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INNOVATION AND ENTREPRENEURSHIP IN CLEAN ENERGY

The Impact of Successful Founders and How Decision Makers Can Support Them

A REPORT BY:

endeavor INSIGHT

WITH SUPPORT FROM:

The Lemelson Foundation

ABOUT ENDEAVOR INSIGHT
Endeavor Insight is the research and policy division of Endeavor, a nonprofit organization with a 20-year history of supporting high-impact entrepreneurs around the world. Our team of economists, data scientists, and policy analysts provide data-backed insights on entrepreneurship and its contribution to economic development. We specialize in understanding how entrepreneurship networks can drive job creation and inclusive growth. We partner with organizations that support entrepreneurs, including foundations, multilateral agencies, and corporations.

ENDEAVOR INSIGHT STAFF
Leah D. Barto
Marine Fujisawa
Ana Paula Gil
Alejandro Noguez-Ibarra
Martin Pickering
Hamza Shad
Divya Titus

ADDITIONAL CONTRIBUTORS
Penmai Chongtoua
Jin Woo Chung
Rhett Morris
Lili Török

CONTACT
For more information about Endeavor Insight, contact Leah D. Barto at **leah.barto@endeavor.org**.

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Based in Portland, **The Lemelson Foundation** uses the power of invention to improve lives. Inspired by the belief that invention can solve many of the biggest economic and social challenges of our time, the Foundation helps the next generation of inventors and invention-based businesses to flourish. The Lemelson Foundation was established in the early 1990s by prolific inventor Jerome Lemelson and his wife Dorothy. To date the Foundation has made grants totaling more than $290 million in support of its mission.

Executive Summary

Endeavor Insight partnered with the Lemelson Foundation to understand how entrepreneurial clean energy companies can maximize their impact in developing countries. The purpose of the study is to provide a data-backed assessment of the challenges and opportunities facing entrepreneurs in this sector, and how best to support them.

The results offer guidance for decision makers who support entrepreneurs as they address the Sustainable Development Goals (SDGs), especially in the areas of affordable and clean energy, sustainable cities and communities, and decent work and economic growth. This study builds on recent research in the international development and social investment communities, and takes into account the impacts of the COVID-19 crisis.

Context and Opportunity

Innovative companies are developing solutions to the urgent need for clean energy throughout sub-Saharan Africa and India. There are three particular areas that entrepreneurs are addressing: access to electricity, clean cooking, and the transition to renewables. Sub-Saharan Africa and India are among the regions most vulnerable to climate change, and significant action is needed to mitigate the effects of pollution. The COVID-19 pandemic has also increased the need for clean energy access.

The opportunity to scale clean energy solutions is immense, considering the high stakes and potential for significant growth. This report primarily considers two types of companies:

- **Invention-based enterprises (IBEs)** provide physical solutions with transformative impact, and are the dominant business type in the clean energy sector. These companies conduct research and development (R&D) and manufacture at least one physical component in which the innovation is unique enough to be patentable.
- **Service companies** are businesses whose primary innovation is not a physical product, including business process innovators and software firms. Service companies act as intermediaries to improve services or grid-level solutions, and offer new solutions that facilitate access to products for end-users.

Founder Pathways

In order to understand the factors that contribute to the success of entrepreneurs within the clean energy sector, Endeavor Insight analyzed the pathways of successful companies, including founders' early careers and educational backgrounds, startup and growth phases, and the impact of COVID-19. The pathways for achieving scale and impact are different for IBEs and service companies, as the former face longer development timelines. The experience of IBEs is also not uniform, and patterns in the pathways can be identified based on product type.

Entrepreneurial Challenges

Founders face several challenges on the road to success. **Customer acquisition** is an obstacle for many businesses, often because of the remote locations of their

intended customers, a lack of distribution infrastructure or retail networks, and issues of affordability. **Access to capital** is another major challenge, and founders noted several barriers in attracting and securing institutional capital and a scarcity of angel investment. In terms of **talent**, recruiting managers is more of a challenge than engineers or technical talent for both IBEs and service companies. Energy is heavily regulated and often subject to changing standards, which makes **government policy** critical in enabling or inhibiting the success of clean energy companies.

Support Ecosystems

Support organizations provide certain benefits to innovative clean energy companies, although some programs are not sufficiently tailored to existing needs, and qualified mentorship is lacking. Ecosystems differ by geography in that founding teams of clean energy companies in sub-Saharan Africa are mostly made up of expats, while teams in India are mostly made up of returnees or locals. By elevating successful founders as leaders, Entrepreneur-Led Economic Development provides an effective approach to strengthening local ecosystems.

Recommendations

This report provides practical recommendations for addressing the major challenges that clean energy founders face, with actionable guidance for entrepreneurs, investors, support organizations, donors, policymakers, and universities. Priority areas include:

1. Increase the alignment of goals between investors and entrepreneurs to make the most of existing opportunities.
2. Enhance early-stage support and funding opportunities for IBEs.
3. Tailor support programs to the needs of the clean energy sector.
4. Elevate the influence of older companies to assist upcoming firms, especially through local mentorship.
5. Provide an enabling environment for founders that facilitates entrepreneurship.

Through these principles, decision makers can empower innovative entrepreneurs in sub-Saharan Africa and India to grow their companies and enhance global access to clean energy.

Methodology

The findings in this study are based on data collected from 138 clean energy companies operating in sub-Saharan Africa and India, as well as interviews with 40 of their founders.

In parallel to this study on clean energy, Endeavor Insight also conducted research on innovative agriculture and healthcare companies, which offer points of comparison. Data was collected on a total of nearly 1,800 investors, grantmakers, mentors, and support organizations, of which approximately one-third supported clean energy companies.

Endeavor Insight's research is rooted in understanding how successful entrepreneurial businesses grow, covering several areas of need including capital, talent acquisition, mentorship, and support programs. Data collection occurred before and during the COVID-19 pandemic, and follow-up research took place in early 2021.

There are clear opportunities for entrepreneurs to accelerate the global transition to clean energy and further the SDGs.

With a focus on sub-Saharan Africa and India, this research explores how decision makers can best support clean energy entrepreneurs as they grow their businesses. The dataset focused on entrepreneurial companies that have innovated in software, business processes, or physical inventions. By considering the type of innovation a company's business model focuses on, this study offers stakeholders a broader menu of interventions to support them.

Key Research Questions

The research process was guided by the following research questions.

- What are the key characteristics of high-performing clean energy companies, especially IBEs?
- How are clean energy companies contributing to the SDGs?
- What are the challenges faced by innovative clean energy entrepreneurs, and how do they overcome them?
- How are ecosystem actors such as investors, mentors, and support organizations helping entrepreneurs?
- How can decision makers better support clean energy entrepreneurs?

I. Context and Opportunity

Innovative companies are developing solutions to pressing needs like the lack of electricity in rural areas, demand for clean cooking fuel, and increasing energy consumption.

THE URGENT NEED FOR CLEAN ENERGY

There is an urgent need for clean energy in countries in sub-Saharan Africa and in India. There are three particular areas that have strong potential for impact on human society and the environment — access to electricity, clean cooking, and the transition to renewables.

The number of people without **access to electricity** is set to decline to 660 million globally by 2030, but 555 million of those remaining without electricity (85 percent) will be in sub-Saharan Africa.[1] India is on track to attain full electricity access by 2030,[2] but the quality of this access is an important consideration. There continue to be inconsistencies in the amount of power generated and the number of hours of connection, with "access" to the grid often loosely defined in terms of a certain number of hours per day. More than four million rural micro-enterprises in India still identify the lack of reliable electricity as a major bottleneck to their business.[3] Rural economic development depends on communities having reliable and continuous access to electricity, not just nominal access.

Despite being the most affordable solution for many rural communities to gain access to electricity, the mini-grid market remains nascent.[4] The lack of purchasing power in rural communities and lack of familiarity with these systems have led the subsector's growth to be dependent on public money. But there are opportunities, particularly in rural economies, for mechanization through clean energy innovations. Many appliances can effectively run on decentralized renewable energy, such as

Defining Access to Energy

Access to energy is a broad term that covers not only electricity, but also fuels used for cooking, heating, and other purposes. In its methodology for 2020, the International Energy Agency (IEA) defines energy access in two dimensions: electricity and clean cooking.*

- Access to electricity for households is defined as "sufficient electricity to power a basic bundle of energy services – at a minimum, several lightbulbs, phone charging, a radio and potentially a fan or television – with the level of service capable of growing over time." The basic bundle is estimated to require 1,250 kWh per household annually.
- Clean cooking is defined in terms of a household's primary reliance on certain low-emission fuels: "Access to clean cooking facilities means access to (and primary use of) modern fuels and technologies, including natural gas, liquefied petroleum gas (LPG), electricity and biogas, or improved biomass cookstoves."

The data available from different countries is not always comprehensive or consistent with these definitions. Therefore, the statistics cited on access to electricity and clean cooking are estimates.

solar-powered pumps, milking machines, and chillers for the large agricultural markets in sub-Saharan Africa and India. Greater energy efficiency will help make these appliances economically viable.[5]

The population without **access to clean cooking** continues to increase in Africa — which is already reliant on biomass — while India is benefiting from policies promoting liquefied petroleum gas (LPG). The use of poor sources of cooking fuel (such as wood, charcoal, coal, crop residue, or animal dung) can cause major lung damage from smoke. This life-threatening issue particularly affects women.[6] By 2030, only 30 percent of people in sub-Saharan Africa will have access to clean cooking solutions, compared to 67 percent in India.[7]

A push towards clean cooking started in the 1970s, but after more than four decades of effort, access to clean cooking fuel and technologies remains an issue, with severe health, gender, economic, and environmental impacts.[8] The recent growth in the clean cooking sector can be dated to 2011, when the Global Alliance for Clean Cookstoves was launched, supported by the World Bank.[†, 9] The initial focus on aid was superseded by market-oriented solutions, characterized by increased industrial-scale production of improved stoves, the emergence of innovative distribution and financing models, and the entry of new entrepreneurs and investors into the sector, often with a focus on cleantech.[10] Access to clean cooking fuels and technologies increased from 56 percent of the global population in 2010 to 63 percent in 2018.[11] But finance for residential clean cooking is well below what is needed,[12] which is holding back access for many people in sub-Saharan Africa and India. Between 2010 and 2018, the proportion of people in sub-Saharan Africa with access to clean cooking rose from 10 percent to a still-low 17 percent. Increased use of LPG in India has helped the country increase access from 22 percent to 49 percent over the same period.[13]

The **transition to renewables**, including solar and wind power, for electricity generation has accelerated in recent years, and this trend is set to continue. African electricity generation will more than double from 2018 to 2040, with the share of renewables rising from 21 percent to 48 percent.[14] In India, while coal will still account for 34 percent of generation by 2040, solar power is predicted to reach 31 percent of the total.[15] The electrification of transportation and heating

* The definitions in this box are quoted from: International Energy Agency. "Defining Energy Access: 2020 Methodology." 13 Oct. 2020. iea.org/articles/defining-energy-access-2020-methodology. Accessed 12 Aug. 2021.
† The Global Alliance for Clean Cookstoves (GACC) is now known as the Cleaning Cooking Alliance (CCA).

is also indirectly increasing demand for renewables.[16] The transition away from fossil fuels will benefit both the environment and the quality of people's lives.

The earliest solar energy innovators introduced their products in the 1970s and reached developing markets by the 1980s.[17] By 2000, around 1.3 million solar systems had been set up, supported by government and donor programs. Broader uptake remained low because of high upfront costs, difficulties in collecting payments from remote areas, and installation and maintenance issues.[18]

In 2015 all UN member states adopted the Sustainable Development Goals (SDGs), which provide a blueprint for the global community to prioritize these issues.[19]

Although several of the UN's 17 SDGs are pertinent to clean energy, three are of particular relevance for this report, which focuses on entrepreneurial companies in the sector: "affordable and clean energy" (#7) primarily, as well as "decent work and economic growth" (#8) and "sustainable cities and communities" (#11). If the SDGs are not properly addressed via an energy transition, the consequences will not only affect India and sub-Saharan Africa, but the entire planet.

Some of the obstacles that are preventing improvements in these areas include inadequate infrastructure, poverty, and climate change itself. A lack of physical infrastructure has hampered access to on-grid electricity and newer technologies in rural communities. Decentralized renewable energy has a major role to play in such communities, and innovative mini-grid solutions are already finding some traction in plugging this gap. Poverty is a major barrier to entry for new technologies, which have high upfront costs. Households in energy-poor areas spend as much as 30 percent of their income on kerosene for lighting, while others live in darkness.[20] Additionally, countries with the greatest need for better access to electricity are struggling to attract the finance for funding expansion and upgrades.[21] Climate change, through increased desertification and the extreme weather events that it brings, is a further obstacle to providing consistent and clean energy. Sub-Saharan Africa and India are particularly vulnerable in this regard and have recorded sharp increases in extreme weather, especially drought and floods, in recent years.[22]

Air pollution constitutes the world's biggest environmental health hazard and contributes to an estimated seven million premature deaths globally per year.[23] According to IQAir's air quality index, which measures levels of the pollutant PM2.5, India had the world's third worst average air quality in 2020, including 22 of the world's 30 worst polluted cities. Over half of this pollution came from industry, around one-third from vehicles, 17 percent from crop burning, and 7 percent from domestic cooking. In 2019, over 1.6 million deaths in India were attributed to poor air quality.[24] Data on air pollution is less precise for Africa, but it is estimated to cause up to 780,000 annual deaths on the continent.[25] Sources of air pollution there vary, but coal and kerosene fuels, agricultural burning, and emission-intense transportation are major causes.[26]

Current fossil fuel-based energy consumption is not sustainable because of its contributions to climate change, and the need for an energy transition is acute. The goal of the UN's 2015 Paris Agreement is to limit global warming to 1.5 degrees Celsius above pre-industrial levels.[27] Failure to reach this target — which is dependent on reducing carbon emissions to net zero by 2050 — would lead to more extreme weather events, sea-level rises, and increased health risks. A comprehensive report on climate science published by

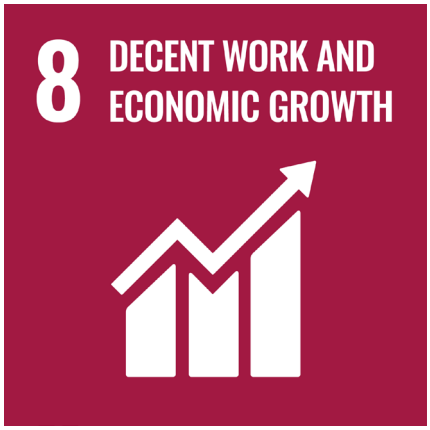
the Intergovernmental Panel on Climate Change (IPCC) in 2021 found that the 1.5 degrees Celsius limit is set to be breached within 20 years, bringing widespread devastation and extreme weather events.[28]

Already since the 1950s, sub-Saharan Africa and India have experienced rising incidences of extreme heat and drought, and extreme precipitation events have increasingly struck western Africa and India. The severity and frequency of such events is expected to increase, posing a high risk for human society and ecological systems, and a series of tipping points may be reached, which would further accelerate the destruction.[29] Economically, the world stands to lose 11 to 14 percent of GDP by mid-century if climate change stays on the currently-anticipated trajectory. In Asia, the impact would be 15 to 20 percent, and in Africa and the Middle East, 14 to 22 percent.[30] The IPCC's 2021 report warns that every tonne of CO_2 emissions adds to global warming, and that urgent action is needed to slow the changes.[31]

The COVID-19 pandemic has raised the stakes and increased the need for clean energy access.

