonic Systems		x	x	x		Advice on energy efficiency
Kensen					x	None
Knights Energy		x	x	x		Energy audits, ICT, e-mobility,
Multilink	x	x			x	Cook stoves
Mwangaza Light	x					Cook stoves, electric pressure cookers
Ofgen				x		Energy audits, e-mobility venture
Power Point Systems	x	x	x	x		Electrical appliances
Questworks				x	x	Design-build company, energy audits
Skynotch	x		x	x		Advisory consultancy services
Solafrique	x	x		x		Energy audits, sale of electrical appliances, water pumps, research and consultancy projects
Solar Poa	x		x			Water pumps, research, consultancy projects

Source: authors' own elaboration.

while the other company is still at the pre-construction phase. In addition, two local companies have previously implemented mini-grids. Some companies have been involved in the installation of mini-grids through involvement in donor projects or government projects (e.g. Knights energy, Harmonic systems, Powerpoint etc.) and/or county contracted projects.

Captive PV systems for commercial and industrial consumers

In this segment, companies design, procure, install and service captive solar PV systems for residential, commercial and industrial consumers, as well as PV pumps for potable water and irrigation in the agriculture and horticulture sectors. These companies typically rely on direct purchases by clients, or collaborate with a financier to offer loans. Nine of the interviewed

local companies have been able to grow their businesses by specializing in this growing market, focusing in particular on projects for industrial and commercial clients. This market has grown rapidly in the past five years, with installations of nearly 40 MW capacity (Bhamidipati et al., 2020). Given the government's plans for more industrial parks, this market is set to rise further, and domestic companies are playing a key role in this segment. Several of the interviewed Kenyan companies are scaling up their activities to implement up to 5 MW of captive solar PV projects in less than a year. In addition, project development within the C&I market segment is also becoming an important area of interest in identifying and closing viable and profitable PPA opportunities with credible off-takers, thus creating and offering project opportunities pre- or post-construction to long-term investors such as pension funds.

Utility-scale PV

In this segment, companies develop grid-connected solar PV projects (which they sell to another organization that is responsible for the EPC contract and operation of the plant), or provide sub-EPC services to other project developers. Two of the interviewed Kenyan-owned companies are undertaking project development for utility-scale PV projects with a capacity above 30 MW. Here project development includes identifying a site location, conducting feasibility studies, making environmental impact assessments and carrying out legal due diligence. It also involves submitting requisite documents to the electricity regulatory authority EPRA setting out the cost structures, negotiating a power purchase agreement (PPA) to cover tariffs, an implementation agreement, legal conditions and obtaining a license to operate. This could take up anything from five to eight years, and most local companies currently have limited capacities to fully implement large-scale projects like the full EPC and O&M. Typically, after the PPA is signed, international companies buy out the project company and take it over.

Having discussed the different market segments in which local companies operate and the various roles they play, the next sub-section complements this by looking further at their project portfolios.

4.2. Portfolios of the local companies

In the following, we take a brief look at the portfolios of the local companies in the form of their past projects and installations, as revealed during the interviews. However, it is important to note here that difficulties emerged in collecting comprehensive quantitative data for individual companies, or in some cases to obtain the exact role of the individual company in a project's implementation.

From a broad summary, and totalling up the installations of all the interviewed local companies, we find that they have undertaken the following:

- Installed systems for over 600 schools, 100 health centres and several institutions
- Installed at least 25 mini-grid projects of varying sizes
- Implemented captive solar PV systems totalling over 12 MW, with several others in the pipeline

- Project development for two utility-PV projects and sub-EPC for two additional utility-PV projects
- Sales of over 10,000 solar PV products and over 5000 cook stoves
- Several consultancy and advisory projects for various clients.

Further details on the portfolio of local companies are presented in [Table 3](#).

In the previous sections, we have described the solar PV market segments in which the local companies operate, along with their project portfolios. As a continuation, we now turn to describe briefly some of the business models used by these companies.

4.3. Business models adopted by the companies to grow in the market

As indicated above, the local companies operate across various market segments, involving different customer bases, different product volumes, financing needs and revenue generation models. While a few local companies continue to focus a large part on product sale and distribution networks, along with arranging credit for their customers (e.g. Gosolar, Multilink, Mwangaza Light), most other companies operate in the services domain, including offering project-development services, consultancy and advice, EPC and after-sales O&M services, requiring varying degrees of specialization (e.g. Ofgen, Epicentre, Questworks, Solafrique, Harmonic, Knights).

The product-oriented companies focus their business models on the sale of products with lower profit margins targeting larger volumes of sales. Their activities are concentrated on product purchases and maintaining an inventory, logistics and supply-chain management, and developing sales and distribution chains through local partnerships. A lot of the entrepreneurial efforts undertaken by these companies are devoted to the development of reliable networks, local partnerships and bundling their products with local sources of finance (e.g. village loan savings associations and local banks). These companies have built a larger pool of marketing and sales professionals, along with lower-end technicians involved in conducting after-sales services. Some of these companies have also benefitted from direct economic and technical support from var-

TABLE 3. Highlights of some of the key projects and installations of domestic companies

Company name	Pico products and SHS	Stand-alone institutional systems	Mini-grids	Captive systems	Utility scale	Others
Automax		Limited number of systems (4-5); stand-alone systems	2 mini-grid projects in Turkana (20 and 30kWp)	5 grid-tied systems (3, 60, 80, 160 and 160 kWp); 2 projects in pipeline (150 and 200 kWp) in Marsabit		5 energy audits for clients in the hotel, NGO, commercial buildings and manufacturing sectors; 10 solar PV feasibility studies for flower farms, malls, hotels and universities
Epicentre Africa						Water treatments, water filtration. 4 PV water pump systems of 10hp for Red Cross and Safaricom. Several other such projects later in Turkana, Madera, Garissa counties. Several water treatment-based PV systems
Go Solar	Several solar pico products, and home systems	Installation of systems for nearly 200 schools and institutions	Installed several mini-grids between 10kW to 60kW in north-eastern Kenya			Other electrical appliances, and installation of solar street lights
Harmonic Systems		Installed several PV systems for refugee camps in Dadaab		Several C&I projects (in the range of 30-200kW) for commercial farms, buildings etc.		
Kensen					Project development for a 40MW project in Lamu	
Knights Energy		Installed PV systems in 60 health centres for DFID	12 mini-grid projects of 60kW for REA	Captive C&I systems installed in nearly 60 Total petrol stations, both as sub-EPC and main EPC. Pipeline - Captive PV systems for 25 industrial clients		
Multilink	Sales of several pico village kits for phone charging to dispensaries and community centres	PV installations for several schools as part of the Last Mile program			Project development for a 40MW project	Cook stove sales to nearly 500 households and more. Won two grants (government) for distribution of cook stoves.
Mwangaza Light	Sales of pico PV systems - bright products through retail stores, church network - at least 500 units. Sales of 6000 solar lamps and mobile charging units, and 50 sound systems.					Sales of 4000 cook stoves

Company name	Pico products and SHS	Stand-alone institutional systems	Mini-grids	Captive systems	Utility scale	Others
Ofgen				Installed of captive PV systems of over 5MW for lodges and commercial consumers; several others in pipeline		Several energy audits and energy management consultancy projects
Power Point Systems	Several electrical and solar consultancy projects; sales of 20 watt PV products; Sales of 3000 PV systems of less than 12 watts	Powering several schools as part of government tenders. Powering 380 schools for a MoE tender	10 mini-grids of 60kW capacity each	Installed 5 captive PV systems totalling 1.2 MW		
Questworks				Over 4 MW of installations, mainly captive PV systems for industrial, residential and institutional clients. 600 kW for Strathmore University, 20 installation for Total petrol stations	Sub-EPC for two utility-scale PV projects totalling 80 MW	
Skynotch	Sales of pico systems, lanterns, etc. for d.light products, managed 4 distributors of solar lanterns and 12 last mile agents		Installed 20kW wind-solar hybrid mini-grid for UNIDO			2 water PV pumping, borehole projects (15kW each). Consultancy/advisory services on energy resource mapping for 44 counties. Project development of small hydro of 7.5 MW; Early development for another 7.5 MW hydro project.
Solafrigue	Sales of solar home systems powering fridges, TVs and lighting.	Early development electrification of healthcare 180 facilities (I and II)		Developed 2 captive PV projects for commercial farms.		Installed/implemented over 3 PV pumping projects totalling 70,000 litres per day.
Solar Poa			Early development stage for a 20MW PV mini-grid in Garissa	Installed 25 kW and 50kW captive PV systems for flower farms. Implemented solar pumps projects (3). Pipeline projects for captive PV systems		Undertaking several research and consultancy projects on solar PV

ious government and donor-funded programs aimed at promoting off-grid solar PV diffusion through private-sector investments. Some companies (e.g. Skynotch, Mwangaza) have tried specific partnerships (e.g. Omnivoltaic, Burn) for product distribution, while others have distributed products from various manufacturers.

The service-oriented companies focus on meeting specific consumer requirements, designing relatively larger solar PV systems, conducting engineering work, and installing and maintaining the systems. The stand-alone institutional installations (installed e.g. at schools or in health centres) are typically part of larger government or donor tenders where the design is specified in the tender requirements. Conversely the market for captive solar PV rooftop systems and solar-powered water-pumps is driven by a demand from private enterprises and hence is more commercial in nature. Such projects require designing and sizing the system and handling the entire procurement and installation. These companies have invested in recruiting technical and engineering staff (as opposed to distribution and sales employees) with the ability to design systems and handle the more complicated maintenance services,

along with project development and customer engagement. These companies have a strong need for funding to provide their working capital, as they will normally cover the EPC costs until the system is commissioned and the payment is made. The revenue streams are relatively more complex, as the margins are spread out across various stages of the procurement process (equipment import) and installation of the system. The funding options available for the local companies and the consumers in this market segment vary from development finance institutions, impact investors and commercial banks. A smaller group of local companies (i.e. Kensen, Multilink) also engage in project development, including pre-project construction, for even larger-scale utility solar PV projects (in the range of 40MW-80MW).

While these various business models are adopted by the companies in order to grow in the market, several business models and financing structures are available and are being exploited by the off-taker, thereby increasing PV uptake and demand.

Table 4 provides a summary of the various business models that are tied to the different market segments.

TABLE 4. Overview of PV business models and means of financing for the off-taker

Market segments	Business models and means of financing for the off-taker
Pico products and SHS	<ul style="list-style-type: none"> • Direct sales to customers • Non-PAYGO distribution through third-party networks (formal and informal) • Financial support from micro-finance institutions and cooperative societies (i.e. MFIs, SACCOs) • Through commercial bank loans secured by the consumers
Stand-alone institutional systems	<ul style="list-style-type: none"> • Public and donor-supported schemes with companies installing and maintaining systems • Grant-based model, funded by international donors, NGOs or government-run programs
Mini-grids	<ul style="list-style-type: none"> • Public and donor-supported schemes operated through public tenders (e.g. KOSAP tenders) • Commercial mini-grid projects with financial support from development banks and commercial banks • Community-collaborated mini-grid projects
Captive PV systems	<ul style="list-style-type: none"> • Direct purchase or loans from commercial banks obtained by consumers at market rates • Concessional loans by commercial banks (supported by donor funds, e.g. AFD, WB) for consumers at low interest rates • Technology bundled with financing (Project SPV model) offered to the consumer along with a contract or PPA agreement • Leasing model, either operating lease or lease to own (offered by an ESCO)
Utility-scale PV	<ul style="list-style-type: none"> • Project development by local companies till PPA is signed and later sold out to an international company • Sub-EPC services performed against fixed contract payment

Source: authors' own elaboration.