In the short term, the economic dislocation caused by the pandemic led to falling demand, sales, and turnover throughout the off-grid energy sector.[32] The International Energy Agency (IEA) estimated energy investment to have fallen globally by 18 percent in 2020.[33] The IEA was blunt in its appraisal that the pandemic put clean energy progress in sub-Saharan Africa into reverse: the number of people lacking electricity in the region rose by 2 percent in 2020, and basic electricity services became unaffordable for up to 30 million people in Africa who had previously gained electricity access.[34] Additionally, India's clean energy transition will be slowed by liquidity and financing constraints brought about by the pandemic.[35]

More broadly, lockdowns affected supply and distribution channels for clean energy companies,[36] and the pandemic led many governments worldwide to shift their priorities away from clean energy provision to emergency measures.[37] On the other hand, COVID-19 has made the potential benefits of decentralized, renewable energy access more evident for governments around the world, especially in the context of building resilient healthcare systems.



OPPORTUNITIES FOR ENTREPRENEURSHIP

The opportunity to scale clean energy solutions is immense, considering the high stakes and potential for significant growth.

To address the existing challenges in energy access and climate change, developing regions must have the capacity to foster innovation and entrepreneurship. This study looks at the factors that enable or hinder founders and their ability to scale. In order to better understand how decision makers can tailor their efforts to support these entrepreneurs, Endeavor Insight examined the different business models and subsectors that comprise the clean energy sector.

At the macro level, the clean energy sector has experienced rising investor interest during the post-pandemic recovery, and over $200 million went to energy startups in Africa in 2020. It is already the leading global destination for off-grid solar investment.[38] Despite this growth, a substantial funding gap remains. The World Economic Forum estimates that Africa's off-grid solar sector represents a $24 billion annual opportunity, but significant challenges remain, including raising investment and empowering more entrepreneurial companies locally.[39]

In India, there is a growing network of cleantech startups whose growth is being bolstered by coordination between universities, incubators, investors, and the public sector. This local ecosystem development is driving demand for new technology which, in turn, is further strengthening the presence of sustainability-oriented startups, investors, and incubators.[40] Increased access to cleantech in both India and sub-Saharan Africa is also creating market opportunities for entrepreneurs in other sectors, because customers require electricity and energy to then make use of other innovative products.

There are entrepreneurs operating in diverse subsectors within clean energy, serving different customer types — including households, businesses, and larger communities. Overall, the most common subsectors for the clean energy companies in this study were household energy solutions, energy manufacturing, utility solutions, clean energy appliances, and business or industrial energy solutions.

This report primarily considers two types of companies: invention-based enterprises (IBEs) and service companies.

IBEs provide physical solutions with transformative impact, and are the dominant business type in the clean energy sector. These are companies that conduct research and development (R&D) and manufacture at least one component that is a physical product in which the innovation is unique enough to be patentable. The physical products that they create are essential for the global transition to clean energy as they are tailored to the needs of the global poor.

In tandem with the introduction of new physical products, **service companies** are needed to act as intermediaries to improve services or grid-level solutions, and offer new solutions that facilitate access to products for end-users. Service companies are businesses whose primary innovations are not physical products. This term incorporates business process innovators (companies that have primary activities delivering products or services that require "on-the-ground" operations, but may involve the use of technology) and software companies (which have primary activities in developing and selling digital solutions and platforms, such as fintech or e-commerce). Software companies often build on the innovations that fintech companies previously brought to consumer markets and apply them to clean energy.

IBEs and service companies have distinct and complementary roles, as they serve different subsectors within clean energy. Within the Endeavor Insight dataset, there were 92 IBEs, making them the most representative in energy manufacturing, household energy systems, and clean energy appliances. There were also 46 service companies, which most commonly operated in utility solutions and business or industrial energy solutions (see table below). Still, some entrepreneurial companies are blurring the lines between innovation types to implement community-wide solutions, providing both invention-based products and service delivery mechanisms.

EXAMPLES OF CLEAN ENERGY COMPANIES BY INNOVATION TYPE

The headquarter country and year founded are indicated in parentheses.

Invention-Based Enterprises (92)

SYS3e Technologies
(India, 2016)

makes a solar tracker to reduce energy costs

Fenix International
(Uganda, 2009)

designs solar home systems for off-grid households

Prakti
(India, 2008)

produces multi-fuel clean cookstoves

Service Companies (46)

Paygo Energy
(Kenya, 2015)

provides pay as you go (PAYG) solutions for LPG

Rensource Energy
(Kenya, 2015)

delivers power and services to SMEs through solar powered micro-utilities

ZunRoof
(India, 2016)

bridges electricity supply and consumption gaps in Indian homes

FEATURE:

The Wide Reach of Solar Firms

Off-grid solar power represents a mature subsector in clean energy, with several companies achieving widespread impact and successfully incorporating elements of both IBEs and service companies.[41]

Younger companies can learn from the business models of large firms such as **d.light**, **Fenix International**, **SELCO India**, and **Mobisol**. These four companies design and deliver efficient, off-grid solar systems and appliances, primarily for rural households and small and medium-sized enterprises (SMEs). All four are at least 10 years old and have achieved widespread impact by collectively providing clean energy access to millions of users.

The Pay As You Go (PAYG) Model

For at least three of these companies — d.light, Fenix, and Mobisol — the integration of PAYG technology was instrumental to their success. Solar products can be unaffordable for customers, especially in rural and underserved areas. However, the PAYG model allows customers to pay in smaller installments over time, which enabled these companies to reach high numbers of users. The companies have also designed features that allow them to disable product functionality remotely if customers do not make payments, which reduces their transportation and other operational costs, keeping prices low.

Company	Users Reached	Employees	Year Founded
d.light	100,000,000	800+	2006
Fenix International	3,000,000	1,000+	2009
SELCO India	1,000,000	500+	1995
Mobisol	800,000	500+	2011

Figures on users reached and employees taken from company websites.

Based in Uganda, Fenix has expanded to multiple countries in Africa. Its primary product is a lease-to-own solar home system that provides power for lighting, charging, and running appliances. In its financing model, customers pay an initial deposit and then pay off their product via periodic mobile payments over a period of up to 30 months. U.S.-based d.light, which designs solar-powered lamps and appliances to replace kerosene, also integrated PAYG technology into its products. Combining physical inventions and service delivery was initially a challenge, as d.light co-founder Ned Tozun explains, "It really felt like we were not just making a product. We basically had to invent multiple businesses for this to work."

The mobile payment structure offered by d.light, Fenix, Mobisol, and other companies simultaneously fills the gap of financial access for underserved populations. Making small payments over time sets up customers with a credit history, as they often do not have formal bank accounts. Customers who develop a positive payment history gain access to solar systems with larger capacity and other products. In the case of Fenix, customers who maintain timely payments even gain the option of other services such as student loans and health insurance.

Additional Strategies for Customer Reach

These companies have employed other strategies to extend their customer reach. Fenix has built a large network of service centers and sales agents — as well as distribution partnerships with telecom companies — to reach customers in remote areas and maintain engagement with them. Like Fenix,

Mobisol works with other companies as distributors to expand its customer base.

Large solar companies have succeeded by designing customer-centric products and testing them before release. Mobisol has a diversified product line beyond solar home systems, including solar-powered productive-use appliances such as hair clippers and stereo systems. This helped the company develop a customer base in urban areas such as the city of Arusha, Tanzania.[42] Similarly, SELCO India has reached over a million Indians by introducing a variety of solar-powered appliances. These products are tailored to the needs of Indians in both rural and urban settings, such as sewing machines, photocopiers, and roti rollers. Although d.light is based in the United States, the company tests its products in local markets prior to entering them, and its founders' experiences living abroad in Benin, India, and other countries has helped them understand rural customers' needs.

Lessons for Younger Companies

The companies featured in this section grew by developing products that customers need and delivering them in accessible, affordable ways. As a result, they combine the strengths of both invention- and service-based business models. Since there is still a need for innovative entrepreneurship in this sector, younger clean energy companies can learn from their experiences. There are two elements in particular that these companies can keep in mind: utilizing customer feedback during the R&D process and paying attention to affordable delivery mechanisms from the start.

A lease-to-own PAYG model is not without risk, as Mobisol discovered in 2019, when — after a contract dispute with one of its investors — it had to declare insolvency before being acquired by ENGIE. Firstly, with hardware costs falling as technologies improve, similar products would be on the market at a lower cost before customers' full payment periods were complete. This can be overcome with a focus on warranties and customer service, but companies will battle to compete with lower-cost competitors that are new to the market. Secondly, if consumers face financial hardship, they may suspend their payments. While the operator has the ability to close the service until payments resume, they have no way to repossess the now idle equipment.[43]

Up-and-coming entrepreneurs can benefit from ecosystem-building institutions created by successful founders. For example, SELCO India's founder Harish Hande created the SELCO Foundation in 2010 to support decentralized innovation and entrepreneurship in sustainable energy and healthcare in underserved communities. Entrepreneurs who are selected by the SELCO Foundation gain access to valuable mentorship, resources, and capital from SELCO India. In addition, Mobisol's Thomas Gottschalk founded the Access to Energy Institute (A2EI) in 2019 as an R&D center that focuses on supporting solar-powered solutions for small businesses and smallholder farmers.[44] Recognizing that R&D can be a lengthy and costly process, the A2EI provides entrepreneurs with facilities, research support, and engineering expertise to develop productive-use appliances.[45] With teams in Tanzania and Germany, it combines a local presence for contextual knowledge and customer feedback with access to international resources and expertise.

Founder-led institutions like the A2EI and SELCO Foundation provide up-and-coming founders with vital insight not only on conducting R&D, but also for ensuring customer access and affordability. This includes spending time with potential customers to tailor product design to their needs and utilizing partnerships and new payment technologies for distribution. There is still a need for more founder-led efforts like this in clean energy, particularly in other subsectors beyond off-grid solar, so that younger companies can learn from the experiences of established firms.

II. Founder Pathways

The pathways for achieving scale and impact are different for IBEs and service companies.

In order to understand the factors that contribute to the success of entrepreneurs within the clean energy sector, Endeavor Insight analyzed the pathways that founders and founding teams took, including their educational attainment, work and geographic experience, company types, and growth strategies. Researching patterns in these journeys is beneficial for decision makers to understand how to best support entrepreneurs. This section separates companies by innovation type to highlight the differences in their business models and trajectories for achieving scale and impact. There are also some companies that blur the line between these categories.

BROAD PATTERNS

Clean energy entrepreneurs share certain attributes relating to their education and previous work experience. Although most are new to entrepreneurship, the founders surveyed are highly educated and experienced. Based on available data from more than 230 founders, 62 percent have a master's degree or PhD, and 70 percent have a degree in science, technology, engineering, or mathematics (STEM). Their prior experience often includes large energy companies or government agencies that deal with energy or utilities, with 65 percent of founders having C-level or management experience. However, only 5 percent had previously founded a company. These patterns hold across innovation types.

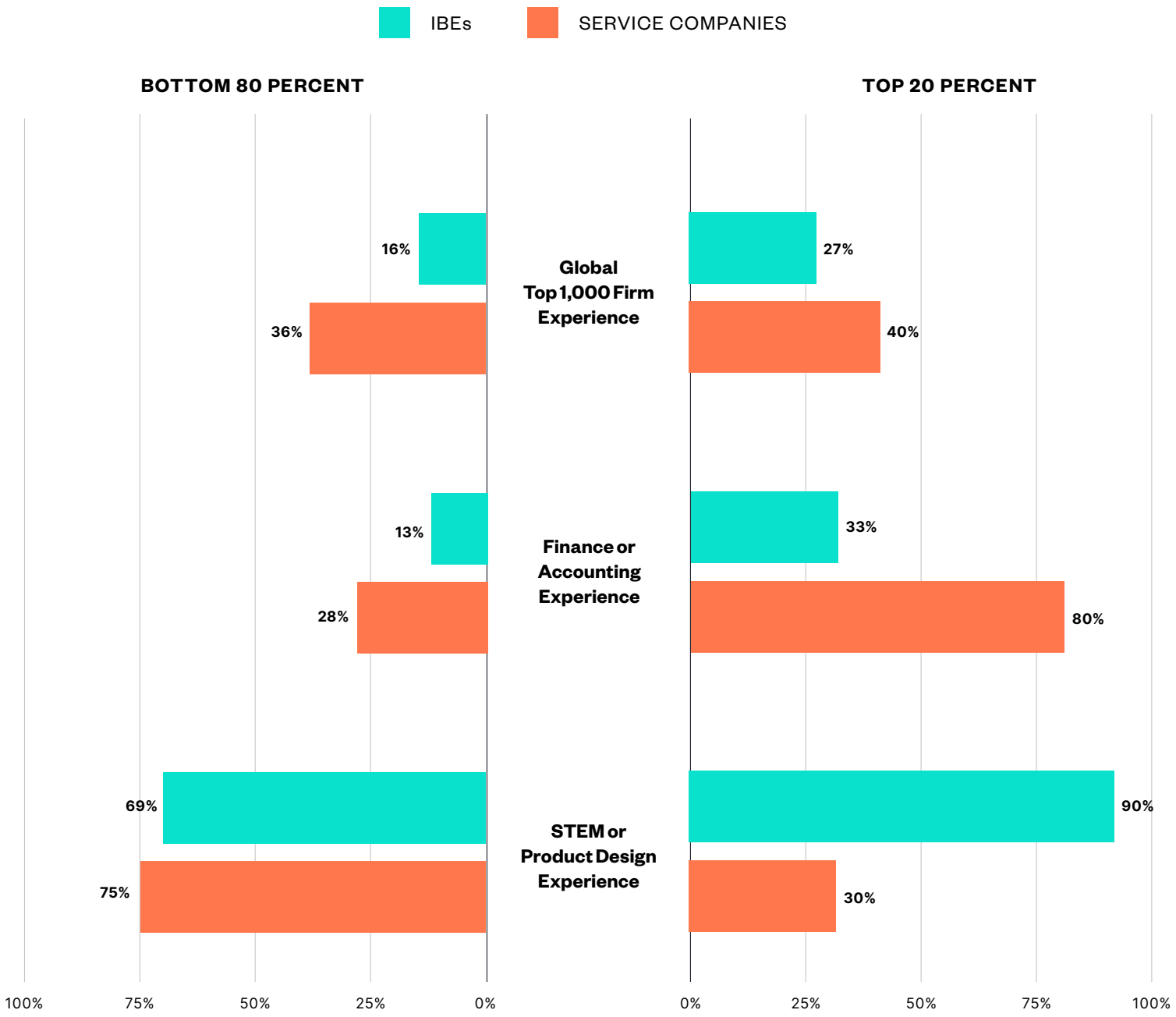
As the graph on the next page shows, the founding teams of the highest-scaling clean energy companies have specialized work experience that enabled their success. When comparing the founding teams of the top 20 percent to the bottom 80 percent of companies by employee size, the former were more likely to have at least one founder with previous experience at one of the 1,000 largest public firms in the world,* as well as experience in a finance or accounting position. This is true for both service companies and IBEs. The highest-scaling IBEs were also more likely to have founders with experience in a STEM or product design role. In contrast, this was not the case for service companies, as they do not generally conduct research and development (R&D) or invent new physical products. The sections below explore further differences by innovation type, including the greater barriers to accessing capital and slower growth of IBEs.

In terms of their impact-driven motivation, the founders surveyed are driven by a desire to increase the accessibility and affordability of electricity and other forms of clean energy for poor and rural households. Many are also motivated by the direct experience of witnessing air pollution and the effects of climate change, and now they want to provide solutions. Respondents emphasized the importance of providing value for money and reliability, as clean energy products have historically been prohibitively expensive for many new customers in sub-Saharan Africa and India.

* This indicates the top largest 1,000 public firms according to the Forbes Global 2000 list, available at forbes.com/lists/global2000.

COMPARISON OF CLEAN ENERGY FOUNDERS' WORK EXPERIENCE BY COMPANY SCALE

The founding teams of the top 20 percent of companies, in terms of employee size, possessed specialized professional experience prior to founding their firms.



Note: Figures represent the percentage of clean energy firms that had at least one co-founder who possessed each type of work experience prior to the founding of the company. Global Top 1,000 Experience refers to previous employment at one of the largest 1,000 public companies in the world based on Forbes' methodology. Finance or Accounting Experience encompasses work in finance or accounting roles. STEM or Product Experience encompasses work in scientific, technological, engineering, mathematical, and product design roles. Categories are not mutually exclusive.

Sources: Endeavor Insight interviews and analysis; LinkedIn; PitchBook; Crunchbase; Forbes. Sample size: 133 companies for Global Top 1000 experience; 127 companies for STEM/Product Design and Finance/Accounting experience. The sample sizes were dependent on available founder data.

INVENTION-BASED ENTERPRISES

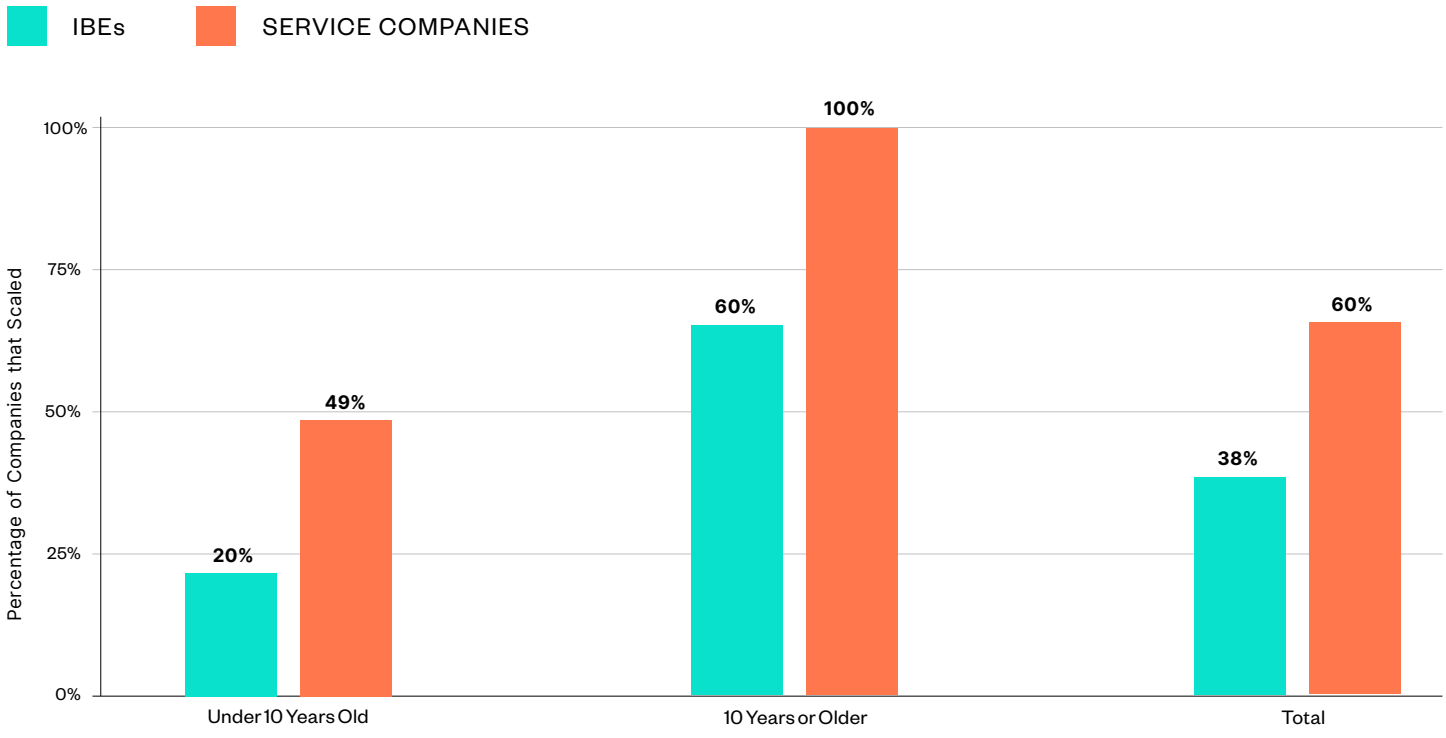
Company Characteristics

Invention-based enterprises are responsible for transformative innovations that solve a wide range of problems in the clean energy sector. IBE founders tend to focus on improving technological solutions and thus the efficiency and/or affordability of physical products. New physical products are the key to transitioning to clean energy, including energy generation, storage, means of transportation, and cooking. These solutions are often proprietary inventions, with 42 percent of the clean energy IBEs from Endeavor Insight's dataset having filed or received at least one patent, compared to 15 percent of service companies.

Founder Education and Experience

The IBE founders surveyed primarily possess degrees in engineering, science, mathematics, or business. They are often trained as scientists: 22 percent of IBEs have a founder with a PhD, compared to 16 percent of service companies. Furthermore, 75 percent of IBE founders have a STEM degree, compared to 61 percent of service company founders. In terms of professional experience, 60 percent of IBE founders have STEM or product design experience, compared to 44 percent of service company founders. Although IBE founders are strong in technical knowledge, some described their lack of business management and financial acumen as a disadvantage.

COMPARISON OF CLEAN ENERGY COMPANIES BY AGE AND SCALE



Note: Based on available data about clean energy companies identified for this study. The sample excludes companies that have closed. Scale is defined as having 50 or more employees.

Source: Endeavor Insight interviews and analysis. Sample size: 138 companies.

Early Stages

IBEs are research intensive and have high upfront costs — it takes significant time and money to bring their products to market. In some cases, founders were able to take advantage of their university's resources while pursuing a master's or PhD, and conducted the R&D needed to build a prototype. This was especially the case for expat founders who studied in OECD countries. Because the development of physical products is expensive and time-consuming, IBEs tend to require significant early-stage support and have longer development timelines than other innovation types. (See Appendix on page 46.) This pattern holds across sectors (when including agriculture and healthcare firms), but is particularly marked in the clean energy sector. These findings are backed by other research, with a 2014 study by the Shell Foundation noting that it can take 6 to 10 years and between $5 million and $20 million for breakthrough innovators in clean energy to become viable.[46]

In the early stages of testing and adapting, IBEs struggle to prove the viability of their business model to investors. This is difficult because product development to build a working prototype requires a great deal of starting capital. According to one IBE founder, "There's a lot of money available for implementation and going to market, but not a lot of funds available to sustain R&D." Founders fill this gap by depending on grant support, often from philanthropic sources based in OECD countries.

Growth & Expansion Stages

Despite these challenges, clean energy IBEs are still scaling to have a greater impact than service companies in reaching new markets and customers. One-third of the IBEs studied have expanded internationally, compared to only 16 percent of service companies. This success may be a result of having more time to grow, as the IBEs included in this study are slightly older on average than service companies. It may also be a function of founding team backgrounds, as the vast majority of companies that expanded internationally had an expat on their founding team.

Of the top 20 percent of companies in terms of customer base, three-quarters were IBEs. The same was true in terms of scale (defined as 50 or more employees). The top five companies in the dataset in terms of scale are IBEs that provide solar home systems and other solar-powered products within the household energy solutions and clean energy subsets. However, IBEs are less likely to reach scale on average, as the graph on the previous page highlights: only 38 percent of IBEs reached scale, compared to 60 percent of service companies. This suggests that while a few top-performing IBEs reach high scale, most do not.

Practical appliances such as cookstoves and lighting systems tend to reach the highest customer size, as they are often small and affordable. This is likely also a function of these subsectors being more mature and relatively well supported with grants. Additionally, industry associations like the Clean Cooking Alliance (CCA) and the Global Off-Grid Lighting Association (GOGLA) have played a large role in enhancing customer awareness and ensuring quality standards to increase uptake in their respective subsectors.

COVID-19 Impact

The COVID-19 pandemic greatly disrupted the operations of clean energy IBEs. Because of lockdown restrictions and labor shortages, many manufacturing plants had to close, so companies could not produce their products. Similarly, companies that conduct pilot programs and trials of their inventions with customers were unable to do so. However, opportunities were also created for some IBEs, like electric vehicle (EV) manufacturers, to expand their customer bases. The Indian company **Gayam Motor Works**, for example, experienced greater demand for its vehicles from e-commerce and delivery companies.

The experiences of IBEs are not uniform, and different pathways can be identified based on product type.

Type 1: Off-Grid Solutions for Electricity Generation/Storage

Companies that generate or provide off-grid energy, or storage solutions, have certain characteristics that distinguish them from other IBE company types. These companies tend to be more mature and well established, having had time to build up their employee and customer numbers.

Solar panel systems bring energy via off-grid technology to rural areas and poorer communities where there was previously no access to electricity. In some cases, they also replace existing on-grid energy sources. These solutions target both individual end-users as well as wider communities or villages. At the group level, such IBE products are cost-effective for rural communities, though for individuals the initial cost may be prohibitive if a pay as you go (PAYG) solution is not viable. For community- or industry-focused products, customer acquisition is not as much of a problem as government cooperation and investor interest are. Energy manufacturing may not be as appealing to investors or officials in comparison to more easily understandable and sleek devices, such as electric bikes.

IBE founders, particularly those producing solar lighting and home systems, also noted the difficulty of competing with cheaper products imported from China and other countries. Local certification requirements for off-grid energy products can exacerbate this problem by slowing down production by several months, while imports continue to flow in. Consequently, there is significant pressure on founders to continuously reduce their products' costs. Industry associations like GOGLA have worked on mitigating this problem by increasing customer trust and recognition of higher-quality products despite price differentials.

Expats from OECD countries, including those who developed their product idea at a university, are quite common among founders for Type 1 companies. Examples of Type 1 companies include: Tanzania's **Devergy**, which provides micro-grid solar systems for villages; **Mera Gao Power,** an Indian IBE which also produces solar micro-grids tailored toward rural communities; and **d.light** of the United States, which has a global presence in solar home systems, lanterns, and appliances.

Type 2: Clean Appliances, Agricultural Equipment,* and Vehicles

These companies mainly seek to replace the current machines and tools used by humans in specific tasks, such as cooking, farming, and transportation, with cleaner and more efficient alternatives. Many of these companies belong to younger subsectors that are utilizing cutting-edge technology in new ways, and therefore they have different growth trajectories.

Clean cookstoves and electric vehicles have tremendous potential to reduce carbon emissions and air pollution. Cooking and transportation are two of the largest energy-use sectors, and a clean transition is essential if premature deaths from indoor and outdoor air pollution are to be reduced. These products are primarily targeted at individual customers, as only a given household can use a single cookstove or refrigerator. However, transportation methods like electric vehicles are more flexible and target both individuals and business fleets, the latter of which can buy them in bulk. To address the challenge of pollution in India's large cities, many companies are particularly emerging to develop clean methods of transportation.

* For more on agriculture-focused companies, including producers of solar-power irrigation systems, see Endeavor Insight's report "Entrepreneurial Ecosystems in Agriculture", available at endeavor.org/entrep-in-agriculture.

Different consumer types require distinct solutions, which can present a challenge for companies in addressing the needs of rural communities. Many rural areas that do have access to electricity still lack efficient electric appliances for agri-processing. Most current agricultural equipment requires the generation of a minimum of 200 watts of electricity, an amount that is beyond the capacity of typical solar home systems and requires a mini-grid or stronger source.[47] For this reason, most of this equipment is designed to be run on mechanical energy produced by diesel generators. Much of the current equipment would need to be modified to be able to run on electricity, and there are opportunities to address the needs of larger equipment in an innovative fashion.