5. A closer look at local solar PV companies in Kenya

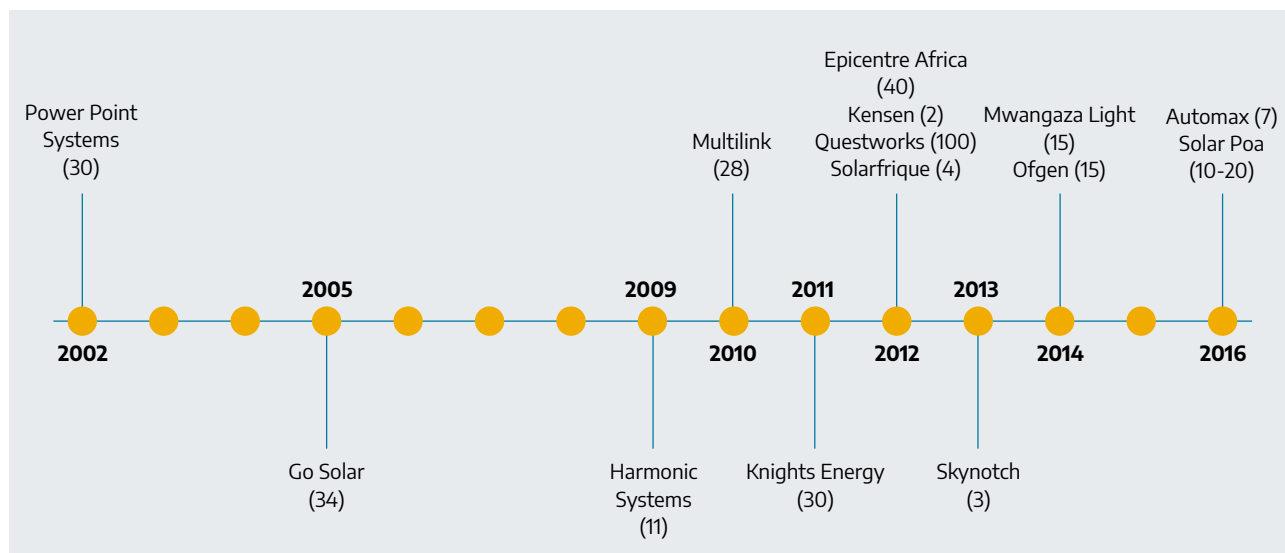
In the following section, we will present further information about the fourteen solar PV companies, mainly in terms of age and size, the founder’s educational profile and work experience, company-level competences, including staff strengths and companies’ linkages and support networks in terms of skills, knowledge and learning as well as finance.

5.1. Company characteristics

The age of the companies covered in our sample range from four to eighteen years (see Figure 2), and their annual turnover ranges from 100,000 USD to 5 million USD. Three of the companies (Epicentre Africa, Solafrique, and Mwangaza Light) have female founders and/or directors. Two companies (Powerpoint and Go Solar) are over fifteen years old and another two

(Automax and Solar Poa) under five years old. Most others have eight to ten years age and experience. The older companies seem to have a relatively large staff, but this is not true for all companies. Most companies fall into the category of small-scale enterprises with between ten and twenty permanent employees.² Only four companies (Automax, Kensen, Skynotch, and Solafrique) fall into the micro-enterprise category, having a total staff count below ten. The companies with the largest staff sizes include Questworks, Epicentre, Go Solar, Knights and Powerpoint Systems. At least three of these companies also have staff working on other businesses in parallel, such as water systems, ICT, e-mobility and building construction, potentially contributing to a higher staff figure. In general, most local companies seem to avoid recruiting many full-time permanent staff and prefer outsourcing tasks to consultants, sub-contractors and temporarily hired

FIGURE 2. Age and size of domestic solar PV companies in Kenya



Source: authors’ own elaboration.

² Micro-enterprise: Jobs < 10 people; Turnover ≤ KSh 500,000; (max \$5000); Plant/Machinery ≤ Ksh 10,000,000 (Manufacturing). Small enterprise: Jobs 10 – 50 people; Turnover KSh 500,000 - KSh 5,000,000; (\$5000 - \$50,000); Plant/Machinery KSh 10,000,000-50,000,000 (Manufacturing). Medium enterprise: (not covered by the SME 2012 Act) Jobs 50 – 100 people; Turnover - \$50,000 - \$8mn.

technicians on a needs basis for specific projects. This is mainly because of market uncertainties, due to which the companies require flexibility and need to avoid salary costs in times when less work is available. The older companies have relatively higher levels of stability, but not necessarily higher rigidity to change, whereas the newer companies have relatively less stability but greater flexibility in chasing new opportunities and markets.

5.2. Educational profiles and work experience

Of the fourteen companies, the founders/directors (FD) of at least seven have a background in engineering, with five of them in electrical engineering, obtained from universities in Kenya. The FDs of the remaining companies have non-engineering educational backgrounds, including commerce, accountancy, law, business management and even philosophy. The details are indicated in Table 5 below. Seven FDs have stud-

TABLE 5. Educational profiles of the local entrepreneurs

		Education in Kenya or in international universities (in the UK and US)		Training in engineering or other university-level training	
Companies		Education in Kenyan universities	Education in international universities	Education in engineering	Education in marketing, ICT, social sciences, other
Automax	Founder 1	Yes		Mechanical	
	Founder 2	Yes		Electrical	
Epicentre Africa	Director	Yes		Agricultural	
	Co-director				Finance
Go Solar	Founder 1	Yes			Maths and chemistry
Harmonic Systems	Founder 1		Yes	Electrical	
Kensen	Founder 1				NA
Knights Energy	Founder 1				Religion and philosophy
Multilink	Founder 1	Yes			Law
Mwangaza Light	Founder 1		Yes		Anthropology
	Founder 2	Yes			Business management
Ofgen	Founder 1	Yes	Yes	Electrical	
	Founder 2		Yes		Law with Business Studies
Power Point Systems	Founder 1	Yes		Electrical	
Questworks	Founder 1		Yes	Electrical	Construction Management
	Founder 2		Yes	Electrical	Engineering & Public Policy
	Founder 3	Yes			Commerce
	Founder 4	Yes			IT and Commerce
Skynotch	Founder 1	Yes			BSc Communications and Languages
Solafrique	Founder 1	Yes			Accounting
	Founder 2	Yes			Finance
Solar Poa	Founder 1		Yes		International Relations and Political Science

Source: authors' own elaboration.

ied in foreign universities, four of whom had obtained degrees in electrical engineering.

Most FDs have acquired a university degree, which they reinforced with additional skills and knowledge through other avenues. Many of them have undergone a series of training programmes building on their engineering training. These range from technician trainings offered by EPRA and SERC via supplier and vendor training on specific equipment to executive courses and certificate courses on project financing (e.g. those offered by GIZ in Kenya), business management and project management.

Moreover, beyond their respective educational backgrounds, the work experience of FDs is reported to have shaped their abilities and skills. Specifically, their work experience consists of: i) technical PV experience of other projects or companies, ii) specialised experience of other sectors, and iii) experience of exposure to donor and development organizations. For instance:

- Companies like Ofgen, Go Solar and Powerpoint systems have FDs with prior technical work experience in other solar PV companies and implementing projects, including in the areas of sales and marketing. Some have also employed directors or managers with a strong background in business management and marketing.
- Companies such as Harmonic Systems, Knights Energy, Epicentre, Questworks and Solafrique have FDs with strong specialization and work experience in fields not related to solar PV, such as ICT/hardware, building and construction, water systems, investment banking and event management, who have branched out organically and found opportunities in allied markets such as solar PV.
- Companies like Skynotch, Multilink and Mwangaza Light have FDs with substantial exposure to and experience of multilateral development organizations, donor agencies, international consultancy firms and the like, such as UNEP and UNIDO, which positions them uniquely to benefit from such international linkages in mobilizing resources.

Based on the interviews, it appears that educational backgrounds or university degrees in isolation may not in and of themselves be critical factors in a company's

development. Rather, it appears that it is the specific combination of skills and experience (market exposure), along with networks, that the owners are able to bring together that matters most for business development.

5.3. Firm competences

We find that most of these companies have at least two FDs; many also have at least one employee serving the HR/admin function, together with a host of technicians, engineers and sales staff. The proportion of sales staff is significantly higher among companies focusing mainly on product distribution and sales (e.g. Go Solar, Powerpoint Systems) and the proportion of technicians and engineering staff is higher among the EPC companies that concentrate on designing, installing and maintaining systems (e.g. Harmonic Systems, Knights, Ofgen, Questworks). Few companies (e.g. Epicentre, Multilink, Mwangaza) also have specialized staff equipped with specific knowledge related to water filtration, desalination processes and finance, or to handling specific equipment, such as cook stoves and grid-tied invertors. A few companies have advisory board members to provide advice on reducing business risks, securing new clients and contributing to building credibility for the company.

The strategies adopted for the hiring and recruitment of new staff vary across the companies. Many of the directors or founders maintain close relationships with local university centres offering electrical engineering degrees and specialized solar PV-related training. Some of them also provide lectures based on their real-world experiences (e.g. Ofgen) and offer demonstrations showing how to install a small solar PV system (e.g. Automax). For some companies, this is rewarded economically while at the same time enabling access to the recruitment of top of the class technicians and engineers. Other companies (e.g. Questworks, Harmonic Systems, Knights) prefer a more ad hoc approach to recruitment, which includes a rigorous interview process, seeking more students able to think out of the box (which does not necessarily mean choosing only top-scoring students), more practice-oriented students, and also focusing on continuous in-house trainings post-recruitment. Yet, other companies (e.g. Knights, Go Solar) prefer to hire fresh graduates on

internships for shorter periods of six months to a year to evaluate their performance.

In sum, most local companies have invested in developing the skills of in-house staff based on their respective needs while experimenting with different ways of recruiting and hiring, though the retention of qualified staff is difficult across the board.

5.4. Support networks

5.4.1. Skills, knowledge and learning networks

Local companies have been able to tap into various opportunities for start-up mentorships, incubation, accelerator support and business management support offered by supporting institutions. In addition, these companies have also been able to access a range of additional training programs for technicians, specific equipment, project implementation and health and safety, among others.

Some of the companies reported having availed of and benefitted from the entrepreneurial and incubator support programs that have been offered by organizations. This includes i) Kenya Climate Innovation Centre (KCIC) (incubation and mentorship programs), ii) Strathmore Business School (short-term executive courses and long-term courses), iii) Venture Capital 4 Africa (VC4A) (accelerator program), iv) ENEL Foundation (entrepreneurship program), v) Open Africa Power (various education ventures), Enlight Institute (workforce support), and vi) GIZ (various technical assistance programs). The local companies have also availed themselves of the business advisory services offered by international organizations, development partners and DFIs, including GIZ, IFC, RTI International, Power Africa-USAID, SIDA and industry alliances, among others.

The local companies have also acquired support through practical training programs and courses, market knowledge, policy insights and skill-building opportunities provided through the Strathmore Energy Research Centre, GIZ programs, EPRA training courses, KEPSA and KERIA training courses and workshops, GOGLA conferences, and need-based training courses provided by specific vendors (for panels, batteries, inverters, etc.), including SMA, Victron, Fronius, Hoppecke, Jinko and courses offered by vari-

ous international organizations, including the German Chamber of Commerce.

Companies such as Ofgen and Skynotch reported having benefitted from KCIC's business support, knowledge networks, office space and joint collaborations in international programs. Skynotch mainly operates from the open colab space provided by KCIC. Ofgen, Questworks and Solafrique have also benefitted in being linked to and associated with the Strathmore Energy Research Centre and the Strathmore Business School. Questworks grew as an architectural construction firm from within Strathmore University, its founders being associated as a faculty at the university and as a procurement/supply chain lead for the University. Solafrique has benefitted from partnerships with SERC regarding research and consultancy assignments. One of the founders of Ofgen was an alumnus of SERC and was responsible for the 6ookW captive project installed by the University. These companies have relied on strong local linkages and networks to grow and develop their core competences.

Some local companies also reported having benefited from peer learning, that is, learning from other companies and their experiences. For instance, Knights Energy began working in the solar PV sector, having diversified from their ICT portfolio. They accordingly engaged in knowledge exchange with the founders of other solar PV companies, such as Harmonic Systems, to gain a better understanding of the hardware, market, consumer demand and business models involved. Another company, Mwangaza Light, benefitted from local linkages when they took over almost the entire staff of a local cook stoves company, expanded their knowledge base and diversified their product portfolio to include selling cook stoves to their solar PV customers. Multilink benefitted in terms of knowledge and learning by entering into exclusive product partnerships with international companies, such as Bosch and Siemens. Ofgen collaborated with an experienced South African EPC company (Sustainable Power Solutions-SPS) to enhance their internal capacities and implement captive PV projects. Several local companies have also collaborated on projects by entering into sub-contract agreements for specific activities including procurement or installation.