Given their focus on individuals, many of whom are poor or in remote areas, affordability and customer access are greater problems for Type 2 companies than for Type 1. As a result, they may require more corporate or government partnerships, as well as public subsidies. Companies selling expensive appliances and vehicles are often dependent on banks to provide customers with financing options in order to successfully sell to customers. The impact of the COVID-19 pandemic made this an issue for companies, as banks became more hesitant to finance products.

Examples of Type 2 companies include: **Sistema.bio**, an international company that designs, manufactures, and installs biodigesters and biogas appliances for smallholder farmers; India's **Ather Energy**, which manufactures electric scooters and is also establishing a charging infrastructure for electric vehicles; and **Prakti**, an Indian multi-fuel clean cookstove producer.

CASE STUDY:

Gayam Motor Works

In an industry with high potential for growth and impact, Gayam Motor Works has established itself as a leading producer of electric vehicles in both the B2B and B2C markets.[48]

Brothers Rahul and Raja Gayam (*opposite page*) founded Gayam Motor Works (GMW) in 2010 after Raja converted their father's bus body building plant into an auto-rickshaw manufacturing plant.[49] Raja was previously a software engineer at Symantec, and Rahul worked in the United States as a solar photovoltaic systems designer for Sun Electronics. As part of his PhD research, Rahul published papers in international journals on materials for supercapacitors with the potential to replace batteries in electric vehicles (EVs).[50] The pair's backgrounds in automotive manufacturing and clean energy led them to join forces to design GMW's EVs. They brought in Raja's former classmate from IIT Hyderabad, Sri Harsha Bavirisetty, who had experience working with startups in business development, marketing, and operations roles, to complete the leadership team.

India's cities suffer from high levels of air pollution, much of which is generated by fossil fuel vehicles, although the transition to EVs has begun. GMW's founding trio saw that the space for traditional EVs was starting to be filled by the major automotive manufacturers, so they decided to target a large traditional Indian sector, the rickshaw. India already has around 600,000 electric rickshaws powered by lead acid batteries, which take several hours to charge and require semi-annual replacement.[51]

GMW became the first company in India to develop an electric three-wheeler with a Lithium-ion battery that uses a battery-swapping system.

The company spent its early years developing its proprietary swappable battery system that would deliver the range, power, and speed needed to impact the rickshaw market. GMW's innovation enables users to immediately swap out an exhausted battery for a fully-charged one. Because of the lack of EV charging infrastructure in India, GMW first concentrated on the business to business (B2B) market, particularly last-mile delivery companies that had already established hubs in urban centers. As Raja explains, "Most of our customers have hubs that are spread throughout cities, where you can set up charging and swapping stations." This allowed them to grow the company without investing in this infrastructure themselves.

The entrepreneurs trialed 10 vehicles with BigBasket — India's largest e-commerce grocery delivery company — which had also been testing EVs imported from China. Raja notes that being a startup with knowledge of local conditions gave his company advantages over the imported EVs. He recounts that "we were able to quickly get feedback [from customers] and iterate the product, while the larger company was taking a long time to adapt." The GMW team's local knowledge also helped them to develop EVs that could survive regional road conditions. "The vehicles imported from China were designed for roads in China, which are extremely good. But in countries such as Nepal, Bangladesh, and India, the infrastructure isn't the same, so you have to develop products that are robust and

durable in rugged conditions. You also have to understand customer requirements. In a vehicle that is supposed to carry three people, you often find 10 to 15 people. So it's not the use-case scenario that you need to target, it's the misuse-case scenario."

Through its network of B2B partners, including BigBasket, Amazon, Ikea, and Flipkart, GMW set up battery swapping and charging stations at the existing hubs. This network of 50 to 60 swapping stations per city allowed the company to target the business to consumer (B2C) market, as they could now guarantee that drivers would always be within two kilometers of a swapping station. GMW-employed technicians can also provide roadside repairs in the case of a breakdown, cutting the usual service time from a couple of days to a couple of hours.

GMW has expanded internationally, with its flagship SmartAuto being the first Indian three-wheeler to gain certification from the EU. But COVID-19 brought challenges to the company, including months-long closures of GMW's manufacturing plant because of labor shortages as staff isolated or returned to their hometowns. Reduced manufacturing capacity has slowed the hoped-for rate of deployment of GMW vehicles. However, the pandemic also increased demand for last-mile delivery services, bringing an upsurge in orders from e-commerce companies. Raja foresees strong growth, both in India and abroad. "Currently we have 1,500-plus vehicles running in Europe, Asia, and Africa. We should enter Kenya, Chile, and Peru in the next six months."

To fulfill the growing number of orders, GMW plans to raise capital by going public. The company plans to list on the New York Stock Exchange (NYSE) by 2022, while still maintaining a majority share. The funds raised by this and other secured investment commitments will, according to Raja, "allow us to scale this initiative across multiple geographies, and by 2025 we plan to have around 300,000 vehicles on roads."

SERVICE COMPANIES

Company Characteristics

Service companies (including business process companies and software firms) are primarily involved in making clean energy more accessible to underserved customers. The founders of these companies seek to make incremental innovations that remove middlemen, improve access, and provide financing options for existing technologies. They also develop financing or insurance programs for customers, or provide energy on credit.

Software companies are the most streamlined, in that they employ fewer employees due to the nature of their non-physical products. In Endeavor Insight's dataset, 39 percent of software companies scaled to 50 or more employees, compared to 69 percent of business process companies.

Founder Education and Experience

Service company founders have a greater depth of business experience than IBE founders, with 52 percent of service companies having a founder with a degree in business, compared to 41 percent of IBEs. In terms of experience, 37 percent of service companies had a founder who had worked at one of the 1,000 largest public firms in the world, compared to only 19 percent of IBEs. Additionally, 26 percent of service company founders had some finance or accounting experience, compared to 12 percent of IBE founders.

Early Stages

Service companies innovate to deliver goods and services, including software solutions, to new markets. Some of these companies take products that already exist in developed markets, and then create the supply chains and integrated systems to introduce them to developing countries. For example, one company built distribution channels for non-governmental organizations (NGOs) to deliver their products to rural areas and then widened its own customer base.

Growth & Expansion Stages

These companies have business models that successfully attract investors, but they also require other kinds of support. The service companies in Endeavor Insight's dataset have outperformed IBEs in raising capital, including institutional investment. Seventy-one percent of the service companies included in the study raised capital, compared to approximately half of IBEs. When analyzing the top 20 percent firms in terms of raising capital, 37 percent were service companies; as service companies comprise only 33 percent of the whole dataset, they are slightly overrepresented among the top capital-raising companies.

Service companies are also more likely to have reached scale, with 60 percent having more than 50 employees, compared to only 38 percent of IBEs, despite the latter's older average age.

Typical service companies include: Kenya's **Copia Global**, a mobile commerce platform built to serve middle-to-low income African consumers and offering a range of products including solar appliances; **Kopagas**, a Tanzanian company that provides PAYG solutions for LPG; and **ZunRoof**, an Indian home-tech startup bridging electricity supply and consumption gaps in Indian homes through a range of clean and smart energy products.

COVID-19 Impact

Due to the onset of COVID-19, service companies have faced major challenges in business logistics. For companies that import their technology from overseas, such as **PowerGen Renewable Energy**, there were procurement delays and shipping backlogs from factories in China and Europe. Although the immediate aftermath of COVID-19 involved disruptions to the sector, demand for clean energy service deliverers is likely to increase.

CASE STUDY:

PowerGen Renewable Energy

PowerGen, a Kenya-based service company, has been innovative and flexible in its business model, allowing it to move quickly to set up mini-grids in several African countries.[52]

Kenyan Mark Wopicho and Americans Alastair Smith and Sam Slaughter founded PowerGen Renewable Energy in Nairobi in 2011 as an installer of off-grid power systems. Smith and Slaughter had backgrounds in mechanical engineering, and Wopicho in energy engineering. The company started by installing wind turbines and small solar projects for schools, refugee camps, and tourist lodges, but pivoted in 2015 to develop and operate its own portfolio of distributed renewable energy (DRE) systems.

The team primarily bootstrapped for many years, with a small amount of friends and family capital, which brought challenges for financial survival and talent acquisition. As Aaron Cheng, PowerGen's CEO, explains, "The first year was about finding projects, surviving, and having enough cash. We built a small, scrappy, and tight-knit team." Grant funding helped them to build a track record and credibility before securing their first institutional financing in 2016, and their second in 2019, which brought in large corporations like Shell and Sumitomo. According to Cheng, "It is a challenging fundraising market — both our Series A and B rounds took 18 months from start to finish. It is not the investor's fault, but a sectoral challenge to raise capital for a budding business model. We were lucky to get one or two investors that had a large enough ticket and who wanted to lead the round."

Mini-grids are a more reliable and cost-effective solution for a country than expanding national grids, but it is still a time-consuming process, and expensive given the smaller scale and higher transaction costs. There is also the challenge of balancing private sector capital with public sector or grant support to enable companies to effectively deploy energy access infrastructure in underserved rural areas. In Cheng's words, "We rely on grants for our rural projects, which I think is true for most rural projects on the continent. We also develop and operate urban DRE systems and grids, sometimes taking over operations of existing grids. These do not always need that donor or government grant, but you can still benefit from grants as they can help lower the cost to the consumer, a win-win. You need to recover the capital that you spend, and balance that with providing the lowest tariff that you can."

Driving demand from end users is key to the commercial success of the project, in order to ensure maximum return for the capital investment made. As a result, PowerGen is considering partnerships with companies that produce appliances. As Cheng explains, "A lot of our customers are getting electricity for the first time, and if they only have a few light bulbs that came with the installation, then average revenue per user is going to be low. So we look at different ways to help them get appliances and large income-generating productive loads like milling, grinding, welding, and water pumping. A lot of the PAYG solar companies have moved into more of a consumer asset finance model, which can help both the consumer and the market. There could be some synergies there between a consumer asset financing company and a power company like us."

To reduce investment risk and become more agile as a company, PowerGen entered into several financing deals with long-term project investors. Project financiers set up special purpose vehicles (SPVs) to fund

the equipment and purchase the assets, paying PowerGen to operate them. “What this financing enables us to do,” explains Cheng, “is essentially recycle that capital so that we don’t have to be as capital intensive and we can scale faster as a developer-operator.” The agreement gives PowerGen the flexibility to continue to move quickly to set up new grids, without having a balance sheet that is complicated by substantial assets and liabilities, often in remote areas.[53]

This agility has enabled PowerGen to serve over 18,000 connections (approximately 90,000 people) across Kenya, Tanzania, Nigeria, Sierra Leone, and Benin. In addition, PowerGen has built more than 200 power systems across 12 sub-Saharan African countries since its founding.

Mark Wopicho, co-founder

Alastair Smith, co-founder

Sam Slaughter, co-founder

Aaron Cheng, CEO

III. Entrepreneurial Challenges

Founders face several challenges on the road to success.

CUSTOMER ACQUISITION

Customer acquisition is a major obstacle for clean energy companies operating in sub-Saharan Africa and India, as it is a prerequisite to success that requires significant time and effort in the early stages. This is mainly related to the fact that many of the innovative products or services provided by clean energy entrepreneurs are designed for individuals or communities in remote locations, the people most likely to lack access to reliable and/or clean energy solutions. These populations tend to be poorer, more difficult to reach, and less likely to have bank accounts to pay for the products or services being offered.

Founders reported that the lack of distribution infrastructure and retail networks is a major obstacle to grow their companies in remote areas. Distribution partners can find it too risky to stock and sell new products and may not be invested in educating consumers about the products.[54] **Greenlight Planet** built a network of sales agents, which took effort to recruit and train, and have distributed millions of off-grid solar products directly to consumers, while also supporting the company's independent distribution partners. Another example is **d.light**, which used multinational energy company Total's filling station network to provide a distribution channel.[55]

There is a clear advantage to remote communities transitioning to energy solutions that offer immediate savings or income benefits, but the initial cost can also be a barrier. Such products most commonly include solar appliances or clean cookstoves for the individual, or solar solutions for communities. It can take months for the financial benefits to be realized, which is a barrier to uptake.[56]

Because IBEs' physical products require significant research and development (R&D) to produce, they are often expensive and out of the financial reach of many households. This initial financial barrier is a reason that early adopters of innovative technology tend to be those in higher income brackets, which presents a challenge for companies focused on markets in sub-Saharan Africa and India.[57] In order to mitigate this problem, successful founders have conducted market research and interviews with relevant stakeholders to ensure a customer-centric product, and then iterated the design based on feedback.

Many clean energy companies, including hardware-based firms, have found it useful to provide financing schemes for end users, such as pay as you go (PAYG) plans or credit. Alternatively, IBEs may find it advantageous to coordinate or partner with service companies that focus on financing schemes in order to reach such customers. Consumer finance constraints are making PAYG models more attractive, but challenges remain. The products currently offered need to be larger in capacity if they are to provide more than basic lighting and mobile charging, and companies offering PAYG solutions will need a substantial increase in funding if they are to scale for broader impact.[58] Some IBEs have struggled with the incorporation of PAYG into their hardware systems. In the

event of non-payment by customers, while they retain the ability to cut supplies, their physical product — which has been supplied on a lease-to-ownership basis — remains in situ and no longer provides revenue.[59]

M-KOPA's model has so far proved effective, offering millions of underbanked customers access to products such as solar lighting, smartphones, energy-efficient televisions, fridges, and cash loans. M-KOPA's PAYG financing model allows customers to build ownership of products over time as well as build their credit history by making flexible and affordable micro-payments.