In sum, local companies have benefitted significantly from programs supporting skills development pro-

vided by international organisations. This includes short-term trainings, skill-building programs and incubation support. More importantly, formal and informal intra-industry peer exchanges, the industry-academia nexus and industry-vendor relations have been crucial, particularly for continuous learning.

5.4.2. Financing linkages and networks

Domestic companies have various options for securing financial support for their business operations. This includes personal and family savings, supplier line of credit, commercial bank loans, staggered client payments, loans provided by private lenders and investors, development funds from DFIs, international debt financiers and impact investors.

In many instances, the companies (including Knights Energy, Harmonic Systems, Ofgen) have secured lines of credit from the vendors or suppliers in order to purchase the solar PV equipment and maintain a steady inventory flow. This has reduced the upfront costs that local companies are unable to pay, particularly if there is a pipeline of multiple projects under way. These credit allocations are contingent on the company's track record and credibility, including its prior payment history, contract agreements with clients and the age of the company.

Some companies have resorted to borrowing from private lenders and investors with less stringent collateral

requirements, while others have secured loans from commercial banks by mortgaging their own assets (e.g. include Epicentre Africa, Skynotch). A few others have been able to access impact investment funds and international debt finance from organizations like Sunfunder, SIMA (e.g. Questworks) or climate funds like Kenya Climate Ventures (KCV) (e.g. Ofgen). DFIs are also routing funds via commercial banks at concessional interest rates (e.g. SUNREF AFD), which makes financing available to large industrial clients for adopting PV systems. In a similar vein, development banks like AfDB have come up with initiatives like the Energy Inclusion Facility (EIF) and IFC with Financial Sector Deepening (FSD), which attempt to cater to smaller businesses and small investment sizes. In reality, however, only three companies (e.g. Ofgen, Questworks, and Skynotch) have received finance from these institutions.

In sum, the domestic companies rely to a large degree on short-term and informal funding solutions, like lines of credit from suppliers or customers, family savings, and loans from acquaintance networks, which puts them in a vulnerable position. Relatively few companies have been able to access debt finance from commercial banks or impact investment funds.

All of these linkages under this sub-section are summarized and presented in [Table 6](#).

TABLE 6. Overview of the key linkages through which the fourteen companies have accessed knowledge and financing

Company	Financing linkages	Knowledge linkages
Automax	No loans or external credit as yet. Been seeking commercial bank credit but are lacking collateral.	Prior work experience of founders in an energy consulting firm, training courses from European vendors, sub-contracting partnership with an international company, training in proposals and finance by GIZ.
Epicentre Africa	Personal savings, using local networks to access private credit, and commercial bank loans with private asset collateral.	Significant prior work experience in government, NGO and donor networks, strong technical partnerships with companies and product suppliers in Europe, India and China, and certifications for niche specialization.
Go Solar	Loans from individuals, supplier line of credit, and government tenders for projects.	Long prior work experience in other solar companies, strong linkages with NGOs, vendor trainings (SMA).
Harmonic Systems	Relying mostly on commercial business, haven't accessed external finance yet but supported consumers by linking them with financiers	Significant prior work experience with data, hardware management, vendor trainings (SMA, Victron), trainings by EPRA and SERC.

Company	Financing linkages	Knowledge linkages
Kensen	No external finance yet apart from winning a competitive grant. Currently seeking funding from climate fund and development banks.	Business and financial advice from private financing advisory network (PFAN) and strong understanding of financing platforms and opportunities.
Knights Energy	Loans from private individual credit sources, support from local networks, and supplier line of credit.	Significant prior experience in ICT industry, learning from local solar network, training courses and webinars by manufacturers, trainings by GIZ, SERC, Nairobi Technical Training Institute and University of Nairobi.
Multilink	Combination of personal savings and small investors; has also won two competitive grant funds and government tenders.	Strong prior experience of working with UN agencies, technical support and partnerships from international companies; training courses by local universities.
Mwangaza Light	Relying on competitive grants so far, seeking loans from commercial banks in near future.	Strong prior experience of working and engaging with development agencies, partnerships with manufacturers and suppliers, and strong local business networks.
Ofgen	Personal savings, commercial bank loans, supplier line of credit, and impact investors. Funding from KCV (World Bank).	Experience of working from SERC and implementing PV projects, close ties with the human resources pool (technicians), KCIC.
Power Point Systems	Personal savings, local networks, and government tenders for projects.	Significant work experience with solar companies, learning on the job, vendor training courses, advisory from a pool of local experts in their network.
Questworks	Sunfunder (working capital) and SIMA, impact investor.	Spin-off of from University of Strathmore, close ties with SERC and co-founder from the Strathmore Business School.
Skynotch	Donor projects, multilateral development banks AfDB.	Significant prior experience with donor agencies, co-working space and support from KCIC, support from accelerator programs (VC4A), strong linkages with consultancy network, strong internal research capacity.
Solafrique	Personal savings and loans from small investors, currently seeking commercial bank loans and impact investments.	Research contracts from SERC, strong local networks in the sector, and vendor training courses.
Solar Poa	Personal savings and loans from commercial bank.	Strong local advisory networks and partners, Kenyatta University, dedicated advisory board, vendor training courses, private finance advisory network.

Source: authors' own elaboration.

6. Development trajectories and business strategies of local companies

In the previous section, we took a closer look at the solar PV companies in terms of their core characteristics, age and size, educational profiles, competences and support networks. In this section, we delve more deeply into analysing their development trajectories, that is, the specific ways in which they have grown and evolved over time, as well as the business strategies that enabled them grow in the market.

6.1. Development trajectories of local companies

The interviewed companies have operated in the solar PV sector for from five to twenty years performing various activities and services, and over time, across multiple market segments. As reported by the company directors in this sample, in some cases these changes were random and opportunistic, being part of their business explorations, whereas in other cases

they were the result of a strategically planned development trajectory to grow as a company and to increase market share. While the roads travelled by individual companies are diverse, through our analysis we have identified twelve different trajectories, which we have grouped into three categories representing ways in which companies:

- 1) move towards new and more advanced functions within solar PV markets
- 2) branch out towards new solar PV market segments and/or deepening within the same segment
- 3) move into allied sectors and non-solar markets.

Figure 3 provides an overview of the twelve identified development trajectories within these three categories.

Each of these trajectories are further elaborated in this section and through Tables 7-9.

FIGURE 3. An overview of the development trajectories of local companies

<p>Moving towards newer, improved functions within PV</p>	<p>Product sales/distribution → Services → Small-scale PV installations Sub-EPC → EPC + O&M Incorporating digitization, automation, use of digital tools</p>
<p>Moving into newer market segments within PV and/or more sophistication within the same segment</p>	<p>SHS (over-the-counter 'grey market') → SHS SHS/Pico and institutional PV installations → Mini-grid or C&I captive systems Small-scale PV systems (electricity) → Solar water heaters (urban), PV pumps (agriculture), water filtration (water) C&I simple system → C&I larger and complex systems Mini-grids, C&I Captive PV) → Utility-scale PV</p>
<p>Moving into allied sectors and non-solar markets</p>	<p>SHS → Cook stoves /clean cooking products/Electric pressure cookers Standalone PV institutional systems → Energy efficiency, energy management solutions C&I Captive PV systems → Electric vehicles/E-mobility SHS → Standalone PV installations → Small-hydro, solar-wind-hydro hybrids</p>

Source: authors' own elaboration

TABLE 7. Development trajectories of companies moving towards new, improved functions within PV

Development trajectory	Description	Examples
Pico and SHS product sales/distribution → Services → Standalone institutional installations	From simple product distribution franchise to a service-based company undertaking small-scale PV installations in health centres, schools, NGO offices and/or smaller captive PV installations. Overall, increasing the range of functions performed and enhancing the skill levels of the tasks.	Skynotch, Solar poa, Solafrique, Automax, Epicentre
Sub-EPC → EPC + O&M	Moving from being contracted for sub-EPC services to scaling up capacities to cater to full EPC functions, client advisory and project development to operations and maintenance (post-project implementation services). Significantly enhancing the skill levels required for the improved functions.	Harmonic Systems, Knights Energy, Ofgen, Questworks, Epicentre
Incorporating digitization, automation, use of digital tools	Providing services such as data analytics, incorporating smart meters and integrating with data-monitoring tools to enhance efficiency and optimize energy consumption and reduction. Diversifying the skill sets and knowledge to improve service provision and add new functions.	Ofgen, Harmonic Systems, Knights Energy

Source: authors' own elaboration

The development trajectories in the tables are all trajectories observed among the fourteen companies. Most companies have followed more than one trajectory, and all trajectories have been observed in more than one company.

We find that many local companies that are moving towards new, improved functions within PV started their business operations mainly by distributing and selling solar PV products (pico and SHS), gradually transitioning into procuring and installing smaller-scale solar PV systems for schools and health cen-

tres. In addition, some companies that operated as sub-contractors and performed a smaller part of the EPC work (e.g. construction) have since moved on to offer the full range of EPC services, including designing systems, sizing, installation and maintenance. In addition to EPC services, a few companies have upgraded to incorporating more digital tools, such as smart meters, to decode energy consumption patterns and incorporating software systems for real-time monitoring of system performance and energy consumption.

TABLE 8. Development trajectories of companies moving into new market segments within PV and/or acquiring more sophistication within the same segment

Development trajectory	Description	Examples
SHS (over-the-counter 'grey market') → SHS	<ol style="list-style-type: none"> Moving into selling more sophisticated, complex products Business model innovation: <ul style="list-style-type: none"> – Moving from independent distributor to bulk distribution – Online market place – Creative distribution channels SHS product diversification, enabling PAYGO 	Go Solar, Powerpoint Systems, Mwangaza Light
SHS/Pico and Institutional PV installations → Mini-grid and/or C&I captive systems	From selling smaller home systems, phone-chargers and lanterns to installing mini-grid projects incorporating electrical engineering, system installation, transmission & distribution etc. and captive projects, expanding the application base and adding new skills (engineering, O&M).	Solar Poa, Skynotch, Solafrique, Go Solar, Powerpoint Systems,
Small-scale PV systems (electricity) → Solar water heaters (urban), PV pumps (agriculture), water filtration (water)	From installing PV systems with an electricity end-goal to diversifying and installing PV systems for integrated services, including irrigation, increased agricultural productivity, water quality improvements, water heating in urban contexts etc., thereby diversifying the products base, using similar competences and reaching out to new customers.	Harmonic Systems, Automax, Solar Poa
C&I simple system → C&I larger and complex systems	<ol style="list-style-type: none"> from single-site to installing systems for multi-site, larger system sizes, and more complicated engineering from simple grid-tied systems to those involving battery storage and multiple energy sources, such as mini-hydro, thereby enhancing the skill sets, improving functions and adding more competences. 	Questworks, Ofgen, Harmonic Systems, Knights Energy
Mini-grids, C&I Captive PV) → Utility-scale PV	Moving from operating in the smaller-scale PV space to large grid-scale PV segments to perform functions like project development, feasibility analysis, due diligence and sub-EPC services like construction work. Employing similar competences, but also focusing on increasing the scale of operations.	Questworks, Kensen, Multilink

Source: authors' own elaboration.

Some companies that are moving into new market segments within PV and/or acquiring greater sophistication within the same segment have diversified into other market segments, including mini-grids, or into solar-powered water pumps. In the process, technicians with core electrical skills have branched out to acquire more diversified skills sets to install PV systems. Their knowledge of hardware has diversified beyond core electrical appliances, and some have even changed teams and moved from product sales to more administrative functions, including client management and procurement handling. We also find that many of the local companies in this category that have

followed any of these trajectories have changed over time from focusing on small solar PV pico systems via small-scale solar PV installations to relatively larger-scale installations, including the captive solar PV segment, thereby also diversifying their customer base from rural customers and households to industrial customers and businesses. A few companies are in the process of enhancing their ability to undertake project development (e.g. Multilink and Kensen for 40MW projects) or conduct sub-EPC work for large grid-scale PV projects (e.g. Questworks undertook the construction work on an 80 MW PV project).

TABLE 9. Development trajectories of companies moving into allied sectors and non-solar markets

Development trajectory	Description	Examples
SHS → Cook stoves / Clean cooking products/ Electric pressure cookers	From selling pico and solar SHS products to selling clean cooking products (cook stoves, electric pressure cookers, solar cookers etc.) to similar groups of consumers, thereby expanding into additional product markets with similar competences and functions.	Multilink, Mwangaza Light
Standalone PV institutional systems → Energy efficiency, energy management solutions	From PV installations to diversifying the skills base to also providing allied energy services, especially to industry and buildings, to optimize energy consumption/demand, sell and install energy efficient products/appliances, and provide advisory services.	Knights energy, Questworks, Ofgen, Automax
C&I Captive PV systems → Electric vehicles/E-mobility	From installing PV systems for industrial clients, offering energy management services and providing low-carbon energy to expanding into transport, especially low-carbon transport, selling EVs and setting up charging stations etc. Expanding into completely new product/service domains, new set of functions, competences and skill-sets with a strategic motive.	Knights Energy, Questworks, Ofgen
SHS → Standalone PV installations → Small-hydro, solar-wind-hydro hybrids	Moving from core PV domain of selling pico and SHS products, installing small-scale PV systems in schools/health centres etc. to exploring wind-hydropower or solar-wind hybrid projects and implementing small hydro projects (being technologically agnostic) with a focus on strategy and viable business models.	Skynotch

Source: authors' own elaboration.

While some of these companies, in moving into allied sectors and non-solar markets, are seeking to increase their market share in the solar PV sector further, others are diversifying away from it into other allied sectors and services. Some of these companies have moved towards offering more integrated energy services combining energy efficiency and renewable energy. These activities include energy audits, energy planning and energy consumption monitoring, and generally involve less competition with international companies. Others have diversified into clean cooking and cook stoves or into the transport sector by exploring e-mobility (Ofgen, Knights). Yet others expressed the intention and ambition to localize the value chain further by scaling up local assembly and aiming to manufacture locally in part.

In addition to the trajectories discussed above, we also uncovered a tendency for some of the local companies that are currently operating in the solar PV sector to have been engaged in very different markets previously. This includes hardware and ICT support, the distribution and sale of water filters and water treatment systems, architectural and construction work, project management and event management. Some companies also operate in allied sectors such as clean cooking (cook stoves) and energy efficiency (including energy

audits and energy management consultancy). At least six of the fourteen companies started their journey in a non-solar PV sector. While some of them have moved on to develop an entirely solar PV-based portfolio, others have retained and continued to operate their earlier businesses in part. This has also meant that some of the staff in these companies (e.g. Knights Energy, Questworks) have had to adapt and re-skill themselves and assume new roles through additional training and learning by doing. In other instances, some companies have benefitted from strong subject-matter expertise (such as water specialization), which complements their solar PV expertise (e.g. Epicentre Africa).

6.2. Business strategies

The process of changing trajectories across sectors, market segments and service functions described in the previous section is the result of a combination of random and pragmatic choices being made along the way and more strategic planning by these companies. The development trajectories of companies are aimed at unpacking “what” the companies did over time, whereas business strategies inform us better about “how” they managed to stay competitive. Moreover, having analysed the development trajectories of com-

panies retrospectively, we have identified the following five business strategies which domestic solar PV companies in Kenya have applied over time, either randomly or consciously:

- Niche specialization: focusing on niche specialization and availing of niche advantages through deepening
- Diversification: diversifying from one focus area into two or more product domains as a way of diversifying income sources and also balancing out the risks.
- Business innovation: offering products through creative distribution channels, or through different business and implementation models.
- Networking: forming partnerships, collaborating, and alliances to offer joint services and to leverage new opportunities.
- New markets: spatial or geographical expansion to capture new markets and countries, thereby gaining a competitive edge.

Most companies seem to have benefitted from a combination of these business strategies, thereby capitalizing on various opportunities to grow. The details of these strategies are elaborated further in [Table 10](#).

In sum, the strategies of the newly established companies are typically opportunistic, as they focus on exploring emerging market opportunities. On the other hand, companies with over five years of experience in the solar PV market have employed one or more of the above-mentioned strategies, whether deliberately or not, across different time periods within their development process. Drawing on and combining these strategies have been useful to local companies in finding a competitive edge for themselves within a constantly evolving and highly dynamic market. The following boxes provide further details of some of these strategies and describe how businesses have employed them to develop themselves further.

For a further brief account of individual company journeys and a snapshot of their evolution, refer to the company profiles in [Appendix A](#).

TABLE 10. Business strategies employed by local companies

Business Strategy	Description of the business strategies of the MSMEs	Examples
Business Strategy	Description of the business strategies of the MSMEs	Examples
Niche specialization	A few companies have focused on a narrow area of specialization, which establishes a niche area where they may have a relative comparative advantage in operating, for instance, in securing government tenders for powering schools and health centres, and for selling SHS through formalized distribution channels. These companies grow steadily, rather than operating in a rushed and opportunistic way.	Go Solar, Ofgen, Kensen
Diversification	Some companies have focused and specialized in one or two areas (product-oriented or service-oriented), instead of fully branching out and operating across a range of products and services. In some cases, this involves a combination of a stable low risk area and an uncertain high-risk area, and/or two fully stable areas of specialization. This is used either as a deliberate risk-mitigation strategy or as a way of generating newer income streams through new opportunities.	Knights, Ofgen, Epicentre, Questworks, Harmonic Systems, Automax, Multilink, Solafrique
Innovative or unique service offering	Some local companies have found ways to thrive by working with different business models and service offerings. This includes collaborating with unique retail networks (electrical shops, local supermarkets), or distribution networks (churches), developing community-supported projects through unique partnership arrangements, or forming an SPV with other companies and financiers for bundled offerings.	Powerpoint Systems, Mwangaza Light, Go Solar, Skynotch, Ofgen
Networking	Many companies have gained and complemented their expertise and resources through collaboration, partnerships and alliances of various kinds with other EPC companies, freelance experts, financiers, or suppliers and manufacturers.	Ofgen, Harmonic systems, Knights, Solafrique, Multilink
New markets/ Spatial Expansion	Many companies have also ventured beyond Kenya and have implemented projects in Uganda, South Sudan, Somalia, Ethiopia, DRC, Burundi, Zimbabwe etc., thereby leveraging 'low hanging fruit' markets outside the country's boundaries (but with difficult logistics) and increasing market volumes. Some have also opened branch offices in these countries.	Ofgen, Skynotch, Powerpoint, Go solar, Harmonic Systems, Mwangaza, Knights

Source: authors' own elaboration.

Box 1: Innovative offering and networking strategy

Companies such as Powerpoint Systems and Go Solar, in addition to offering newer and tailored products, have also moved to enhanced ways to reaching out to their last mile consumers "through online marketplace, capitalizing on e-commerce, using social media and google ads to get referrals", and through supermarket chains all over the country, through electrical shops and retailers, among others. These companies have had the advantage of an early entry into the

market, which gives them experience, and credibility. They have also had the advantage of deep NGO networks (e.g. Mercy corps, Red Cross), of stable long-term relationships with product manufacturers (e.g. SMA), and thereby supplier credit lines, regularised vendor trainings, and relatively hassle-free supply chain linkages. Through these manufacturer long-term relationships, they have also had more exposure to new and improved products, and the associated knowledge.

Box 2: Niche specialization and Diversification strategy

Some have opted for targeting specific category of users or consumer types within the same product offering. For example some companies (e.g. Ofgen) target only servicing blue-chip entities (Toyota, GSK, Swissport), some only commercial clients as hotels, or petrol stations (Serena Hotel, Total), even others (e.g. Harmonic Systems) prefer clients with systems capacities of less than 300kW. Through such niche targeting, these companies overall reduce the total market share but instead capitalizing on less volumes, stable growth, but also relatively less competition. In even another way of niche specialization, some companies (e.g. Kensen) have focused only in one product domain (e.g. utility-scale PV project).

Other companies have diversified from the sale of small pico systems and SHS to increasingly being involved in the design, management and installation of stand-alone (institutional) projects, and mini-grids (...). Yet others have also diversified

into selling other larger-sized PV products including solar powered water pumps, water heaters, and solar powered water desalination systems, and subsequently transitioning into installations for these systems (Powerpoint Systems and Go Solar). These projects require firms to manage a range of additional tasks related to the design, construction, operation and maintenance of the installations, including electrical engineering and project management. Some firms that previously operated as sub-contractors for other contractors of captive PV projects, for example by performing a smaller part of the EPC work (e.g. construction), have moved on to offer the full range of EPC services (Knights Energy, Ofgen, Harmonic Systems). Similarly, some firms have transitioned from being involved mainly in mini-grids or captive projects to being involved in large, utility-scale solar power projects (with installed capacities of up to 45 MW), and conduct sub-EPC work such projects (e.g. Questworks).

7. Summarizing insights on the domestic solar PV markets

7.1. Market presence and business models

- Most local solar PV companies in Kenya operate in multiple market segments. They consist of companies offering diversified products and services across different market segments and application areas, including electrification, health, irrigation and industry. Most local companies have recently moved away from the off-grid market segment. While some still rely on sales of pico and SHS, even fewer rely on agents and direct sales of small lanterns and such off-the-shelf sales alone, having moved on to the larger home systems market and other customer segments, such as television and refrigerators. Many companies view the market for pico and small home systems as only a side business for income-generating purposes, with lower margins but relatively steady income streams.
- Local entrepreneurs are able to leverage creative distribution and sales channels for effective market penetration for pico solar products and SHS. This includes partnering with churches, local retail stores, technicians, local distributor networks, supermarket chains and local branches of commercial banks. While such informal networks may not achieve scale, these are critical in accessing relatively low-income households with limited technological knowledge. That said, local companies also reported having been crowded out of the off-grid PV market to some extent due to stiff competition.
- Compared to their international counterparts, they may be less invested in any specific business models (such as PAYG, direct purchase, lease-to own, operating lease, co-owned), or in developing a long-term vision and deliberate strategies. They are geared more towards being opportunistic in a bid to survive, getting clients through word of mouth and referrals, improvising newer variations of business models, developing an expanding customer base, and exploiting local contacts and linkages with the help of referrals and on a trust basis.
- One particular strength identified across the companies is their ability to engage directly with their customers and in gauging their needs. Local entrepreneurs possess the skills, the strong awareness of specific local needs, including the language, and the culture. They have a good understanding of the contexts in which specific solar PV products are put to use, the incentive structures that constrain uptake, and the technological challenges for consumers. This might be one of the reasons behind the relatively high local business participation in the captive solar PV market, which requires in-depth engagement with the customer and their specific needs and preferences. This is quite different from marketing and selling standardized SHS products to a large mass of rural consumers, where larger multinationals have found a better presence, but with a greater ability to access donor and impact capital. This also indicates an almost parallel network through which locally owned companies have been able to gain ground and operate competitively while also facing some obvious disadvantages vis-à-vis international companies.
- It is important to note that several local companies have made significant headway into the rapidly growing captive solar C&I market and are also making increasing headway with solar water-pumping solutions, among others. Several local companies have implemented C&I solar projects and also are working on an impressive pipeline of projects. It is important to acknowledge the multiple roles (e.g. project development, EPC, arranging project structures and finance, technical complex execution with battery storage etc.) that local companies have been playing in furthering the uptake of solar PV among C&I customers. In a large number of cases, C&I consumers are able to avail themselves of commercial bank loans. In addition, donors and development

banks (e.g. AFD, USAID) have been supporting projects through concessional loans and specific leasing financing avenues (e.g. Crossboundary). The captive C&I solar PV market will continue to form a large part of the portfolios of local companies in the near future.