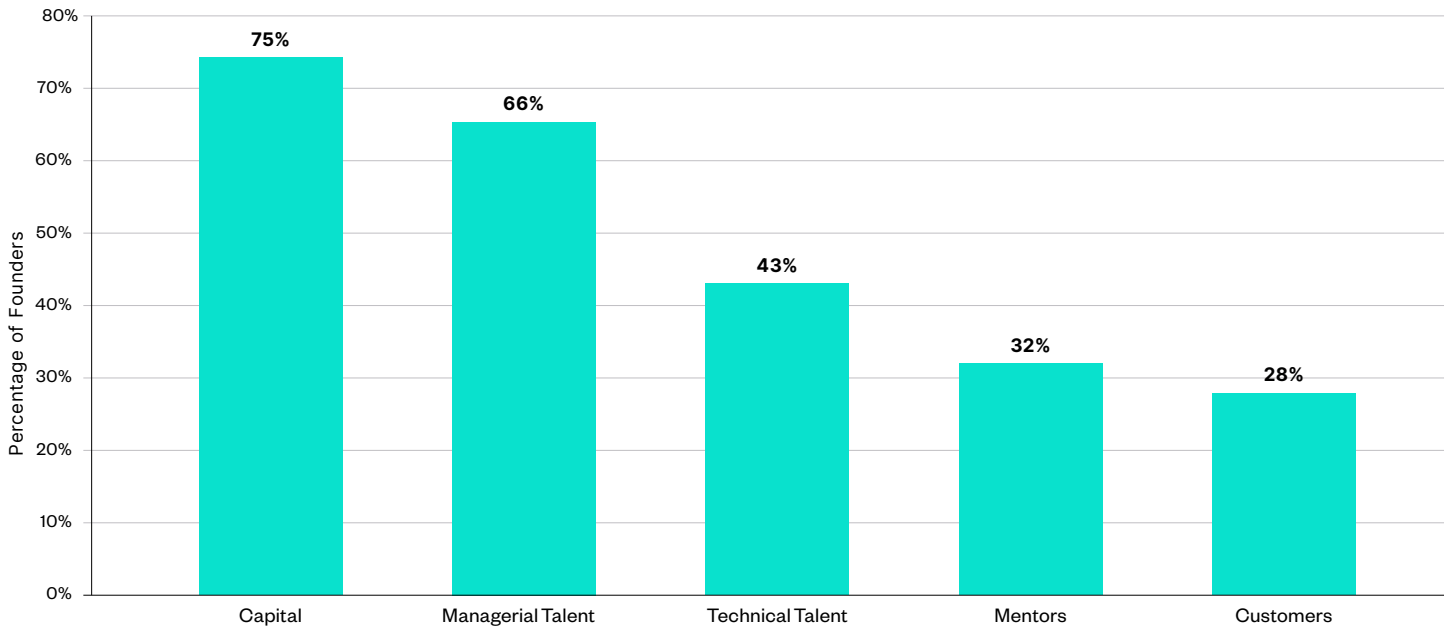
ACCESS TO CAPITAL

Access to capital is the most common challenge facing the clean energy entrepreneurs included in this study. As the graph below shows, 75 percent of founders surveyed by Endeavor Insight reported it as a major or severe obstacle to their businesses, ahead of any other category. There were multiple reasons for this being the case. Some founders reported that there is a gap between investors and investees in terms of their goals and commitments. Others noted that some investors are reticent because they either lack knowledge of — or do not value — decentralized energy networks and other off-grid solutions.

Another challenge reported by founders was that some investors are not knowledgeable about the markets that these companies are operating in, particularly in sub-Saharan Africa. Entrepreneurs from Africa noted a lack of understanding of their context, including that investors have an "imaginary image" in mind. The importance of geographic familiarity is reflected in the fact that nearly 90 percent of the clean energy companies based outside Africa and India raised capital, compared to only half of those within these markets. Partly this is a matter of trust, with African founders noting that it can take a long time for them to build trust with international investors and venture capitalists based in the United States and Europe.

The time-consuming nature of attracting new investors is a further barrier that many founders reported. For example, seeking investment can lead to the business being sidetracked from its original purpose and instead focusing on what investors want to see. Founders describe having to leverage networks and frequently travel to attend conferences around the world, particularly in Europe and the United

GREATEST OBSTACLES REPORTED BY FOUNDERS OF CLEAN ENERGY FIRMS



Note: Figures represent the percentage of interviewed founders of clean energy firms who reported access to each category as a major or severe obstacle.

Source: Endeavor Insight interviews and analysis. Sample size: 32 founders.

States, although this has been disrupted by COVID-19. Closing investment deals can take 12 to 18 months, according to some founders, which heightens the financial pressure on nascent businesses.

Founders who did raise capital, particularly institutional investment, frequently mentioned that it was instrumental for their growth and expansion, though some also mentioned that growth-stage capital is harder to find. Raising capital not only brings financial resources, but also an endorsement that there is international trust in the company, which can enable their expansion into new markets.

Endeavor Insight's research found that while institutional investment is increasingly available in these emerging markets, it is primarily provided by impact investors, not traditional investment firms. Impact investors are generally more willing to take risks and provide the patient capital that founders need. However, impact and other institutional investors can also take a long time to close deals, which hinders the growth of companies. Some founders also noted that at times, investors claim to be impact-focused but do not act as such when making deals, instead asking for higher returns than impact-focused companies would normally have. Founder interviews and external sources suggest that some impact investors seek internal rates of return (IRRs) of 20 percent or more, which approach the IRR goal of 30 percent that is typical of conventional venture capital, while the range of 8 to 10 percent is more realistic for clean energy firms.[60] There is also a lack of locally based institutional investment in the studied markets, with 70 percent of institutional investors connected to clean energy companies based in OECD countries.

Institutional investment is particularly a challenge for **IBEs** given their unique business model. Investors, including impact-focused firms, are hesitant to support companies that focus on physical solutions because they are more accustomed to supporting companies that create apps or provide Software as a Service (SaaS), which they perceive as less risky and easier to scale up. In the words of one IBE founder, many investors seek to "push you into a business model that is more like a service model." Some founders also reported that investors drove them to expand to new markets and geographies faster than they would have liked, due to the lack of time to prepare.

Angel investors are an important source of funding, but they are relatively rare in sub-Saharan Africa. Angels invested in 23 percent of the clean energy companies in Endeavor Insight's dataset, the vast majority of which were Indian companies. Overall, the majority of angel investors do not have relevant geographical or sectoral experience: 42 percent of them possess experience in the country of their investee, and only 16 percent have worked in the clean energy sector. There is also a geographical disparity in terms of the location of the angel investors, with local angels being common in India but relatively rare in sub-Saharan Africa. Most of the angel investors for India-based companies were based in India, but fewer than 10 percent of the angel investors for Africa-based companies were based in the same country.

Grants were cited as an important source of capital at critical times by clean energy company founders, half of whom had been recipients. Grant funding was more prevalent in sub-Saharan Africa than India, with 53 percent of Africa-based companies receiving grants, compared to 38 percent of Indian companies. Grants often serve as a bridge to other sources of funding, as they can act as a seal of approval. One founder mentioned participating in grant competitions in order to facilitate access to more customers and other investors.

Loans are the rarest form of capital in the clean energy sector, and were secured by only 16 percent of companies. According to several founders, commercial banks are risk averse in giving credit to the sector, a gap that is often filled by grant-awarding foundations. Lenders frequently require collateral as well as prohibitively high IRRs comparable to those of impact investors, without considering the mission or social impact of clean energy companies. Loans were more prevalent among OECD-based companies than Africa- or India-based ones.

Many of the studied clean energy companies purchase inputs and owe debt in U.S. dollars, but earn revenue in local currencies. As a result, they are exposed to foreign exchange risk, and the depreciation of local currencies against the U.S. dollar can cause financial stress for growing companies.

Founders highlighted the need for more commercial loans and working capital in local currencies to mitigate this risk. This reflects findings from Open Capital Advisors and the Shell Foundation, which specifically describe that local providers of capital in Uganda view off-grid energy companies as too risky to support.[61]

The **COVID-19** pandemic has also brought more immediate capital requirements in order for companies in the sector to survive. An extensive 2020 survey by Energising Development (EnDev) on off-grid clean energy access in the wake of the pandemic reported that 31 percent of companies with an annual turnover of $20,000 to $25,000 needed direct support of up to $25,000, and another 25 percent need support of $25,000 to $50,000.[62] Last mile distributors, which operate at the lower end of annual turnover (up to $10,000), are in more critical need.[63]

ACCESS TO TALENT

Recruiting managerial talent is more of a challenge than engineering or technical talent for both IBEs and service companies, with 66 percent of surveyed founders reporting it as a major or severe obstacle, compared to 43 percent for technical talent. A major reason for this, according to founders, is the difficulty of competing with larger companies, as some professionals are more attracted to the prestige associated with working for a well-established corporation.

At the same time, some companies have been able to find passionate, skilled technicians and engineers who are willing to work below the market rate because they believe in the mission of the founder's company. Some investors also help founders with talent needs by arranging fellowships to place qualified individuals.

Managerial talent is essential for the growth and expansion of entrepreneurial companies. Founders reported that building the right team that is equipped with the skills necessary at the expansion stage is especially difficult and requires significant amounts of capital. Whereas the pool of technical talent available from local pipelines, such as university graduates, is relatively larger, qualified managers — those who have significant management experience — comprise a small pool of candidates, especially in the studied regions. As a result, founders often rely on their networks to recruit for managerial positions with varying levels of success.

GOVERNMENT POLICIES

Energy is heavily regulated and often subject to changing standards, which makes government policy critical in enabling or inhibiting the success of clean energy companies. Utilities and on-grid energy sources are primarily government responsibilities, and their functioning affects demand for other clean energy innovations. Governments vary in their level of support for private sector involvement, with some supporting off-grid partnerships and others seeking fully public-owned utility provision.

Some government policies, such as requirements to follow certain testing procedures and obtain certifications, have created specific challenges for clean energy founders, adding delays and costs. New regulations can delay the release of products by months, in which time cheaper imports can enter and overtake the market. Entrepreneurs are better served in an environment of regulatory certainty, and the clean energy sector has at times been subject to rapidly changing government policies, disrupting business models.

Government policies with regard to subsidies drive dynamics within the sector. Some entrepreneurial companies, particularly those undertaking large-scale projects like rural electrification, have benefited from enhanced government subsidy programs when they struggled to find sufficient capital through other means. Still, government subsidies and grants can distort and oversaturate the market by supporting businesses that would otherwise not be successful or competitive. Conversely, founders in India report that subsidies that continue to exist for fossil fuels undermine the transition to clean energy. Directing subsidies to consumers for the purchase of clean energy products, rather than to companies, can help form markets without distortion and reduce the problem of customer acquisition.

Local and national governments also serve as major customers of clean energy products, which raises the imperative for greater communications with businesses in the sector. As noted by one founder, "the government had to be a partner, either as a customer or a channel partner" in order for their company to scale.

International development organizations and donors can help to influence policy based on their knowledge of entrepreneurs' needs. This kind of conversation can be beneficial for all. As one founder said, "We have benefited from donors who have worked with governments to shape regulation to create an enabling ecosystem. That has been key in unlocking certain markets."

COVID-19 has led governments to divert funds towards emergency measures, to the detriment of business development for clean energy. For example, in Uganda public subsidies for the electricity access program were put on hold.[64]

The pandemic did, though, herald some progress for clean energy initiatives from governments. The Indian government has awarded landmark supply contracts for flexible renewable power, as well as various renewable stimulus measures.[65] Central and state governments also took steps to support the domestic clean energy sector, with the state of Gujarat, for example, bringing in a new solar energy policy that offers incentives such as removing the upper limits on installation capacities and allowing consumers to lease their roofs and premises for setting up solar plants. The state government also now allows consumers and small and medium-sized enterprises (SMEs) to sell their surplus energy back to the grid.[66]

IV. Support Ecosystems

The quality and accessibility of support can influence entrepreneurial ecosystems.

SUPPORT AND MENTORSHIP

Support organizations provide certain benefits to clean energy companies, although their programs are not sufficiently tailored to existing needs, and qualified mentorship is lacking. Support organizations include incubators, accelerators, and other selection-based programs that provide networking, training, and other services to entrepreneurial companies. Participation in these programs is quite common, representing 74 percent of the clean energy companies in this study. IBEs were more likely to participate in support programs, with 79 percent having done so, compared to 64 percent of service companies.

Support programs have proved helpful for many, with founders reporting value in building connections and networks, accessing early funding, and improving their business skills. However, many founders reported that the support programs that they participated in were not helpful or did not provide the services they sought. For example, founders mentioned that participating in such programs can distract from their overarching business goals, and in some cases actually slowed their growth. Some support programs do not provide clean energy founders with connections to investors for growth stage capital, though nearly half of the programs studied have in-house funds focused on earlier stages. Furthermore, there is concern among some that selection processes are not well targeted, with one founder noting that "tiny companies that cannot scale receive outsized support."

Endeavor Insight's data shows that there was not a measurable difference for clean energy companies in reaching scale — defined in this report as a company growing to 50 or more employees — based on participation in a support program, but participation was associated with a 20 percent increase in the likelihood of raising capital. These findings are somewhat different from research published in 2021 by the Global Learning Accelerator Initiative (GALI) on companies that participated in accelerator programs, regardless of sector. That study found that participating companies were more likely to reach higher scale and receive more outside investment than non-participants.[67]

The graph on the next page shows that most support organizations for clean energy companies focus on earlier stages,

while relatively few assist with growth and expansion. Out of 121 support organizations in the sector, 84 served the pilot or early stage, while only eight served the growth or expansion stage, and 29 supported both. In contrast, Endeavor Insight found that a large majority of entrepreneurial companies active in the sector were at the growth or expansion stage — 118 out of 138.