7.2. Company characteristics, education profiles, competences and support networks

- There is a tendency for many companies to rely on temporary, freelance staff in addition to limited permanent in-house staff. While this reduces their operating costs and strengthens their local networks, it also increases the likelihood of their not being able to access the right human resources at the right time. This outsourcing model can also be witnessed in the core business of some local companies. In some instances, companies outsource the project design component, installation, or operation and maintenance role to a third party due to a lack of expertise or resources or as part of their business strategy. Some companies focus their resources on the niche aspects of their businesses, partnering with other companies to carry out the rest.
- With regard to owners' skills and competences, we find that, independently of their educational background and experience, their rigorous technician training, vendor training, continuous learning by doing and practical exposure to projects have contributed immensely to building their overall capabilities. Moreover, some owners and directors also seem to have innate entrepreneurial abilities with or without educational degrees in entrepreneurship and business management. In our study, we find that, while university training is important, it needs to be combined with other hands-on training and practical experience. Whether technical training is at the university level or business training is at the university level is not so important, as long as the other training element is achieved through practical training and learning by doing.
- Beyond the challenges of education, training and capabilities, there are also inherent systemic biases that local entrepreneurs are subjected to. In our interviews, entrepreneurs reiterated this point and

stated either not being invited to high-level events or not being able to afford to gain access to them, such as exclusive business gatherings, and financing and matchmaking forums. In some instances, local entrepreneurs have had to engage with international consultants in order to pitch financial proposals and increase the likelihood of their securing funding. In general, companies with founders who have international exposure, international education or language sophistication have easier access to funding.

7.3. Firm competences

- Most of the companies included in this report have a full-time staff size of over ten, including sales staff, technicians and administrative personnel. Some also have additional advisory board members for advising on various business matters. Most companies value having a stable team of qualified employees.
- Across the board, the focus on competence development has mainly been in the areas of engineering and technical skills, which are perceived as crucial, and most companies seem to have less focus on finance, accountancy and business skills in general at either the management or employee level. In a rare case or two, local companies have a full-time finance officer and a junior staff member specifically handling accountancy and book-keeping.
- Companies have also strengthened their competences, both technical and financial, with the support of various local and international linkages and networks (formal and informal), including vendor training, skill-based training, executive business and finance coaching, and private support of individuals and consultants, among others.

7.4. Development trajectories and business strategies of local companies

- We find a lot of dynamism in the development trajectories among the local companies as they have grown and competed over time in different market segments, on smaller and larger scales, and across niches and diversified areas. This reflects the level of competition that the companies have faced from the

more established international companies in the market. These movements in their trajectory require them to reinvent themselves constantly and upgrade their capacities, knowledge and networks. More importantly, these movements seem to have been triggered by a variety of factors, including an impetus to increase their business turnover, to diversify and explore newer market segments, to consolidate the business to focus on a niche area and to satisfy entrepreneurial aspirations, among others. These movements in company trajectories entail expanding or consolidating their human resources or staff strengths, accessing or securing additional capital, gaining new competences and knowledge, and expanding their networks, among other things.

- Several of the domestic companies have moved away from pico solar and standalone institutional PV installations to providing relatively larger-scale installations (mini-grids and C&I), which is an indicator of companies scaling up and enhancing their capacities. In some instances, companies also continue operating and competing in smaller segments while moving into larger segments as a way of safeguarding themselves from market uncertainties. Within and across various market segments, some companies are strategically building their competences and offering services, including full EPC, digitization services etc. Yet others are also branching out in order to tap into allied sectors and markets with future business potential, such as energy efficiency, efficient cook stoves and electric vehicles.
- Companies' various development trajectories are not mutually exclusive: that is, one company has been pursuing more than one trajectory either at the same time or at different times. These are essentially different routes through which domestic companies have become competitive in the market and have survived and thrived over time. The process of trajectories across sectors, market segments and service functions involves employing business strategies, including niche strategies, networking strategies etc.
- Diversifying from a single country to similar markets in other countries is a strategy that many local companies are currently employing, mainly due to lower competition along with the opportunity to capture the 'low-hanging fruit'. While these condi-

tions seem to apply to remote areas of Kenya, such as the north-east, local companies seem to have relatively less success in these areas.

By summarizing the key takeaways and insights regarding the roles and activities of local companies in Part I of this report, we now turn to Part II to delve more deeply into understanding the most critical challenges that constrain these companies from growing and thriving further.

PART II
**Challenges for further
growth**

8. Impediments to the future growth of local companies

This section takes a closer look at the factors that are constraining the domestic solar PV companies and entrepreneurs from scaling up and ensuring a foothold in the market. There are a host of challenges that the local companies face, including regulatory, economic and financial challenges, uncertainties in market conditions, skills limitations, inadequate information and low quality of hardware.

In this report, however, we have chosen to focus on three specific challenges that the companies themselves highlighted as the most important barriers preventing their future growth: (i) finance; (ii) skills and competences; and (iii) policy and regulation. In the following sub-sections, we analyse the specific barriers within these three categories, providing a deeper understanding of the local company challenges.

8.1. Finance

According to the interviews, the most prominent barrier for the domestic solar PV companies' operations and scalability is their restricted access to credit from financial institutions, such as local banks, impact investors and donors. While this topic has gained immense traction in the literature, there are still several blind spots, particularly with regard to the financing of local solar PV companies. The difficulties in accessing capital vary depending on PV market segments and associated business models, the stage at which the funds are required, the time periods and the size of investments.

In general, the interviewees considered the capital requirements of local entrepreneurs to be small in size: for instance, the working capital needs typically range from 50,000 USD to 1 million USD, though concentrated towards the lower end of that range. This need for finance typically works against local entrepreneurs for two reasons. Firstly, most DFIs and impact investors are geared towards large projects and investments with high returns and large impact metrics. Secondly, the

transactional costs for international commercial banks or debt financiers in administering loans or grants are similar, regardless of the size of the loan, which disincentivizes smaller investments. To compound this problem further, many international investors have limited knowledge of Kenya, which sometimes leads to distorted perceptions of local entrepreneurs, the profitability of domestic companies and the high risks allegedly involved. Reportedly, international investors also typically fund companies that have a foreign partner or equity shareholder or that are owned by a parent company overseas.

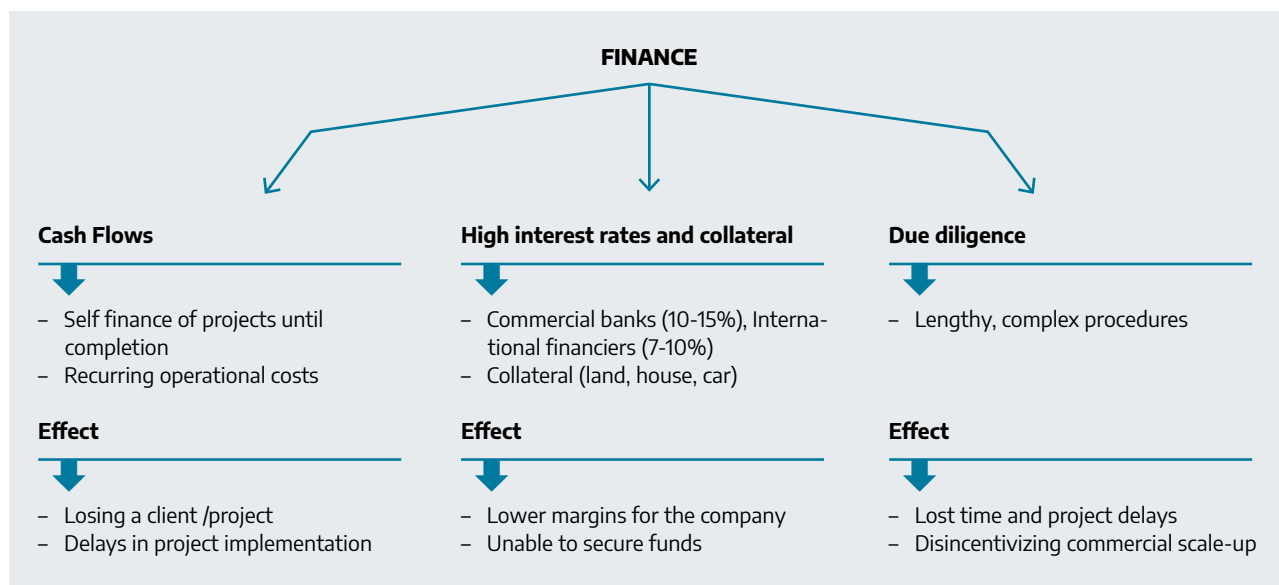
Some domestic financing avenues, including commercial banks and national development banks, have begun to extend support to local solar PV companies, but commercial banks often perceive the latter as high-risk customers, particularly those with a limited or no record of projects. According to our interviewees, this perception may be due to a lack of detailed knowledge of the solar PV market in the banking sector, as well as of renewable energy markets at large, particularly in the retail banking sector.

Even domestic solar PV companies that have been successfully operating for more than ten years still find it challenging to obtain credit and project financing. Many have benefitted from donor programs, NGO programs, donor funds, commercial bank loans and commercial ventures. However, most companies rely on a combination of personal savings and family networks for private lines of credit and, if obtainable, commercial bank loans or supplier credit. Based on the interviews, the three specific sub-challenges related to financial constraints are: i) high interest rates and demand for collateral, ii) constraints with cash flows and iii) due diligence (see [Figure 4](#)).

8.1.1. Constraints in obtaining capital for cash-flow needs

An acute lack of working capital is reported by all of the domestic solar PV companies as the most critical bar-

FIGURE 4. Key finance-related challenges and their implications



rier inhibiting the scaling-up of their businesses. For many, this means that they are obliged to self-finance their projects up until completion, which often extends from one to six months or sometimes up to a year. In this period, companies have to pay their sub-suppliers, as well as manage their operating costs. Self-finance is a problem both with direct customer payments (in the case of C&I, water pumps) and when project financing is involved (i.e. external financiers offering debt). There is a significant degree of risk involved for the companies related to their responsibility for making early project investments while waiting a stream of revenue later on.

8.1.2. High interest rates and collateral requirements for loans

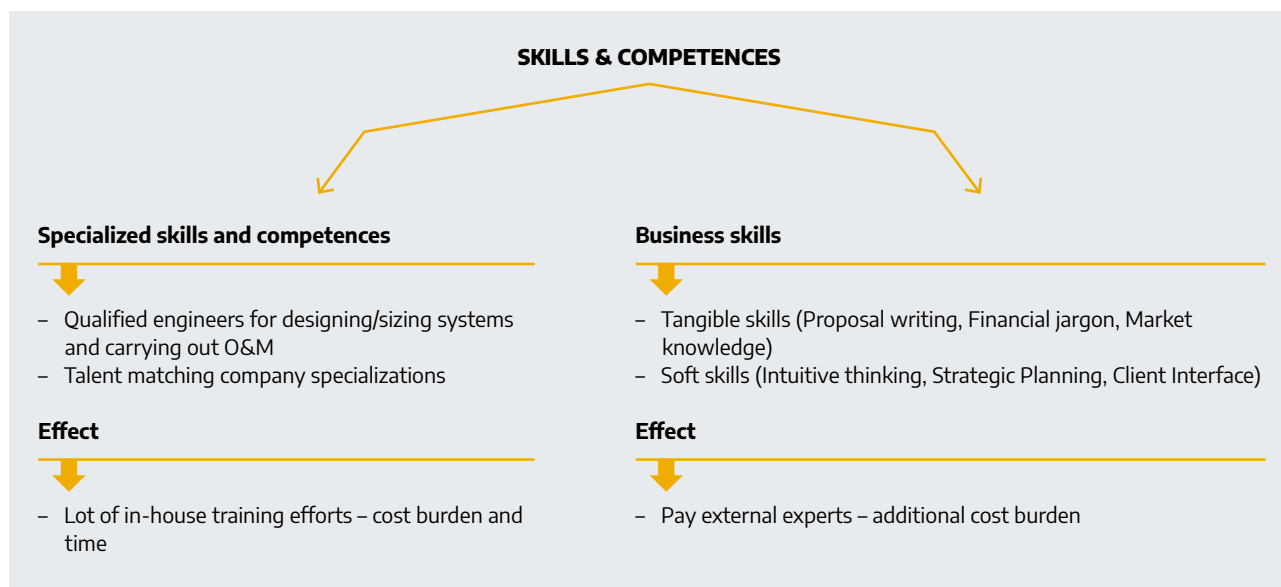
As mentioned above, many local companies need credit from external financiers such as local commercial banks to ensure working capital for projects and day-to-day operations. To minimize the risk of financial loss, it is standard procedure for banks to require either a guarantee or collateral in form of an asset such as land, property or a car to provide security for a loan. This collateral requirement presents a strong barrier for many companies in obtaining a loan, as they often simply lack such assets or have to mortgage private assets, placing them in a highly vulnerable position. Mortgaging solar PV equipment or providing signed contract agreements as guarantees is not acceptable to commercial banks in Kenya at present.