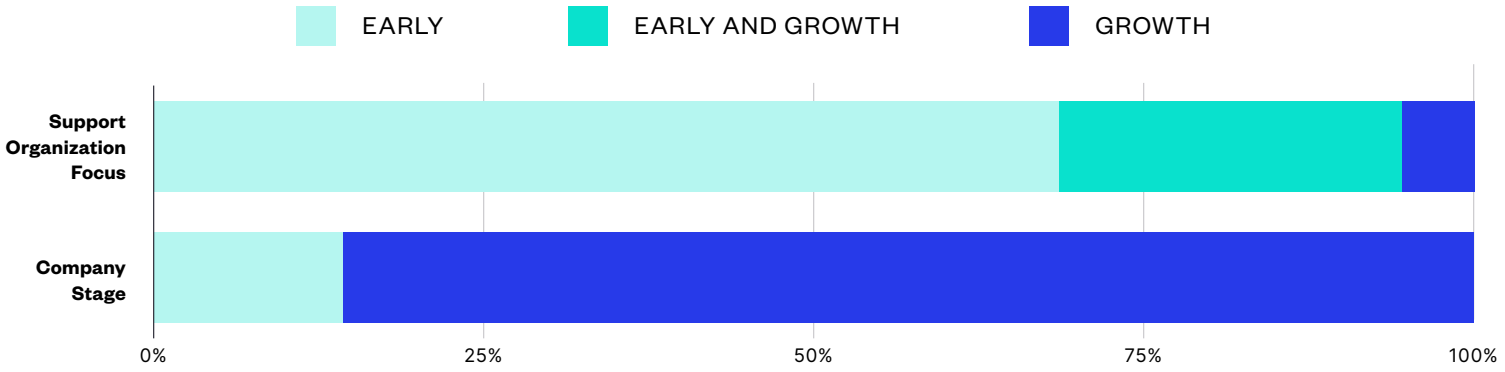
There are clear geographic disparities in terms of local support: while 60 percent of Indian companies received support from local organizations, only 13 percent of African companies did. None of the top 10 support organizations that served the most companies in this study are headquartered in Africa, and African companies were more likely to have participated in a program offered by an organization based in OECD countries. The dearth of support organization programs for clean energy companies is not restricted to sub-Saharan Africa and India, with GALI finding that only 4 percent of accelerators worldwide had an energy-specific focus.[68]

Mentorship is not very common, with only 27 percent of support programs for clean energy companies providing a mentorship or networking component. Some founders reported that these programs were too basic or simplistic, and the mentors were often not knowledgeable about their sector. According to one founder, "A lot of times they [support programs] offer to help with something, and then pair you with someone who is not an expert in the space and knows very little. Then we are forced to get on a weekly phone call with someone who can't really help us. Those instances have been frustrating." Local mentorship was also found to be rare, though it is more common in India. According to interviews with founders, 48 percent of mentors of Indian companies were based in the same country, compared to only 26 percent for sub-Saharan African companies.

Founders who reported negative experiences in support programs largely had different expectations about what services would be offered than was actually the case. As research by the Argidius Foundation has shown, a mismatch in expectations can be avoided to reduce the frequency of negative experiences by improving communication in the selection process and increasing the available information on the nature of services provided.[69]

COMPARISON OF SUPPORT ORGANIZATION OFFERINGS AND COMPANY STAGES IN CLEAN ENERGY

Support organizations tend to focus more on the earlier stages, whereas more companies are at the later stages of growth.



Note: Data on support organizations includes those that served at least one target clean energy company in the study. Support organizations were categorized according to the stage focus of their programs. "Early" includes the pilot stage, whereas "Growth" includes expansion. Out of the 121 support organizations that supported clean energy and had data available, 84 supported the early stage, 8 supported the growth stage, and 29 supported both. Clean energy companies were categorized as being at the early stage if they were 0-4 years old or at the growth stage if they were 5 or more years old. This data included 138 companies, of which 20 were at the early stage and 118 at the growth stage.

Sources: Endeavor Insight interviews and analysis; LinkedIn; PitchBook; Crunchbase; support organization websites. Sample sizes: 121 support organizations and 138 companies.

CASE STUDY:
Burn Manufacturing

For Burn Manufacturing, producing clean cookstoves in Kenya has created hundreds of local jobs and investing in R&D capacity has positioned the company well against competitors.[70]

In 2010, having spent 13 years as a cookstove consultant in Central America and sub-Saharan Africa, Peter Scott (*below left*) launched Burn Manufacturing and its nonprofit R&D division, Burn Design Lab, in Washington state. Scott explains that starting in the United States was a necessary early step, as it gave him access to technically skilled workers and volunteers to design and develop the company's fuel-efficient cookstoves. Funding was difficult at first, as Scott explains, "People are wary of Africa, they're wary of manufacturing, they're wary of hardware innovation, they're wary of cookstoves — all those things were stacked up against us, which made it very difficult to raise money."

For three years "we were just working on the design of the product," recounts Scott, "until we got some initial funding from OPIC [the Overseas Private Investment Corporation, now the U.S. International Development Finance Corporation] and General Electric, which allowed us to launch assembly in Kenya." Additional funding allowed Scott to "move the entire operation to Kenya — first assembly, then manufacturing, and finally R&D." The solar-powered facility in Ruiru, Kenya opened in 2014 and now employs over 400 people, mostly women, with the capacity to produce 70,000 stoves per month.

Burn has also created more than 200 jobs in sales, marketing, distribution, and monitoring. The company's mission is to save lives and forests through the design and manufacturing of fuel-efficient cooking appliances.

At first, Burn designed its products for low- and middle-income Kenyans, who overwhelmingly use solid fuel sources such as charcoal and wood for cooking. The financial barriers to cleaner options such as liquid petroleum gas (LPG) or electricity were initially prohibitive. Therefore, the company focused on manufacturing charcoal cookstoves that minimize the escape of pollutants from the cooking process while also markedly improving efficiency, so that the stoves would be financially viable for the consumers. Burn's Jikokoa charcoal stove uses 50 percent less fuel than traditional cookstoves, and its harmful emissions are 60 percent lower.[71] The company calculates that the use of their efficient stoves has saved over 4.5 million tons of wood and has positively impacted over 6 million lives in sub-Saharan Africa.

More recently, Burn has begun to design and release electric, LPG, and hybrid (biomass/electric) cookstoves to complement its other products. The company did not enter the LPG market sooner because it was difficult to stand out in such a commoditized market. Scott explains, "Now we're seeing that we can make a higher quality product cheaper than Asia, so it makes sense for us to do that." Additionally, Burn is positioned to support the growing demand for electrical cooking appliances as electricity access continues to expand across Africa, often generated through clean, renewable sources.

The initial costs of establishing research and manufacturing facilities in Kenya have paid off. The company has been net income positive since 2017, and Scott sees an advantage in being based in Kenya. Although setup costs were high in Kenya, labor costs are more competitive than in China, and — particularly given the supply chain issues magnified by COVID-19 — transportation problems are minimized by having a local production capacity. In addition to lower labor and transportation costs, Burn has invested in brand building through product warranties and after-sales support to outcompete cheaper alternatives. As Scott puts it, "for some Chinese manufacturers making an LPG stove, there's no warranty, there's no support, so you have no idea what you're buying."

Burn has partnered with different financial institutions and PAYG companies in an effort to reach more consumers who might otherwise not be able to afford a stove. These companies offer credit, and some allow customers to pay as little as $1 per week for an agreed period of time. Having an array of credit lines also allows the company to extend credit to small-scale distributors, and in turn, increase their products' reach.[72]

The company has raised more than $4.4 million in debt and equity financing from GE, OPIC,* Acumen, AHL Venture Partners, and Yunus Social Business. It has also benefited from grant funding, which the company has used to support research and development. To date, Burn has sold 1.1 million stoves, 900,000 of which are its flagship Jikokoa model, and the company has expanded beyond Kenya to 12 other countries in sub-Saharan Africa.

* Originally known as the Overseas Private Investment Corporation, OPIC merged in 2019 with the Development Credit Authority (DCA) to form the U.S. International Development Finance Corporation (DFC).

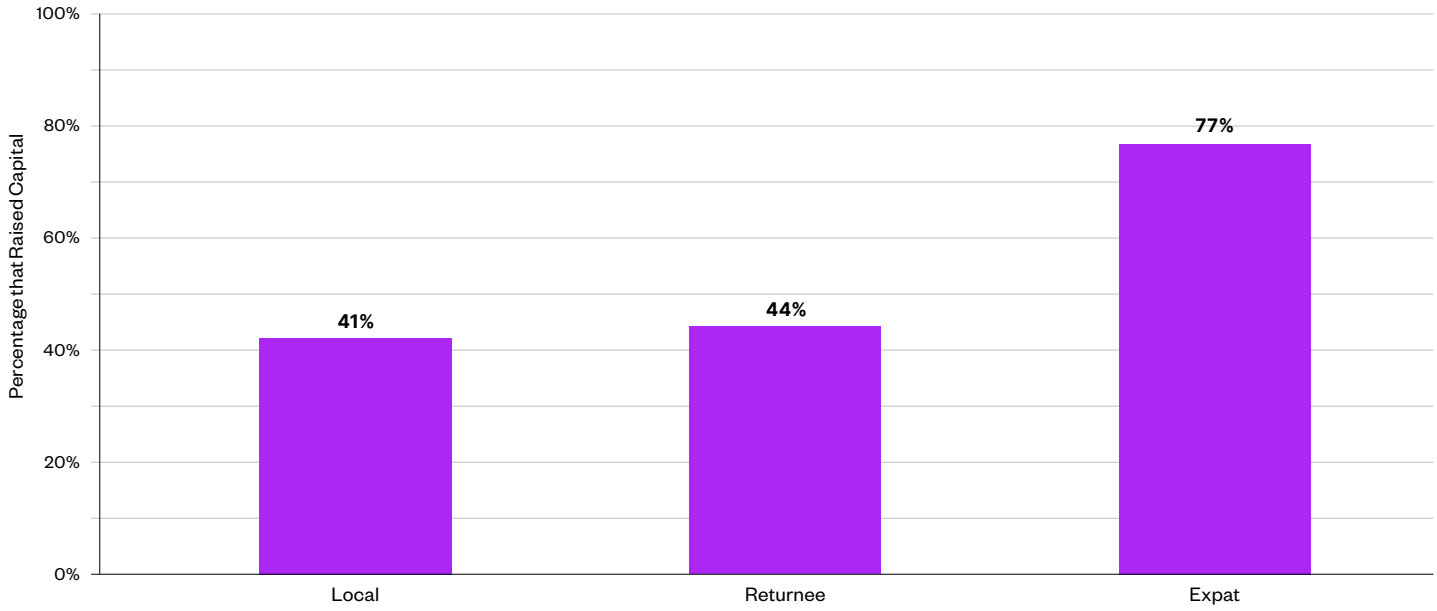
FOUNDING TEAMS

There are notable geographic differences in the backgrounds of founding teams of clean energy companies, with 80 percent of sub-Saharan African companies led by expats. Indian companies are more likely to be led by returnees — those who have studied or worked abroad — who account for 51 percent of clean energy founders in the country. One Indian founder noticed the impact potential of solar energy as it started to emerge in the United States while he was working in Silicon Valley, and he quit to enter the solar industry in India. All-local teams, those that have no expats or returnees, only represented 11 percent of sub-Saharan African companies, and 31 percent of Indian firms.

Expat entrepreneurs from Europe and the United States are common in the clean energy sector, particularly for companies based in sub-Saharan Africa. According to founder interviews, one reason for the disproportionate involvement of expats is that entrepreneurs find it easier to start their companies in developing countries due to the sector's heavy regulation and barriers to entry in the Global North. Additionally, the lack of preexisting energy systems in many of the rural areas of sub-Saharan Africa and India means that those countries are more accommodating to decentralized, off-grid energy networks.

Unequal access to resources can mean that local-led teams face greater barriers to capital and reaching scale (defined as 50 or more employees). As noted in the Access to Capital section, African founders reported that it takes longer for them to build connections with investors based in Europe and the United States. Local founders can face linguistic and cultural barriers that make it more difficult for them to engage with offshore capital. As the graph below illustrates, a much greater proportion (77 percent) of expat teams were able to raise capital, compared to 44 percent of returnee teams and 41 percent of all-local founding teams in this study. There were similar

PERCENTAGE OF CLEAN ENERGY COMPANIES THAT RAISED CAPITAL BY FOUNDING TEAM TYPE



Note: Founding teams are defined as "local" if they have no expat or returnee co-founder, "returnee" if they have at least one returnee but no expat co-founder, and "expat" if they have at least one expat co-founder.

Sources: Endeavor Insight interviews and analysis; LinkedIn; PitchBook; Crunchbase. Sample size: 135 companies.

contrasts for scale: 59 percent of expat teams scaled, compared to 40 percent of returnee teams and 22 percent of all-local teams. This aligns with findings from the World Resources Institute, which found that local entrepreneurs in Kenya were being overlooked by impact investors, and consequently their businesses were growing more slowly than those founded by expats.[73]

As the visualization on the next page illustrates, the clean energy companies that have received the most resources and services in sub-Saharan Africa are expat-led firms. On the other hand, the most well-connected companies in India are primarily local- or returnee-led, with less expat prominence over time.

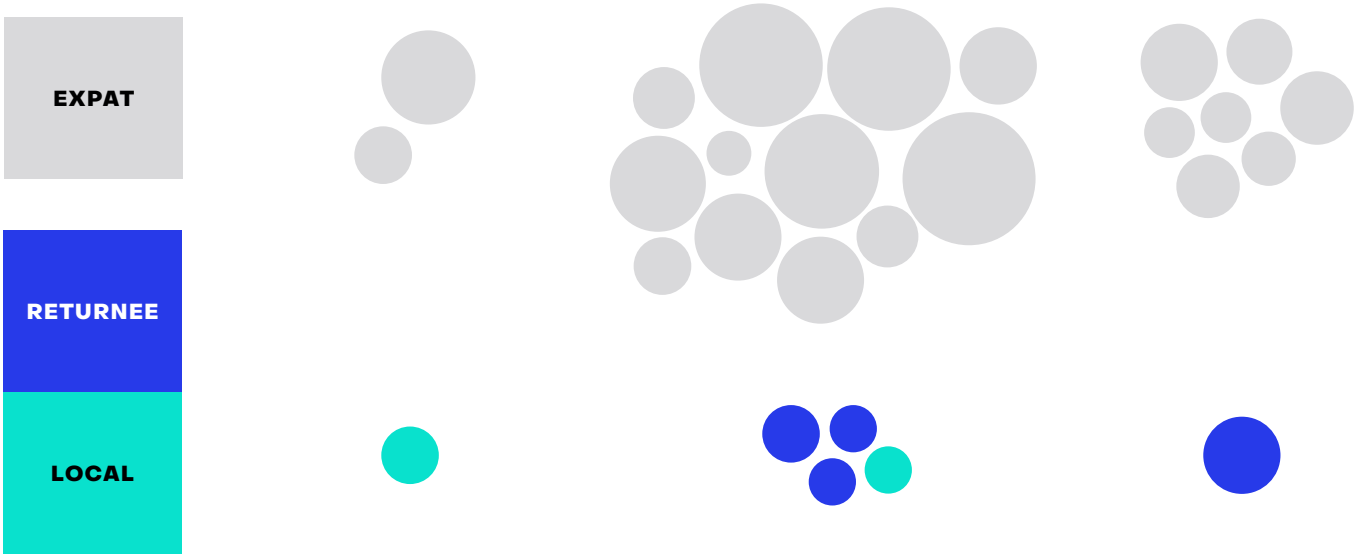
Although sub-Saharan Africa has a high concentration of expat founders, they can also contribute to the development of local ecosystems. **Burn Manufacturing**, originally founded in the United States, progressively shifted its assembly, manufacturing, and R&D operations to Kenya, embedding itself in the local community. (See case study on pp. 34-35.) Its founder, Peter Scott, believes that existing constraints in the sector such as investor wariness make the model of expecting local innovators to raise capital and build up businesses infeasible. According to Scott, a more viable model may be to "embed those innovators into a larger organization that has manufacturing capacity, that has enterprise resource planning (ERP) systems, that has modern accounting, and then those businesses can grow with an innovation mindset."[74]

Additionally, there are potential synergies for founding teams with a mix of expat and local entrepreneurs. As in the case of **PowerGen**, an expat founder may have access to international networks and resources, while a local founder may possess vital contextual knowledge and local experience. Founders with a foreign background should consider partnering with those who have a local background when starting a company in a new market.