Furthermore, even with collateral, interest rates remain high, and commercial banks are mandated to charge anywhere between 10-15% or even higher in some instances, while international financiers may charge 7-10% on Euros or Dollars, excluding currency conversion charges. It is important to note that there is no cap on interest rates in Kenya, which implies that higher rates of interest could be charged by banks (based on their perception of business risks), while, given hedging, a lower cost international currency loan may not be very differently priced. The prospects of obtaining a loan at such high interest rates often discourage domestic solar PV companies from lending, as the interest rate affects their profit margins. As a result, firms are forced to operate with a very low margin of economic security and at the worst lose projects.

8.1.3. Lengthy due diligence procedures

Due diligence is a standard procedure for all financial institutions when screening the credit worthiness for borrowers. Our interviewees from the domestic solar PV companies describe due diligence procedures as being exceedingly lengthy and tedious. In some cases, they may last more than one year, the companies being asked to provide various documentation to prove their bankability, legal status, shareholder structure, tax compliance, technical competence and client referrals. Moreover, many financiers use international standards and benchmarks for lending, including environmental, health and safety standards, which is not always

FIGURE 5. Key skill-based challenges and their implications



well adapted to the Kenyan context. For instance, lending by international financiers often involves producing fully audited financials for the company, management accounts, environmental, social and governance due diligence, management interviews, and references from some of the company’s clients.

8.2. Skills and competences

The second pillar concerns skills and competences. According to the interviews, acquiring and retaining the right skills and competences is a challenge for many domestic solar PV companies. This is the case in terms of knowledge and the specialized technical skills of engineers and technicians for system design, installations, operations and maintenance, as well as in terms of business skills at the management level within the company. These skill needs and their implications are presented in [Figure 5](#).

8.2.1. Lack of specialized skills and competences

The interviews stressed that, while most companies have well-qualified technicians, sales and distribution managers, and administrative staff, they struggle to find people with specialized skills. Designing, sizing, operating and maintaining solar PV systems require very specific knowledge and qualifications. According to interviewees’ reports of their experiences, the engineers available in the market have a strong theoretical

understanding, but lack specific practical skills, which can only be acquired from practical work with solar PV systems. For example, the engineers may not understand how to size systems optimally and plan O&M tasks, and they have limited knowledge of up-to-date products, which prevents them from selecting the best suited charge controllers and batteries. This points to the overall issue of the gap between what is taught in university courses and the more practical skills required in the solar PV market in Kenya. This problem is magnified in areas outside Nairobi that have limited practical training opportunities. The low levels of practical training of staff is compensated for by in-house training and learning by doing, which involve time and costs.

Some local companies have specialized their business portfolios to such an extent that specific combinations of knowledge and skills are required that are not available in the company. For instance, specialization in solar PV and water treatment technology requires skills in both chemistry and electrical engineering, as well as more practical experience in installing solar-powered water pumps and purifiers. Consequently, many companies need to provide extensive in-house training to their employees enabling them to perform such tasks, which is both time-consuming and costly.

Furthermore, the important point to note here is that most companies prefer to have limited numbers of

full-time staff in order to reduce operating costs and avoid staff attrition. The companies in turn remain small, but rely on a large pool of freelance technicians, lawyers, finance specialists and skilled professionals who are employed on temporary contracts when needed for specific projects. However, this involves additional training costs, especially when the companies are unable to find staff with adequate skills and competences at the right time.

Lastly, companies find it difficult to retain trained staff, as their newly acquired skills make them highly attractive on the market. This means that the companies continuously have to allocate resources to the training of new staff.

8.2.2. Limited business and financial skills

A lack of the business skills required to access financial institutions and win awards of projects constitutes a strong barrier to local solar PV companies. Specifically, these companies lack the skills needed to write strong proposals and international grant applications, keep documented cash flow records and make complex financial calculations. This means that staff are often unfamiliar with the financial jargon needed to communicate properly with the financiers, and therefore companies often hire external consultants to conduct such work.

The companies also stated there were challenges related to “soft skills”, those related to client management, strategic leadership and organizational development. A few companies also indicated that they lacked market knowledge and up-to-date information about product availability on the market and the challenges of understanding demand patterns. These are aspects that are all crucial if the companies are to run competitive businesses and ensure the best competences and products. Furthermore, most of the decision- and strategy-making, along with all operational responsibilities, falls on the shoulders of the company owner, who is then overstretched, limiting the company’s activities, profits and growth.

8.3. Policy and regulation

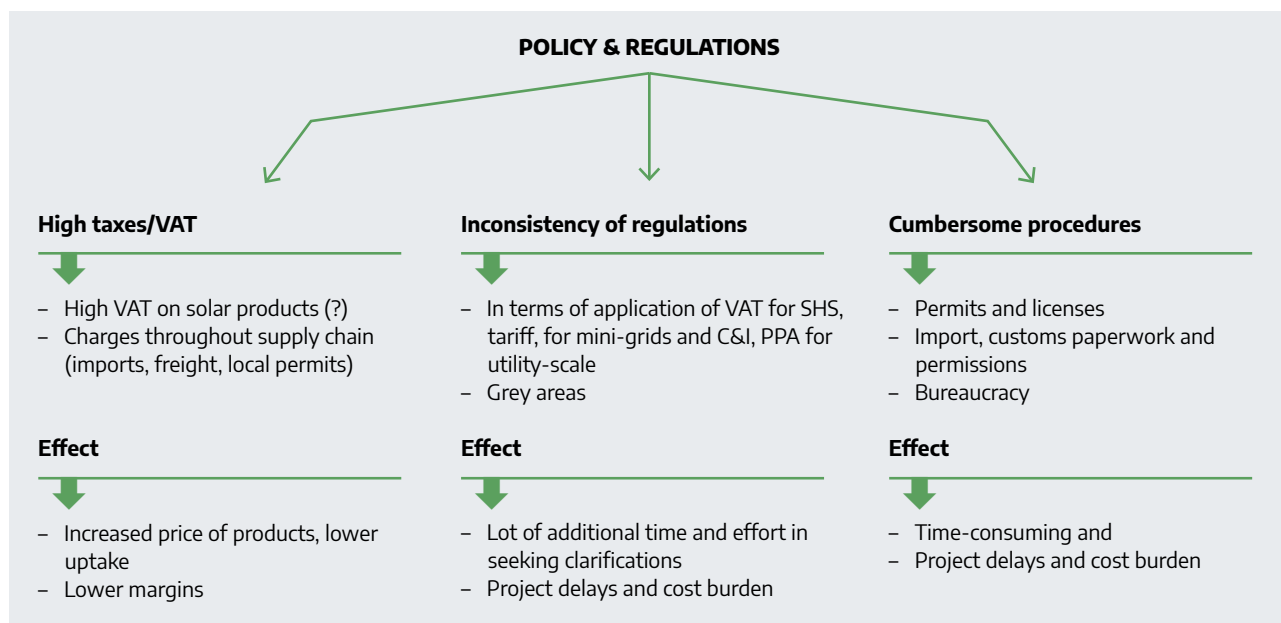
The last pillar concerns policy and regulation, which are crucial to providing the requisite support to domestic companies. Our interviewees indicated a range of barriers, which we prioritized as the three sub-categories that are shown in [Figure 6](#) and described in further detail below.

This entails three crucial points: i) high taxes/VAT; ii) unclear regulations and their inconsistent application; and iii) cumbersome procedures and bureaucracy. The implications of these challenges are higher product costs, lower potential uptake, project delays and the associated burden of higher costs. Solving these regulatory issues and reducing costs are important given the size of the market, as increased costs will normally be translated into increased prices, thus making products less affordable and less competitive compared to other alternatives (e.g. diesel or kerosene lamps) providing the same services. This would negatively affect the size of the market and may also reduce profits. It is important to note that in a few instances ‘unsolved’ regulatory issues or ‘less clarity’ also open up spaces for interpretation and negotiation, which are sometimes advantageous and other times disadvantageous to local companies. In this section, however, we focus instead on the challenges and constraints.

8.3.1. Taxes and VAT

In spite of PV products officially being exempt from import duties and VAT, in practice both are still imposed on several sub-components of PV systems. For a long time, this has been an ongoing issue for companies importing products and lacking clarity on how individual pico products, system parts or home systems are being taxed. This has led to higher product charges, lower margins for the companies and higher product prices for consumers, thereby reducing demand and the overall size of the market. In a few instances, companies have also become tangled in extended legal problems and unanticipated charges and fees, leading to big setbacks for the business. Moreover, a new VAT of 14% is currently being considered for reintroduction as part of the new Finance Bill in Kenya. The VAT percentage rate is constantly being changed, with new terms set nearly every financial year, which also leads to unpredictability and uncertainty, over and the above the absolute cost implications. In addition, various fees are charged throughout the sup-

FIGURE 6. Key policy-level challenges and their implications



ply chain from imports, customs clearances and local permits, which affects the companies' margins.

8.3.2. Unclear regulations, inconsistent application and grey areas

Inconsistent regulations can be seen in all market segments in terms of how VAT applies to solar PV and related products. In the case of solar PV mini-grids, for example, regulation is a grey area, since there is currently no regulatory system in place for mini-grids in Kenya. Rules for the allocation of distribution licenses have been ad hoc since 2015, agreed tariffs are temporary, and there is a lack of clarity on the question of integrating existing mini-grids with the main grid. For C&I systems, there are unclear regulations regarding the process of securing licensing permits and the systems that are exempt from the permit. Furthermore, companies involved in utility-scale solar PV systems have witnessed inconsistencies in the application of regulations when it comes to negotiations for power purchase agreements. In addition, domestic solar PV companies reportedly experience so-called "silo operations" among the institutions, resulting in different interpretations of the same regulation. Furthermore, there is a lack of clarity regarding regulations across all market segments, as they are still under development despite projects already being implemented. This applies, for example, to the mini-grid draft regulations, C&I PPA/leasing conditions, net metering

and a draft policy for an auction scheme. This means that companies must devote significant resources to obtaining clarification of the regulatory issues, which often results in project delays and additional costs. In a few instances, this has also resulted in the retrospective imposition of charges and fines by the revenue authorities.

8.3.3. Cumbersome procedures

Apart from the two points just mentioned, the domestic solar PV companies also point to issues of heavy bureaucracy, corruption, red tape and lengthy paperwork and procedures, not only when it comes to permits and licensing procedures, but also for imports, customs procedures and the various permissions and certifications involved, which are both complicated and time-consuming, involving major cost burdens and project delays.

These three sets of challenges have significantly hindered companies from scaling up further.

9. Conclusions and recommendations

The fact that local companies in the solar PV market capture only a small percentage of the investments and value has generated calls for action specifically targeted at supporting domestic solar companies and for targeted policies to create an enabling environment for this industry. While there is large international focus on how to expand the solar PV market in general, to promote energy access and to expand the utilization of domestic finance, little attention has been paid to how domestic companies can grow their share of this market. This report provides unique insights into fourteen domestic Kenyan solar companies that have been operating in Kenya for five years or longer, as well as firm-level insights regarding who they are, including their characteristics and portfolios, how they operate and have evolved over time and what different challenges they face.

Our findings show that Kenyan solar PV companies have been navigating and manoeuvring tight competition from international companies and their subsidiaries. These domestic companies have constantly reinvented themselves, entering various market segments from small-scale to relatively larger-scale, from distribution to installation, from government tenders and donor projects to commercial contracts. Some of this has occurred through random opportunism, whereas in other cases specific business strategies have been employed, such as investing in strategic linkages and networks, developing a credible pipeline of projects, developing longer-term relations with vendors and constantly investing in building internal capacities and skills.

Despite some of these companies having evolved and been established for nearly a decade or more, they continue to face significant challenges that impede and constrain their further scaling-up and from gaining still larger shares of this market. This has wider socio-economic implications and spill-overs beyond just technological diffusion and access to electricity, such as skills development, job creation and local con-

tent across the value chain. Some of the key challenges, as described above, are still concentrated in the areas of finance, skills and policy. Within these categories, these companies face very specific constraints which require targeted actions. This report has set out to address the needs and challenges that are specific to domestic solar companies and to provide recommendations for how this group of SMEs can be supported.

9.1. Recommendations

In the following, we put forward a range of specific recommendations targeted at the different stakeholders in the sector. These are not exhaustive and should be seen as only a starting point. The recommendations overall call for closer collaboration between industry players and supporting institutions, such as commercial banks, development partners, training and academic institutions, ministries and other government bodies to pursue coordinated and strategic efforts to strengthen the domestic solar PV industry. We also elaborate further on some of the recommendations in the form of a [policy brief](#).

Business associations and local companies

Business associations and companies are recommended to take the lead in pushing this agenda and contributing to solutions for change. This calls for better organization within the industry itself and a shared vision among domestic solar PV companies in order to strengthen advocacy and take the lead in forming the necessary partnerships (e.g. with banks and training institutions), as well as pushing for supportive policy formulations and making the necessary interventions on behalf of the sector as a whole. Domestic solar companies are diverse in terms of products, market focus, capabilities etc. However, while they are in reality competitors, the group of domestic companies as a whole would benefit from increased collaboration in order to strengthen their position, learn from each other and build stronger networks. This could take the form of

information-sharing, especially with regard to conveying solar PV business models and business cases to investors, as well as creating potential mentoring programs in which more established and successful companies exchange information and experience with other domestic companies either bilaterally or through other formats.

Domestic companies struggle to present adequate and appropriate information of high enough quality to investors. In this regard, the solar PV industry association could facilitate thematic seminars and workshops by engaging with expert stakeholders on these topics and/or facilitating peer-to-peer knowledge exchange. They could also take the lead in creating a platform for sharing the details of successful project proposals and projects and/or developing standardized information and data requirements for them. In addition, the links with training institutions and universities need to be strengthened in order to push industry needs into the curricula at the training institutions.

Banks associations and local banks

As domestic companies are largely dependent on commercial banks for financing, especially for working capital, there is a need for local banks and domestic companies to work on lowering the barriers to lending through strategic collaboration. The banking sector is increasingly recognizing the renewable-energy and energy-efficiency market as a future growth market for investments. However, the barrier of high collateral requirements, high interest rates and the lack of high-quality information on the part of the companies is found across the sector. Some donor programs and development banks (AFD SUNREF, AfDB, IFC) have been extending support to commercial banks with technical assistance and concessionary financing in a bid to reduce these barriers. Based on these experiences, commercial banks are recommended to establish a strategy for increasing their renewable energy portfolios. A sector-wide strategic focus by the banking industry on how local commercial banks can increase lending volumes and reduce access barriers by modifying lending terms and requirements will greatly benefit domestic companies. A realistic estimate of the risk metrics for lending to clean energy companies would also help commercial banks expand their lending volumes in this sector.

In addition, based on experience in the sector, the banks could explore new and innovative approaches to reducing the high collateral requirements. Examples of ways to bring down these requirements and alternative forms of security exist in the sector already. This information should be compiled, published and communicated in a form that can provide inspiration for the banking sector and domestic companies alike.

Lastly, retail bankers, who are often those who deal with loan applications from domestic companies, lack adequate expertise in the technical aspects and business modalities of solar PV projects. This limits their ability to assess the risk quotient of applications or to support companies with lending and financial transactions. Technical assistance and training support for banks are currently routed through development partners (such as IFC, World Bank, AFD) and are targeted mainly at the corporate banking level. Banks should therefore focus on in-house training and knowledge exchange between the corporate and retail levels. In addition, formal collaboration between solar PV training institutions, private-sector associations and commercial banks could focus on training bank staff in the technical aspects and business modalities of solar PV projects.

TVETS, universities, training institutions and research institutions

Domestic solar companies face challenges with a range of broader business skills. This includes problems in writing proposals, making complex financial calculations and understanding financial jargon (terms, concepts) in order to communicate with financiers, and presenting adequate, appropriate and high-quality information to investors. Currently, solar PV curricula developed by TVETS and universities have a strong technical concentration and are less focused on the important business and financial aspects. TVETS and universities are therefore recommended to include these aspects in their curricula and course design.

Furthermore, there is a gap between what is taught in traditional university degrees and TVET courses, and the practical up-to-date experience needed in what is a changing and dynamic market. One option is for training institutions to come together with the private sector and the government to establish a formal multivendor forum to provide specialized top-up courses in collaboration with solar PV vendors. Such multiven-

Forums could be complemented with other formal channels of knowledge-sharing, like a regular solar PV conference or a national skills competition, to ensure continuous learning and greater exposure to new technological developments.

Government and development partners

Although solar PV companies are often MSMEs, they are not necessarily viewed as part of industrial policy realm from the policy perspective. Domestic solar companies could benefit from stronger linkages between energy policies and industrial development policies and from targeted interventions cutting across the two ministries to achieve synergies between SME development and energy development.

Donor- and government-supported financial guarantee schemes and concessional loan schemes in collaboration with commercial banks are other important instruments for improving lending conditions for domestic companies and reducing the risks for lenders. While many such schemes already exist, they tend to be under-used by international companies operating with large ticket-sizes. It is therefore recommended to explore why existing finance (portfolio) guarantee schemes are under-used by domestic companies and design schemes in targeting the specific needs of domestic companies. One possibility is a debt fund that can make relatively small individual investments, as suggested by Sanyal et al. (2020).

Government, development partners and international funders alike should seriously consider introducing and implementing local content requirements, for instance, as part of their tendering and funding criteria, determine the extent of local employment benefit generated as part of their funding modalities and introduce transparent reporting requirements regarding them. This inclusiveness will help promote the development of more domestic solar PV companies, but it could also lead to more local spillovers of services – local suppliers, sub-contractors, local repairers, among others – thus creating potential scope for local assembly. Development partners could also introduce local content requirements for domestic banks and offer long-term working capital (or patient capital) as they disburse concessional loans for clean energy projects.

Future directions and research

With regard to knowledge production and market intelligence, yearly market reports with detailed breakdowns of market segments, as well as analyses of specific business models and their characteristics, are important knowledge products that can support companies and investors alike in decision-making. For newer market segments, including some productive use segments and C&I PV, there is an opportunity for private-sector associations to establish dedicated chapters to work with members on sharing and publishing data. Furthermore, relevant data and knowledge generation in support of company-specific insight-generation and research, including, inter alia, company portfolios, linkages and strengths, could be published in the form of a domestic solar PV company database showcasing domestic companies. Such research and market knowledge can help establish a better understanding of the domestic sector when information is limited for international as well as local investors. Future work could also be conducted to arrive at standardized and better adapted risk indicators and benchmarks to assess the credibility of local companies, instead of strictly imposing international safeguards and expectations. In terms of academic research, there is a further opportunity to analyse the agency of domestic PV companies and their upgrading potential in the PV market from the perspective of global value chains.

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Appendix A.

Local company profiles: highlighting the individual journeys and a snapshot of their development over time

1. Knights Energy

Knights Energy specializes in PV systems for businesses, NGOs and residential clients. The founder has over a decade of experience in ICT, which helped the company transition to the energy sector. With nearly five years' experience in energy, it has implemented grid-tied PV projects of over a 1000 kW for C&I clients (as sub-EPC and EPC contractor). This is in addition to several smaller PV projects in health centres and schools for donor projects (e.g. DFID) and government contracts. The company is expanding its captive PV portfolio and venturing into allied businesses, including energy efficiency advisory services and energy efficient appliances for households, as well as experimenting in the domain of e-mobility (selling EV cars in Kenya). Knights is a resilient company, willing to experiment and learn from its mistakes. Its growth in the last three years has reportedly tripled, and its current ambition is to create a one-stop centre for clean energy and energy efficient products and services.

2. Power point Summary

Powerpoint specializes in the sale and distribution of electrical systems and PV components nationwide through 200 dealers, retail outlets, online web sales and partnerships with supermarkets. With over fifteen years of experience, the company has developed a reliable supply chain and inventory. The founder and director has a background in electrical engineering and a decade of experience as a sales engineer in PV, which led to him developing a strong local network. The company's portfolio has expanded into the implementation of small-scale PV installations to electrifying schools, covering over 500 schools and powering health clinics for international donors, NGOs and the Ministry of Energy. Powerpoint has provided critical labour resources to the utility-scale 50MW PV project in Garissa. Lately, it has diversified further by providing EPC services for captive PV systems for C&I clients, and now has a portfolio of over 1000kW. Powerpoint is a steadily growing, well-structured (with an advisory

board), well-networked, resilient company with vast experience in the PV sector.

3. Skynotch Summary

Skynotch Energy focuses on installations of renewable energy technologies (including solar, wind and hydro) mostly through mini-grids for productive use. The company prides itself in having operated for nearly seven years, with the founder having experience in working with donor institutions and sharpening his skills in project management, design and resource mobilization. Skynotch has evolved from distributing pico PV products, SHS and installing solar water pumps to project development of mini-grids and conducting energy resource mapping for counties. Skynotch's flagship project is a small hydro project of 7.8 MW in Meru, which has completed its development phase and secured funding from AfDB. The project is piloting a community-collaborated SPV model that allows for a community stake in the project. In the future, the company aims to build more hydropower and hybrid projects in the productive use of energy.

4. Solar Poa

Solar Poa, which is a subsidiary of Sacred Ventures, specializes in the installation of distributed renewable energy solutions such as mini grids, and solar water pumps for irrigation and the distribution of SHS in off-grid areas. The company is led by a team of four experts with diverse backgrounds in engineering, academia, editing and communications, operations and management, but with relatively limited experience in the renewable energy sector. Solar Poa's current focus is on counties located in so-called arid and semi-arid lands (ASALs), where the company has partnered with counties to develop mini-grids and share ownership. The company has also partnered with international manufacturing companies, acting as their local distributors in a bid to diversify its own portfolio. The company aims to focus on irrigation PV pumps and the C&I market in the next five years.

5. Questworks

Questworks was formed in 2012 as an offshoot from Strathmore University. The four directors have high educational qualifications and diverse backgrounds in engineering, public policy, IT and commerce. The company initially began with a focus on international procurement for Strathmore University and later on diversified its portfolio to cover engineering, architecture and solar PV installation. Questworks installs solar PV through Renewable Energy Solutions (Resol), which is the company's renewable energy solar PV division. The company describes itself as a solar service provider in the C&I market for solar PV and energy efficiency solutions. Questworks has installed 4 MW of solar PV to date in C&I and was subcontracted by an international EPC for a total of 80 MW (combination of two projects) in Eldoret. The company has been nominated for and won many awards, for example, for energy efficiency.

6. Solafrique

Solafrique specializes in a range of offerings, from retailing solar PV back-up systems via project installation for institutional and C&I PV to offering consultancy services, among others. The founder and CEO has a background in finance and has worked closely with financial institutions supporting the solar PV sector. The company's current focus is on county government, which it helps develop their energy county plans owing to the opportunity provided by the Energy Act 2019 for the participation of local companies at the county level. So far the company has installed around 75kWp of captive solar, as well as solar water-pumping systems.

7. Automax Engineering

Automax focuses on solar PV installation for C&I PV, mini-grid and SHS. However, it has diversified its portfolio by offering electrical and energy management services. It has also partnered with a local Kenyan university, where they installed prototype solar PV systems to assist in training and for demonstration purposes. Their flagship project was a Somalia project, which was a 320 Kwp battery system in Somalia, where the company was subcontracted by UNOPS to take part in the installation. With six years in operation, the company aims to focus mainly on C&I systems in order to grow its portfolio.