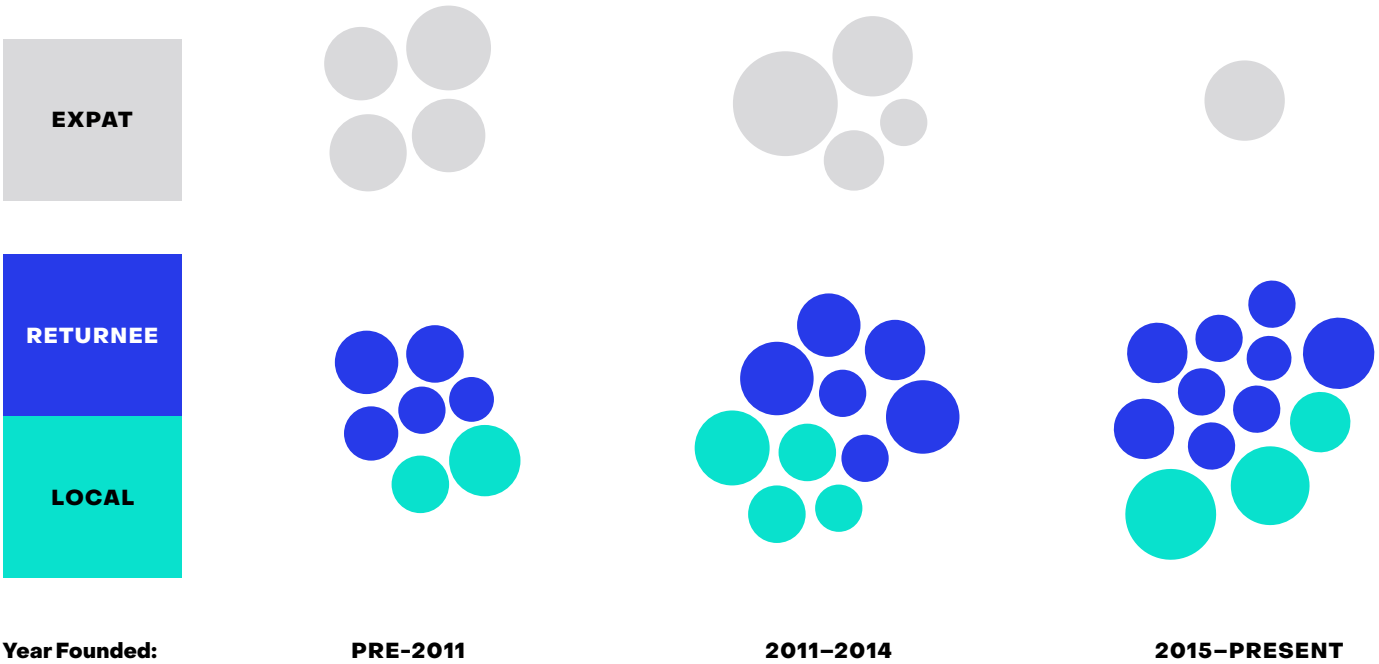
FOUNDING TEAM BACKGROUNDS AND CONNECTIONS FOR CLEAN ENERGY FIRMS BY REGION

The size of the circle is proportionate to the resources a company received including mentorship, investment, and other support.

In Sub-Saharan Africa, Most Well-Connected Clean Energy Companies Are Expat-Led



In India, Most Well-Connected Clean Energy Companies Are Local- or Returnee-Led



Note: Companies were included if they received resources or services from at least three investors, mentors, and/or support organizations. Each bubble represents a company, and its size is proportionate to the number of relationships it had with those providers. Empty sections indicate the absence of companies with at least three investment or support relationships. Founding teams are defined as "local" if they have no expat or returnee co-founder, "returnee" if they have at least one returnee but no expat co-founder, and "expat" if they have at least one expat co-founder.

Sources: Endeavor Insight interviews and analysis; LinkedIn; PitchBook; Crunchbase; company websites. Sample size: 697 connections.

LESSONS FOR ENTREPRENEURIAL COMMUNITIES

Entrepreneur-Led Economic Development provides an effective approach to strengthening local networks.

Decision makers can improve the development of local entrepreneurship communities. In 2018, Endeavor Insight completed a study supported by the Bill and Melinda Gates Foundation on the software sector in cities across sub-Saharan Africa and South Asia. It examined how entrepreneurial communities develop and what decision makers can do to help them become more productive. The resulting recommendations outlined five key principles for "Entrepreneur-Led Economic Development," two of which are particularly relevant to the development of innovative clean energy companies.*

Identify local entrepreneurial strengths and increase capacity for the support that has already proven to be helpful.

- Each business that local founders build represents an experiment on the types of subsectors and business models that can thrive in that market.
- Decision makers often ignore the knowledge that these founders possess when making decisions on which types of companies to focus on.
- Research, like the methodologies from Endeavor Insight that focus on founder-level data, is necessary to understand what local entrepreneurs need to scale their solutions, but their needs will change over time and depend on local conditions.
- Decision makers who wish to launch initiatives to support local entrepreneurs should understand what types of support the most promising entrepreneurs are currently utilizing, and focus on increasing the capacity of existing initiatives.

Expand existing mechanisms such as mentorship and investment that leaders of companies at scale use to influence up-and-coming founders.

- Leaders of entrepreneurial companies that reach the scale of 50 to 100 or more employees can improve the performance of other local founders by acting as mentors and investors.
- Those founder-to-founder relationships are important in helping newer companies succeed, but are rare in many entrepreneurial communities.
- Many successful founders have the capacity to mentor more entrepreneurs and include additional companies in their angel investment portfolios.
- Decision makers should encourage the leaders of entrepreneurial companies that have reached scale to be more active in influencing upcoming founders.

* For more information on Entrepreneur-Led Economic Development, see Endeavor Insight's report "Fostering Productive Entrepreneurship Communities", available at endeavor.org/fpec.

V. Recommendations

This section provides practical recommendations for addressing the major challenges that clean energy company founders face.

There is great potential for entrepreneurs in sub-Saharan Africa and India to improve access to clean energy, reduce pollution, and mitigate the impact of climate change. In order for the global community to maximize these benefits and make progress towards the SDGs, decision makers should take action to address the challenges that clean energy entrepreneurs face and the systems-level gaps that persist. This section presents recommendations to improve the areas that most affect entrepreneurs: capital, talent, support, mentorship, and policy. Many of these recommendations involve cooperation between different actors, in recognition of their complementary roles and the potential benefits from a well-connected ecosystem.

In addition to the interviews with founders, Endeavor Insight spoke with several investors, support organization leaders, and other experts on clean energy entrepreneurship in sub-Saharan Africa and India. The following practical recommendations for decision makers emerged from those conversations and the analytical findings of this report.

1 Increase the alignment of goals between investors and entrepreneurs to make the most of existing opportunities.

Access to capital was the highest ranked challenge among the founders interviewed for this study. To address this obstacle, capital providers and entrepreneurial companies need to reach greater alignment in their goals. This would enable more efficient processes and allow both parties to benefit from the existing potential of the sector.

In many cases, investors lack the technical knowledge to differentiate between clean energy startups that have high growth potential and those that do not. This is amplified by the heavy concentration of large incumbent firms. Furthermore, founders noted that foreign investors lack contextual knowledge of local markets, especially in sub-Saharan Africa. To address these issues, investors should build stronger connections with subject matter experts and local investors in their countries of focus prior to selecting companies. Offshore investors can partner with local capital providers in funding rounds, as the latter can provide important information.

Long timelines for finalizing funding deals present another challenge, as the delays can put young companies at risk of bankruptcy. Investors and companies should adhere to mutually agreed timelines and be clear about their expectations at the outset. Late-stage investors often receive applications from early-stage companies and keep them under consideration for long periods of time while waiting for the firms to grow larger before closing deals. Instead of perpetuating this mismatch, investors should be more direct in communicating their stage focus. By increasing communication from the start, investors and founders can alleviate the discrepancy in expectations and reduce funding timelines. Because fundraising is time consuming and founders must simultaneously run their companies, some founders find it advantageous to hire qualified leaders who can assist in managing fundraising efforts. These executives can help provide investors with more information and evidence to prove their company's track record and assuage investor concerns.

There is also a need for greater local investment in these developing countries, which would have several benefits. Successful local entrepreneurs should serve as angel investors for younger companies, especially in sub-Saharan Africa, to build up their entrepreneurship ecosystems. Policymakers and support organizations can also work to increase local awareness on investment opportunities in entrepreneurial companies within their own communities, in order to broaden their scope beyond only traditional investments. Additionally, international donors and philanthropic organizations can encourage local angel networks and commercial lenders to catalyze more local investment, which would help reduce foreign exchange risk for companies.

At the same time, there is now a growing momentum of investment for mitigating climate change, and some companies have successfully exited after raising large amounts of capital. The clean energy sector has a sizable number of investors providing funding for the growth and expansion stages, though investors should ensure that these funds reach local founders as well. Although founders reported that some impact-focused investment firms act more like conventional investors, mission-oriented impact investors have benefited many clean energy companies. When impact investors are clear about their expectations and provide patient capital, they enable companies to grow and succeed.

2 Enhance early-stage support and funding opportunities for IBEs.

As this report has shown, invention-based enterprises are qualitatively different from service companies and require tailored support. IBEs are essential for the success of the clean energy sector. In the words of one founder, "Hardware takes time, but without hardware, no service model can work." Until now, however, most early-stage support and funding opportunities have been more suitable for service-oriented business models, which do not account for the iterative research and development (R&D) process needed to develop physical products.

"Hardware takes time, but without hardware, no service model can work."

Due to the long timelines involved in developing new inventions, entrepreneurs need flexible, patient capital. More mature companies in the sector, like **SELCO India**, took more than a decade to become profitable, and nascent high-tech firms may take similar lengths of time. Support organizations and philanthropies can increase support for IBEs in earlier stages by providing a greater number of grants to conduct experimental R&D. Grantmakers should have greater risk tolerance during early-stage product development because groundbreaking innovations are time- and resource-intensive to generate. Early-stage IBEs also frequently have to spend money to access research facilities and technical expertise, and support organizations can provide more cost-effective avenues for this.

Entrepreneurial inventors who seek to tackle new issues and develop new business models find it difficult to convince investors of the need for their novel approaches, and institutional investors are hesitant to invest in companies before they have demonstrated consistent sales. Support organizations can help entrepreneurs secure customers at earlier stages to prepare them for institutional investment. At the same time, the public sector can underwrite risk and provide incentives for private institutional investors to move towards selecting companies at earlier stages of growth.

Donors and philanthropies who fund support organizations and wish to see

more tailored solutions should also adopt a flexible approach to encourage these changes. This includes increasing multi-year support and discretionary pilot funding, as well as non-financial assistance like programmatic expertise, to allow support organizations to refine their practices and capacity to serve IBEs.

3 Tailor support programs to the needs of the clean energy sector.

Support organizations should provide more tailored assistance to clean energy companies by accounting for the needs of the sector. They are well positioned to have a greater positive impact on companies by providing qualified mentorship and assisting with customer and talent acquisition.

Many founders who were interviewed for this study reported that the support programs they participated in did not match them with qualified mentors. Support organizations should pay greater attention to identifying mentors who have had substantial experience in clean energy. In particular, those who have technical expertise are especially valuable because companies in developing countries are often in need of such assistance. Support organizations can tap into their alumni networks, as well as connections at affiliated investment firms, in order to encourage successful founders to become mentors.

Local universities and support organizations should form partnerships to build on each other's strengths. While universities can provide founders with access to facilities for R&D and product testing, support organizations can offer specialized knowledge on bringing products to market. Some support organizations offer value in this saturated sector by working with founders to secure potential customers for their companies before they graduate from the program. Setting periodic milestones for founders to reach certain levels of product efficiency in order to make them attractive to both customers and investors is a beneficial tactic.

There is also unrealized potential for support organizations to help entrepreneurial companies in talent acquisition, which was the second highest ranked challenge in this study. Managerial talent is particularly important, as many companies end up hiring managers with little experience because they do not have the capital to attract more experienced talent. This is especially the case for local-led companies in developing countries in sub-Saharan Africa. Policymakers should consider incentives that engage diaspora professionals either to refer candidates or to return and serve in senior positions at local companies. Support organizations can also leverage their alumni networks to share postings for managerial positions at younger companies.

4 Elevate the influence of older companies to assist upcoming firms, especially through local mentorship.

In order to build a more well-connected entrepreneurial ecosystem, upcoming founders in the clean energy sector can learn more from the experiences of successful founders, especially those who are local to the same geographies. As a relatively mature sector, clean energy has several large entrepreneurial firms that have scaled successfully and achieved widespread impact. New entrepreneurs often face similar challenges to the ones that established founders have already overcome, so mentorship is highly valuable for the transfer of knowledge. Founders

reported that mentorship is most useful when it is unstructured, long-term, and centered on specific issues that they are facing.

Although some ties between older and younger companies exist, there is substantial room for greater engagement in this sector. To create this change, founders that have already scaled their companies should move beyond a zero-sum mentality in which they view upcoming founders as competitors. As the principles of Entrepreneur-Led Economic Development show, successful local founders can serve as leaders for their entrepreneurial communities and contribute to long-term capacity building. For example, SELCO India spun out a foundation to support rural entrepreneurship, and the company provides access to hundreds of experienced mentors from among its own staff.