8. Ofgen

Ofgen company's focus is on the C&I PV market segment and the LED lighting system, as well as on sub-metering. Its portfolio is an extension to their energy management offering, in which conducted energy audits for its clients. The company has over six years of experience, with an installation capacity of over 5 MW. The company has leveraged partnerships with financial institutions and international solar PV companies to grow its offering in terms of skill and the provision of capital. It has also conducted several projects from project inception to completion. Ofgen has organically grown to serve other countries in East Africa, such as Uganda and Tanzania, while aiming to grow its reach further.

9. Go Solar

Go Solar was formed in 2005 with an initial plan to focus on the NGO market in remote areas of Kenya, Somalia and South Sudan. The company's founders have experience in working for one of the first solar companies in the country and thus have used early market entry to give it a competitive edge. The company has installed a wide range of systems, including solar water heaters, off-grid and on-grid large solar PV systems, and mini grids. Go Solar has achieved key milestones, such as being subcontracted by the Ministry of Energy and REREC to power around 200 schools using solar. The company has also worked with NGOs to solarize health facilities, as well as boreholes to improve sanitation for rural communities. Go Solar is currently focusing on tapping into the grid-tied systems segment, serving clients from the C&I, the private sector, NGOS and government.

10. Kenya Solar Energywy (Kensen)

Kensen focuses on the development of utility-scale PV projects, having started off distributing SHS and solar lamps. Kensen's three founding partners have backgrounds in entrepreneurship, IT and survey. Kensen's key project is the 40MW Lamu project, which is at an advanced project-preparation phase. The company plans to form an SPV and get other companies or interested parties to buy shares, although it still intends to take part in the actual implementation of the project. It has pursued this project from the start, from site identification via feasibility studies to environmental assessments, legal due diligence, PPA negotiations, etc.

11. Harmonic Systems

Harmonic systems, with a Pan-African presence, specializes in installing PV for both residential and C&I clients. The founder and owner has a background in engineering and significant international work experience in data management, software development and programming. The company's services range from designing of systems to the entirety of engineering, procurement and construction (EPC), as well as operations and maintenance (O&M) for solar water heaters, C&I systems and PV pumps. The company has installed several C&I projects accounting for up to 3MW capacity in countries including Tanzania, Somalia, South Sudan, Zimbabwe and Kenya. The company is also interested in the installation of solar water heating and solar water pumping technologies, as well as battery storage.

12. Epicenter Africa

Epicenter Africa mainly focuses on the water and energy space. The founders have a strong background in engineering and finance, with vast experience in the water industry. Epicenter largely works with humanitarian actors and the government in installing solar water pumps for rural communities and agriculture. Epicenter also offers water treatment and desalination services to provide clean water for drinking and cooking in urban households. It also conducts water tests and treatments for boreholes. Epicenter has since introduced electric systems and solar PV installation in form of street lights and other solar PV systems. The company operates in Kenya, Uganda, South Sudan and Somalia and is planning to expand its operations to other Sub-Saharan African countries.

13. Multilink

Multilink was founded in 2010 and has worked in various technologies, such as clean cook stoves, large scale biofuels, solar PV and solar thermal. Its founders have solid experience in working with the UN and development agencies, with very strong local influential networks, while having educational backgrounds in the legal sector. The company has also taken part in government initiatives for powering schools. Over time, Multilink has transitioned from small-PV systems, cookstoves and institutional PV systems to carrying out project development for utility-scale projects (40 MW) as well. Multilink leverages on partnerships and created a subsidiary called East Crown to act as a project SPV. Multilink sees itself as an active, versa-

tile company and seizes various opportunities in the renewable energy sector.

14. Mwangaza Light

Mwangaza has been in operation since 2014. It mainly started by selling bright products through retail networks. The company has two directors who have respective experiences in the IT sector and academia, along with strong experience and exposure to development aid organizations. The company has strategic partnerships with the National Council of Churches in Kenya and its Green Churches Initiative, which aims at working together with rural communities. The company mainly uses SACCOs and the Churches initiatives as its main channels for distributing its solar products. The company aims to partner with more churches in future. It has also been venturing and expanding its cook stoves portfolio, as well as securing new funding and partnerships in the clean cooking sector.

Appendix B.

List of Interviewed Stakeholders

	Organizations	Representative stakeholder	Date	Type of inter- view
1.	Ministry of Industry	Principal Secretary State Department, Industrialization	19-Feb-2020	In-person
2.	Questworks	Co-Founder and CFO	19-Feb-2020	In-person
3.	Solafrique	Founder and CEO	19-Feb-2020	In-person
4.	KEPSA	Vice Chair and Board Member	20-Feb-2020	In-person
5.	Multilink	Co-founder and Managing Director	20-Feb-2020	In-person
6.	EPRA	Senior Renewable Energy Officer	20-Feb-2020	In-person
7.	Go solar ltd	Founder and CEO	21-Feb-2020	In-person
8.	World Bank	Senior Energy Specialist	21-Feb-2020	In-person
9.	Ministry of Energy	Deputy Director, Renewable Energy	24-Feb-2020	In-person
10.	Epicenter Africa	Founder and CEO	24-Feb-2020	In-person
11.	Davis & Shirtliff	Solar Division Manager	24-Feb-2020	In-person
12.	Knights and Apps	Chief Executive Officer	24-Feb-2020	In-person
13.	Ofgen	Director	25-Feb-2020	In-person
14.	Automax Engineering	Technical Lead, Energy Projects and Business Development	25-Feb-2020	In-person
15.	Sunfunder	Technical Lead	25-Feb-2020	Phone
16.	Solinc	Quality Assurance Manager	26-Feb-2020	In-person
17.	Skynotch	Chief Executive Officer	26-Feb-2020	In-person
18.	Kensen	Managing Director	26-Feb-2020	In-person
19.	PFAN	East Africa and Kenya Coordinators	27-Feb-2020	In-person
20.	Equity Group Foundation	Associate Director	27-Feb-2020	In-person
21.	Mwangaza Light	Managing Director	28-Feb-2020	In-person
22.	RTI International / Power Africa	Senior Technical Advisor	28-Feb-2020	In-person
23.	KEREA	Administrator	28-Feb-2020	In-person
24.	Strathmore University	Deputy Vice Chancellor	02-Mar-2020	In-person
25.	Power point systems	Founder and Technical Director	02-Mar-2020	In-person
26.	Solar Poa	Co-founder	02-Mar-2020	In-person
27.	HIVOS	Advocacy Officer for Climate and Energy	02-Mar-2020	In-person
28.	African Development Bank	Regional Principal Officer, Climate Change and Green Growth	15-Sept-2020	Online
29.	AFD SUNREF	East Africa Team Leader	29-Sept-2020	Online

Appendix C.

Broad Interview Guide/ Questionnaire for Local Companies

Short introduction to our project and the team

Kindly introduce yourself (educational background, work experience, idea behind starting your business, year of establishment etc.)

1. Could you kindly elaborate about the historic development of the company from its beginning? (in terms of chronology, timeline)
2. How has your company evolved in terms of its market focus, different functions, different products and service offering? What enabled these decisions?
3. What have been the main turning points and major changes/milestones in the company's journey?
4. What role have alliances and partnerships (formal or informal) played for your business?
5. How has your business benefitted from international and local linkages? (In the form of consultants, universities, accelerator support, others)
6. How did you finance the start-up, and what kind of financing support have you received in business operations? How do you financially continue to fuel your growth?
7. Did you face any human resources constraints to sustain the growth of your business? What helped you to acquire the right talent, skills, and competences to support this growth?
8. How can local firms like your own remain competitive in the market? How do you maintain your edge despite the influx of many international firms?
9. What is the company goal or ambition for the next five years? Or, where do you see yourself?
10. Which incentive structures (are in place or) should be in place to support this industry for local firms and SME growth?

Appendix D.

Methodology (specific process, case selection etc.)

In the first stage, we prepared a detailed inventory of PV companies operating in the Kenyan market. For this, we used the existing EPRA database of PV companies in Kenya with registered technicians. The compiled list had over a hundred companies. However, as we observed a few gaps, SERC also added additional PV companies to the meta-list and categorized them further as either locally owned or foreign-owned companies. Subsequently, we removed around twenty companies from the list, as they were found only to have a marginal focus on solar PV based on information provided on the company's websites. In sum, we identified about 85 companies operating in Kenya focusing primarily on solar PV as their core business or a substantial part of the business, of which nearly half were local Kenyan companies. This categorization of local and foreign-owned companies was undertaken based on information obtained from company websites, media articles, prior research by the authors, reports published on the sector and an initial round of telephone interviews undertaken with representatives of the firms.

Here locally owned companies mainly refer to those in which the majority shareholding/equity stake lies with Kenyan nationals. Such a categorization was not exhaustive and did entail data gaps. Moreover, the local companies were further categorized according to the various market segments they operated in – off-grid, mini-grid, captive PV, utility-scale – based on UDP and SERC prior knowledge and experience in the sector. This was also cross-verified with the companies directly in certain instances. Based on this, we selected at least one company from each of the market segments. Additional companies were selected based on prior knowledge, their presence in the sector (website/media coverage), the response rate (accessibility and availability of the company founders) and through snowballing.

Subsequently, we interviewed fourteen local PV companies (majority Kenyan-owned) who have operated in the market for a minimum of four to five years across multiple market segments (off-grid, mini-grid, captive PV, water pumps, project development). The data collection was undertaken in person in Nairobi in February and March 2020, and data gaps were covered through subsequent email and telephone follow-ups and exchanges. The interviews focused on the company's history, its development trajectories, its business models, its strategies in focusing on specific market segments, its partnerships and challenges, and its future growth plans. During our in-person interviews, we sought to learn about each company's business journey from their inception until now, from the vision to the execution thus far, while focusing on the turning points and challenges and how they navigated them. In addition, we also interviewed two additional companies, one of which is an international company (Davis & Shirliff), the other a PV panel assembly plant (Solinc). This allowed us to broaden our perspectives on the experiences of a local assembly plant in Kenyan context.

Appendix E.

Institutions relevant to supporting the MSME ecosystem in Kenya

Institutions	Role and Functions
Ministry of Trade, Industry and Cooperatives	Designated industry responsible for formulating, reviewing and supporting policies, strategies, plans and programs that promote and ensure the expansion and diversification of trade, cooperatives, environmentally sustainable industrialization, appropriate technology development and transfer to generate wealth for poverty eradication and benefit the country socially and economically.
Micro and Small Enterprise Authority (MSEA)	The Act gives the Authority the mandate to formulate and coordinate policies to facilitate the integration and harmonization of various public- and private-sector initiatives for the promotion, development and regulation of MMSEs in becoming key industries of tomorrow.
The Kenya National Chamber of Commerce and Industry (KNCCI)	Mandated to support and protect the interests of the industry. The Chamber will help deal with challenges including the introduction of a Chamber Sacco with the aim of supplying cheap credit to members, lobbying government for an SME KNCCI-driven Business Fund, establishing an apprenticeship internship programme, and creating an SME Academy to build capacity by offering short business and technical courses to members.
Kenya Investment Authority (KIA)	Issuing investment certificates, assisting investors in obtaining the requisite licenses, permits, incentives and exemptions, advising the government on improving the investment environment etc.
Kenya Private Sector Association (KEPSA)	Private-sector apex and an umbrella body to represent the business community and influence public policy in favour of an enabling business environment by working together with the government and other stakeholders. Some of KEPSA's role in business reforms, i.e. Public-Private Dialogues for business reforms (policy, legislative and institutional reforms), include Presidential Round Tables (PRTs), Ministerial Stakeholder Forums (MSFs), Speaker's Round Table, Attorney General's forum etc.
Kenya Renewable Energy Association (KEREAA)	Promoting the interests of members of the renewable energy industry with government, the public sector, the general public and any other organizations that may impact on the development of the industry. Also the creation of a forum for the dissemination and exchange of information and ideas on matters relating to renewable energy development and utilization in Kenya.



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