Investors and support organizations, especially locally based ones, have a major role to play in facilitating these connections. They have ties to successful companies that they have supported in the past, and they also continue to select new startups. For example, networking events to connect upcoming entrepreneurs with industry-specific and market-specific mentors are beneficial. Donors and philanthropies should play a role in these efforts by elevating support organizations and funds that explicitly build bridges between current companies and alumni.

5 Provide an enabling environment for founders that facilitates entrepreneurship.

At a more fundamental level, decision makers in African countries and India need to foster an enabling environment for local founders to succeed. Governments should focus on constructing the basic infrastructure, STEM university systems, and R&D facilities in underserved areas that can make meaningful differences to entrepreneurial companies. This is especially important in sub-Saharan Africa, where there is a significant need for investment in local R&D capacity and technical expertise to foster long-term innovation.

The COVID-19 pandemic has presented an opportunity for a greater focus on this, as it has made clear the need for decentralized, sustainable energy sources that are resilient to supply chain issues. There is substantial potential for more public-private partnerships, through which private enterprises can fill gaps in energy access for rural communities that are off-grid. If governments subsidize products for end users, this would lower the barrier of affordability and accelerate uptake. By facilitating the transition to clean energy sources, governments can mitigate the effects of climate change and reduce pollution.

In addition, governments can contribute to reducing the risk perception about clean energy products for investors and customers. For example, government interest in and support of the solar industry in Kenya helped in making it viable and attractive to capital providers, including loan-making banks. When governments invest in and develop regulations around a sector, it serves as a signal to investors that the sector is less risky. Transparency and stability in clean energy policies would also reduce risk perception.

Other elements in the ecosystem include local universities and research institutions. These organizations can play an important role in supporting the development of clean energy companies, especially IBEs, by promoting “learning by doing” and an entrepreneurial mindset among students through hands-on experiences like class projects and innovation competitions.

Furthermore, conducting greater levels of research in the hard sciences at local universities would have the benefit of increasing the number of professionals with advanced degrees relevant to the energy sector. These steps would enable those individuals to pursue careers in which they can apply their technical skills outside of academia to local needs.

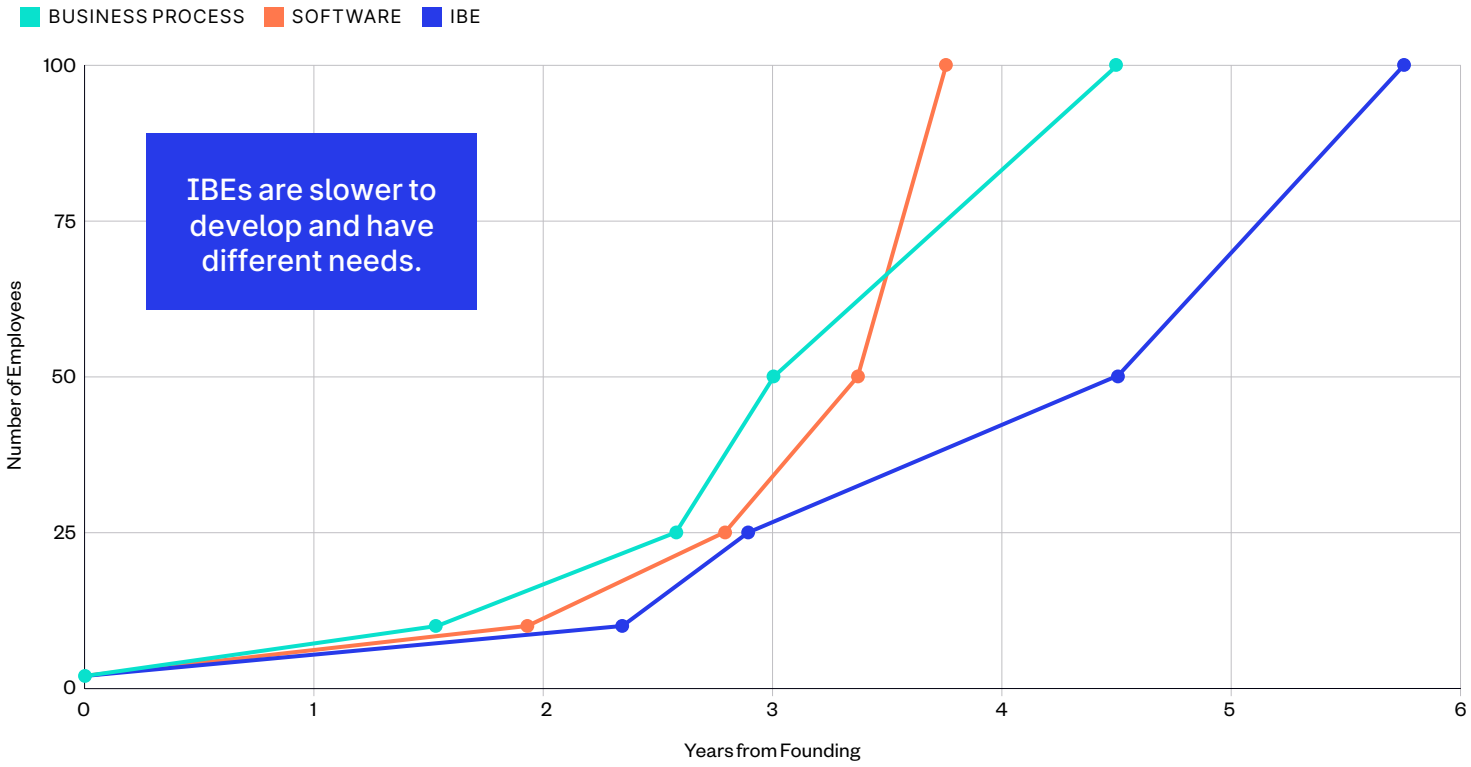
Greater government investment is needed to bolster domestic R&D capacity. Governments should financially support both basic research in clean energy and the translation of that research into usable products for the general public. International development institutions and other foreign donors are also in a position to shape local entrepreneurship ecosystems in clean energy. These foreign actors should reinforce local efforts to build up infrastructure, educational institutions, and R&D capacity by providing financial resources and sharing knowledge.

Through these principles, decision makers can empower innovative entrepreneurs in sub-Saharan Africa and India to grow their companies and enhance global access to clean energy.

Top Recommendations for Decision Makers	
Entrepreneurs	• Learn from the experiences of successful firms in conducting customer-centric R&D and paying attention to affordable product delivery mechanisms. • Provide investors with detailed information and evidence to assuage concerns. • Give back to the local entrepreneurial ecosystem as a mentor and angel investor.
Investors	• Build stronger connections with subject matter experts and local investors prior to selecting companies. • If offshore, partner with local capital providers in funding rounds. • Reduce the length of time required to finalize deals and adhere to decision-making timelines. • Provide patient, flexible capital to IBEs, including experimental R&D grants.
Support Organizations	• Tailor programs to the needs of the sector, including customer acquisition and talent recruitment. • Enhance early-stage support for clean energy IBEs. • Support more local founders in sub-Saharan Africa, especially with connecting to investors.
Donors and Philanthropies	• Encourage local angel networks and commercial lenders to catalyze more local investment, reducing foreign exchange risk. • Increase multi-year support and discretionary pilot funding, as well as non-financial assistance, to enable support organizations to refine their practices. • Elevate support organizations and funds led by successful founders. • Reinforce local efforts to build up infrastructure, educational institutions, and energy-specific R&D capacity.
Policymakers	• Underwrite risk and provide incentives for investors to support early-stage firms. • Foster an enabling environment by investing in domestic STEM universities and applied R&D. • Provide subsidies directly to consumers to purchase clean energy products. • Establish more public-private partnerships with entrepreneurs to fill gaps in on-grid energy capacity and facilitate the global transition to renewable energy.
Universities and Research Institutes	• Promote “learning by doing” and an entrepreneurial mindset among students. • Develop partnerships with support organizations to provide R&D facilities and bring clean energy products to the market. • Encourage STEM students to apply their knowledge to local needs.

Appendix

COMPARATIVE DEVELOPMENT TIMELINES OF COMPANY INNOVATION TYPES



Note: Data includes entrepreneurial companies that reached 100 or more employees across three sectors (agriculture, healthcare, and clean energy).

Source: Endeavor Insight interviews and analysis. Sample size: 131 companies.

Glossary

Bootstrapping: Founding and building a company without external investment, relying instead on personal capital and the company's operating revenues.

Cleantech: The use of technological solutions for clean energy and products.

Entrepreneurial companies: For-profit businesses that are started by individuals. This excludes businesses that began as government entities or subsidiaries of larger companies.

Founder backgrounds:

- **Expat:** Founders who have started a business in a country that is not their home country.
- **Local:** Founders who have started a business in their home country, without educational and/or work experience abroad.
- **Returnee:** Founders who have started a business in their home country after gaining educational and/or work experience abroad (also referred to as "boomerang").

Innovation types:

- **Business process companies:** Companies that primarily deliver a product or service that requires "on-the-ground" operations, and may also involve the use of technology.
- **Invention-based enterprises (IBEs):** Companies that conduct research and development, and manufacture at least one component that is a physical product, oftentimes where the innovation is unique enough to be patentable.
- **Service companies:** Businesses whose primary innovation is not a physical product, including business process companies and software companies.
- **Software companies:** Companies that have primary activities in developing and selling digital solutions and platforms, such as e-commerce or financial technology.

Investment types:

- **Angel investment:** An investment in a company made by an individual, not on behalf of a business or investment firm.
- **Institutional investment:** An investment made by a company or organization.
- **Venture capital:** Investment in businesses that have high growth potential. Venture capitalists (VCs) often provide expertise in finance and operations, in addition to capital.

Mentorship: A relationship through which a mentee will meet a mentor; in this study, defined as meeting at least three times for a minimum of 30 minutes to discuss critical business issues.

Mini-grid: An off-grid electricity distribution network involving small-scale electricity generation.

Network: A group of actors working to support local entrepreneurs. This includes capital providers such as investors and foundations, support organizations, government and international aid agencies, and experienced entrepreneurs.

Pay as you go (PAYG): A system of meeting costs for a service as they arise, according to usage.

Scale: A measure of a company's growth; in this study, defined as employing 50 or more people.

Startup: New companies less than one year old with at least one employee.

STEM: Science, technology, engineering, and mathematics.

Support organizations: Organizations offering skill-development programs, investment, mentoring, or other support for entrepreneurs. These include incubators, accelerators, and other programs.

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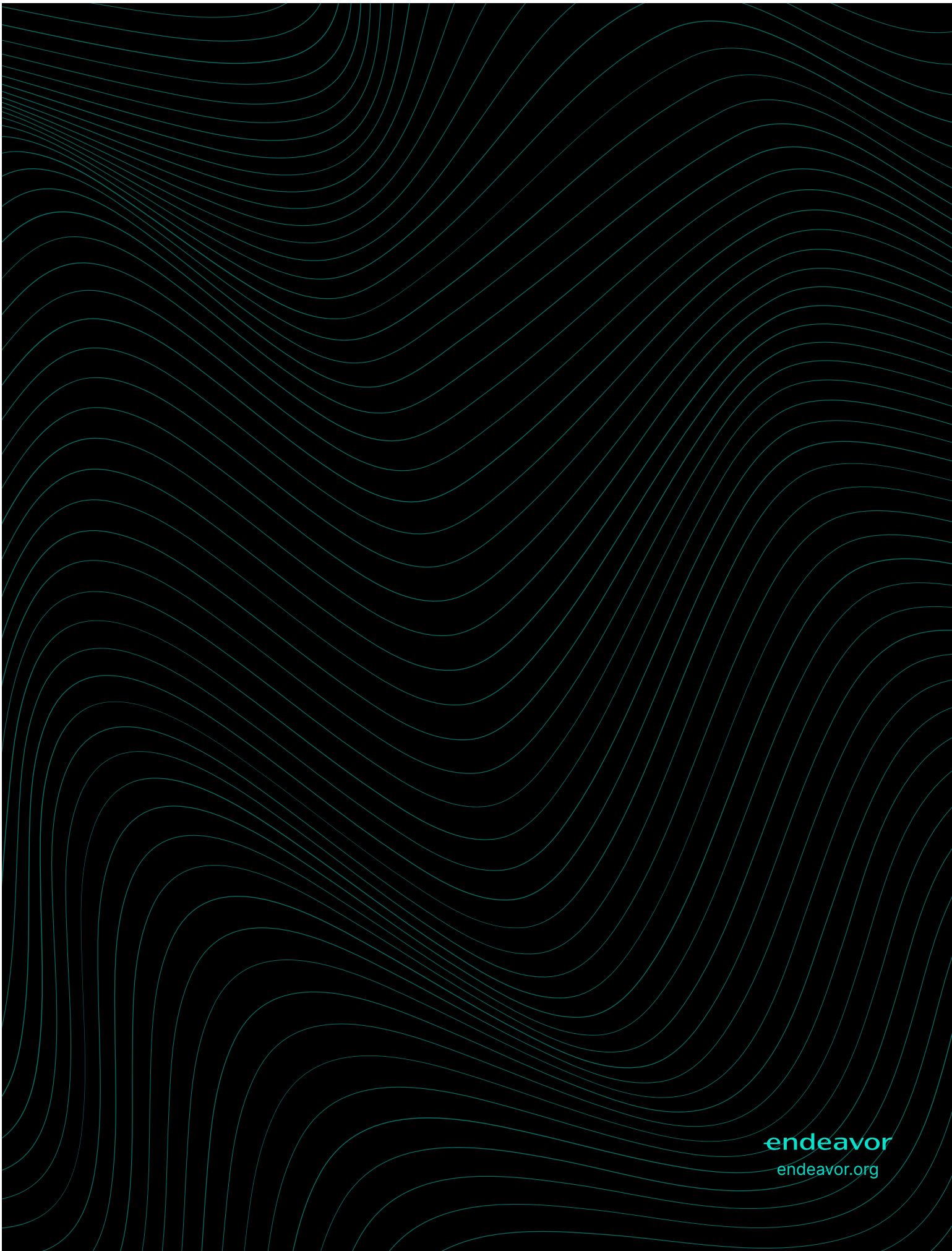
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